

TECHNICAL MANUAL

**OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT,
AND GENERAL SUPPORT MAINTENANCE MANUAL
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LISTS
FOR
OSCILLOSCOPE, TEKTRONIX MODEL R7704
(NSN 6625-00-007-8487)**

HEADQUARTERS, DEPARTMENT OF THE ARMY

8 SEPTEMBER 1980

**WARNING
DANGEROUS VOLTAGES EXIST IN
THIS EQUIPMENT**

Dangerous potentials exist at several points throughout this equipment. When the equipment 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 equipment or replacing parts.

DON'T TAKE CHANCES!

TECHNICAL MANUAL
No. 11-6625-2922-14&P



HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 8 September 1980

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND
GENERAL SUPPORT MAINTENANCE MANUAL
(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LISTS)
FOR
OSCILLOSCOPE, TEKTRONIX MODEL R7704
(NSN 6625-00-007-8487)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703.

In either case, a reply will be furnished direct to you.

Table of Contents

		Paragraph	Page
SECTION	0. INTRODUCTION		
	Scope	0-1	0-1
	Indexes of Publications.....	0-2	0-1
	Maintenance Forms, Records, and Reports.....	0-3	0-1
	Reporting Equipment Improvement Recommendations (EIR)	0-4	0-1
	Administrative Storage	0-5	0-1
	Destruction of Army Electronics Materiel.....	0-6	0-1

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. Since the manual was not prepared in accordance with military specifications, the format has not been structured to consider levels of maintenance.

TABLE OF CONTENTS

SECTION 1. R7704 SPECIFICATION	Page		Page
Introduction	1-1	First-Time Operation	
Table 1-1 Electrical		General	2-7
Vertical Deflection System	1-1	Setup Information	2-7
Triggering	1-2	Calibration Check	2-8
Horizontal Deflection System	1-2	Vertical and Horizontal Mode	2-8
Calibrator	1-2	Triggering	2-9
External Z-Axis Input	1-2	Control Illumination	2-10
Signal Outputs	1-3	Readout	2-10
Character Generator	1-4	Beam Finder	2-10
Power Supply	1-4	Z-Axis Input	2-10
Display	1-4	Test Set-Up Chart	
Table 1-2 Environmental Characteristics	1-4	General	2-10
Table 1-3 Physical Characteristics	1-5	General Operating Information	
Standard Accessories	1-5	Simplified Operating Instructions	2-10
Instrument Options		Intensity Controls	2-16
General	1-5	Display Focus	2-16
Option 1	1-5	Trace Alignment Adjustment	2-17
Option 2	1-5	Graticule	2-17
Option 3	1-5	Light Filter	2-17
System Specifications		Beam Finder	2-17
		Control Illumination	2-17
		Readout	2-18
		Remote Readout	2-19
		Display Photography	2-19
		Vertical and Horizontal Mode Switch	
		Logic	2-19
SECTION 2 OPERATING INSTRUCTIONS		Vertical Mode	2-20
General	2-1	Horizontal Mode	2-21
Preliminary Information		Vertical Trace Separation	2-22
Operating Voltage	2-1	Trigger Source	2-22
Operating Temperature	2-2	X-Y Operation	2-22
Rackmounting	2-2	Intensity Modulation	2-23
Display Definitions	2-2	Raster Display	2-24
Plug-In Units		Calibrator	2-24
General	2-3	Signal Outputs	2-24
Plug-In Installation	2-3	Probe Power Connectors	2-25
Controls and Connectors		Remote Connector	2-25
General	2-3	Remote Single-Sweep Reset	2-25
Display Controls	2-5	Applications	2-26
Mode Selectors	2-5		
Output Connectors	2-6		
Input Connectors	2-7		

CONTENTS (Cont)

SECTION 3 CIRCUIT DESCRIPTION		Page		Page
	Introduction	3-1	Lubrication	4-3
	Block Diagram		Visual Inspection	4-3
	General	3-1	Semiconductor Checks	4-3
	Circuit Operation		Recalibration	4-3
	General	3-3	Troubleshooting	
	Logic Fundamentals		Introduction	4-3
	General	3-3	Troubleshooting Aids	4-3
	Symbols	3-3	Troubleshooting Equipment	4-4
	Logic Polarity	3-3	Troubleshooting Techniques	4-7
	Input/Output Tables	3-4	Special Troubleshooting Information	4-9
	Non-Digital Devices	3-4	Corrective Maintenance	
	Main Interface		General	4-18
	General	3-7	Obtaining Replacement Parts	4-18
	Logic Circuit		Soldering Techniques	4-18
	General	3-7	Component Replacement	4-19
	Horizontal Logic	3-7	Recalibration After Repair	4-25
	Z-Axis Logic	3-13	Instrument Repackaging	4-25
	Horizontal Binary	3-14		
	Vertical Binary	3-16		
SECTION 5 PERFORMANCE CHECK/CALIBRATION				
1	Plug-In Binary	3-18	Introduction	5-1
	Clock Generator	3-20	Test Equipment Required	
	Vertical Chopped Blanking	3-21	General	5-1
	Chop Counter	3-24	Test Equipment	5-1
	Vertical Mode Logic	3-26	Accessories	5-2
	Trigger Selector	3-27	Adjustment Tools	5-2
	Vertical Interface	3-30	Short-Form Procedure and Index	5-3
	Vertical Amplifier	3-33	Performance Check/Calibration Procedure	
	Horizontal Interface	3-35	General	5-5
	Horizontal Amplifier	3-36	Preliminary Procedure for Performance	
	Output Signals	3-38	Check Only	5-6
	CRT Circuit	3-41	Preliminary Procedure for Complete	
	Line to DC Converter/Regulator	3-45	Calibration	5-6
	Low-Voltage Regulator	3-49	Preliminary Control Settings	5-6
	Controls and Cabling	3-53	Calibration Steps	5-7
	Readout System			
	Introduction to Readout System	3-54		
	Circuit Analysis of Readout System	3-60		
SECTION 6 RACKMOUNTING				
			Introduction	6-1
	Introduction	4-1	Instrument Dimensions	6-1
	Cover Removal	4-1	Rack Dimensions	6-1
	Power-Unit Removal	4-1	Slide-Out Tracks	6-1
	Preventive Maintenance		Mounting Procedure	6-1
	General	4-1	Removing or Installing the Instrument	6-5
	Cleaning	4-2	Slide-Out Track Lubrication	6-5

CONTENTS (Cont)**SECTION 7 ELECTRICAL PARTS LIST**

Abbreviations and Symbols
 Parts Ordering Information
 Index of Electrical Parts List
 Electrical Parts List

**Part Number-National Stock Number
 Cross Reference Index**

Page**SECTION 9 MECHANICAL PARTS LIST**

Mechanical Parts List Information
 Index of Mechanical Parts List and
 Illustrations
 Mechanical Parts List

**SECTION 8 DIAGRAMS AND CIRCUIT BOARD
 ILLUSTRATIONS**

Symbols and Reference Designators 8-1

Voltage and Waveform Test Conditions 8-2

Diagrams

Circuit Board Illustrations

CHANGE INFORMATION

Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change Information, if any, is located at the rear of this manual.

		Page
APPENDIX	A.	REFERENCES..... A-1
APPENDIX	B.	COMPONENTS OF END ITEM LIST (Not applicable)
APPENDIX	C.	ADDITIONAL AUTHORIZATION LIST (Not applicable)
APPENDIX	D.	MAINTENANCE ALLOCATION
Section	I.	Introduction..... D-1
	II.	Maintenance Allocation Chart for Oscilloscope, Tektronix Model R7704 D-3
	III.	Tool and Test Equipment Requirements for Oscilloscope, Tektronix Model R7704 D-4
	IV.	Remarks D-5
APPENDIX	E.	REPAIR PARTS AND SPECIAL TOOLS LIST (See Section 7, Electrical Parts List)
APPENDIX	F.	EXPENDABLE SUPPLIES AND MATERIALS LIST (Not applicable)

SECTION 0 INTRODUCTION

0-1. Scope

This manual contains instructions for the operation and organizational, direct support, and general support maintenance of Oscilloscope, Tektronix Model R7704. Throughout this manual, Oscilloscope, Tektronix Model R7704 is referred to as the R7704.

0-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

0-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 735-11/NAVINST 4440.127E/AFR 400-54/MCO 4430.3E and DSAR 4140.55.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

0-4. Reporting Equipment Improvement Recommendations (EIR)

If your R7704 needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Readiness Command, ATT'N: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

0-5. Administrative Storage

To prepare the R7704 for administrative storage, perform the procedures described in Section 4, Maintenance, and Section 5, Performance Check/Calibration. Upon removal from administrative storage, perform the procedures described in Section 5, Performance Check/Calibration, to determine that the equipment is fully operational.

0-6. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

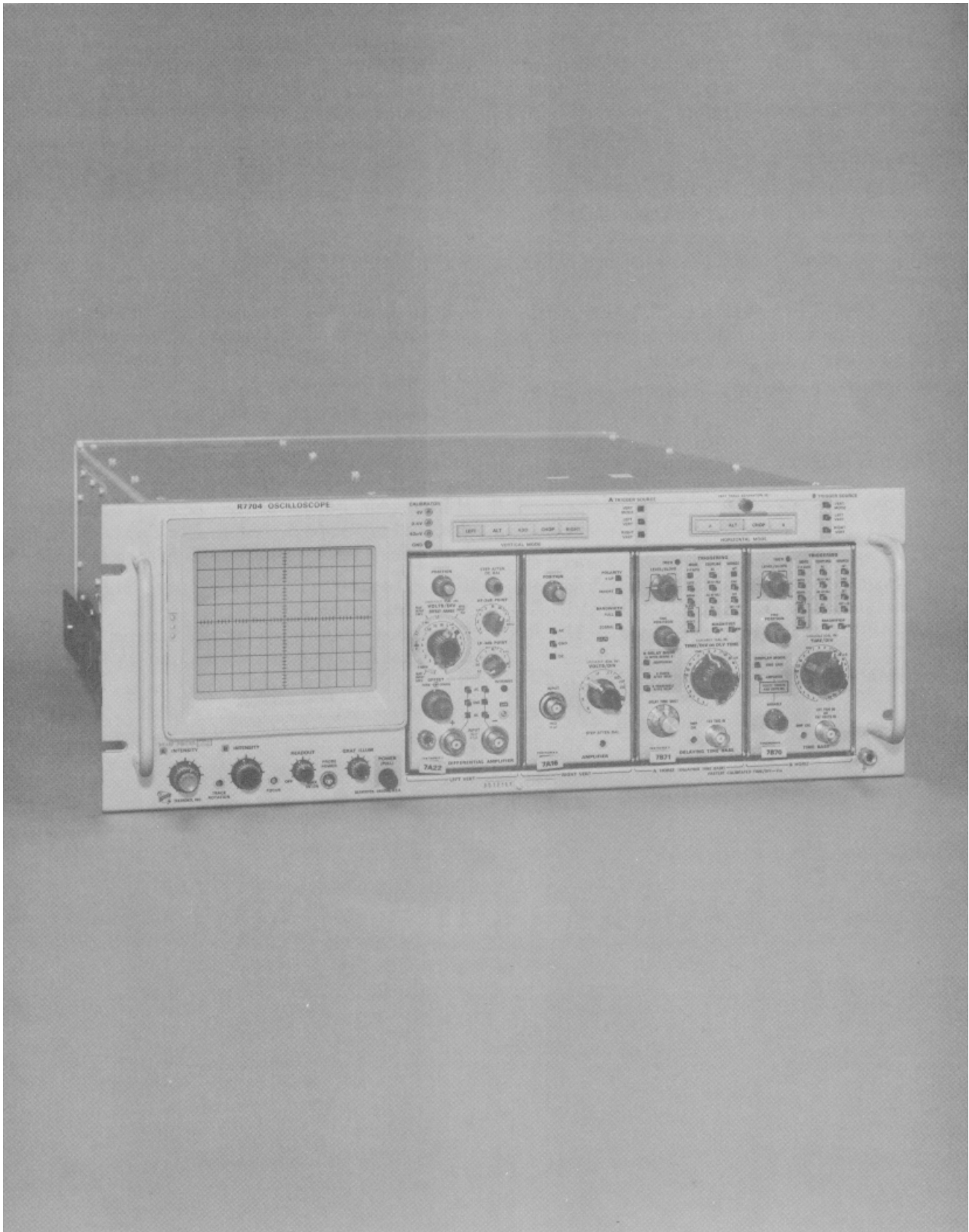


Fig. 1-1. The R7704 Oscilloscope

R7704

(A)

**SECTION 1
R7704 SPECIFICATION**

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

The Tektronix R7704 Oscilloscope is a solid-state, high performance instrument designed for mounting in a 19-inch rack (complete rackmounting information is given in Section 6). This instrument accepts Tektronix 7-series plug-in units to form a complete measurement system. The flexibility of this plug-in feature and the variety of plug-in units available allow the system to be used for many measurement applications.

The R7704 has four plug-in compartments. The left pair of plug-ins is connected to the vertical deflection system. The right pair is connected to the horizontal deflection system. Electronic switching between the plug-in units connected to each deflection system allows a dual-trace vertical display and/or a dual-sweep horizontal display. This instrument features regulated DC power supplies to assure that performance is not affected by variations in line voltage and frequency, or by changes in load due to the varying power requirements of the plug-in units. Maximum power consumption of this instrument is about 225 watts (60 hertz, 115-volt line).

The R7704 features a CRT with small spot size and high writing speed. Graticule area is 8 X 10 centimeters. In addition, the instrument contains a readout system to provide CRT display of alpha-numeric information from the plug-in units; data such as deflection factor, sweep rate, etc. can be encoded.

This instrument will meet the electrical characteristics listed in Table 1-1 following complete calibration as given in Section 5. The performance check procedure included in Section 5 provides a convenient method of checking instrument performance without making internal checks or adjustments. The following electrical characteristics apply over a calibration interval of 1000 hours and an ambient temperature range of 0°C to +50° C, except as otherwise indicated. Warmup time for given accuracy is 20 minutes.

NOTE

Many of the measurement capabilities of this instrument are determined by the choice of plug-in units. The following characteristics apply to the R7704 Oscilloscope only. See the system specification later in this section for characteristics of the complete system.

*TABLE 1-1.
ELECTRICAL*

Characteristic	Performance
VERTICAL DEFLECTION SYSTEM	
Deflection Factor	Compatible with all 7-series plug-in units.
Deflection Accuracy	Less than 1% difference between vertical compartments.
Low-Frequency Linearity	0.1 division or less compression or expansion of a center-screen two-division signal when positioned anywhere vertically within the graticule area.
Bandwidth	Varies with vertical plug-in selected.
Risetime	See System Specifications.

Characteristic	Performance Requirement
Isolation Between Vertical Compartments	At least 100:1 from DC to 150 megahertz.
Chopped Mode Repetition rate	One megahertz ±20%.
Time segment from each compartment	0.4 to 0.6 microsecond.
Delay Line	Permits viewing of leading edge of triggering signal
Difference in Delay Between Compartments	0.2 nanosecond or less.

TABLE 1-1. (cont)

Characteristic	Performance
Vertical Display Modes (selected by front-panel VERTICAL MODE switch)	LEFT: Left vertical unit only. ALT: Dual-trace, alternate 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 +4 to +6 or -4 to -6 divisions from the A trace.

TRIGGERING

Trigger Source (selected by front-panel A TRIGGER SOURCE and B TRIGGER SOURCE switches)	VERT MODE: Determined by vertical mode. LEFT VERT: From left vertical unit only. RIGHT VERT: From right vertical unit only.
---	---

HORIZONTAL DEFLECTION SYSTEM

Deflection Factor	Compatible with all 7-series plug-in units.
Deflection Accuracy	Less than 1% difference between compartments.
Fastest Calibrated Sweep Rate	Two nanoseconds/division.
Bandwidth at 10% Down	DC to at least three megahertz (10-division reference). DC to at least six megahertz (five-division reference).
Without phase correction	
With phase correction	DC to at least three megahertz (10-division reference).
Phase Shift Between Vertical and Horizontal Deflection Systems	2° or less from DC to at least 35 kilohertz.
Without phase correction	
With phase correction	Adjustable to less than 2° from DC to two megahertz.

TABLE 1-1. (cont)

Characteristic	Performance Requirement
Chopped Mode Repetition rate	200 kilohertz ±20%.
Time segment. from each compartment	2.0 to 3.0 microseconds
Horizontal Display Modes (selected by front-panel HORIZONTAL MODE switch)	A: A horizontal unit only. ALT: Dual-sweep, alternate between horizontal units. ADD: Added alphabetically CHOP: Dual-sweep, chopped between horizontal units B: B horizontal unit only.

CALIBRATOR

Wave Shape	Square wave.
Polarity	Positive going with baseline at zero volts.
Output Voltage Open circuit	40 mV, 0.4 V, 4 V at front-panel pin jacks. 4 mV and 40 V available at internal circuit board connections.
Into 50 ohms	20 mV, 0.2 V, 0.4 V at front-panel pin jacks.
Output Current	40 milliamperes with current-loop accessory (012-0259-00) connected between 4 V pin jack and ground.
Repetition Rate Accuracy	One kilohertz. +15 ° C to +35°C 0°C to +50°C
Voltage and current Repetition rate	Within 1%. Within 0.25%. Within 2%. Within 0.5%.
Risetime and Fall-time	0.25 microsecond or less.
Duty Cycle	50% ± 0.1%.

EXTERNAL Z-AXIS INPUTS

High Sensitivity Input Sensitivity	Two volts peak to peak provides trace modulation over full intensity range.
------------------------------------	---

TABLE 1-1. (cont)

Characteristic	Performance Requirement
Useful input voltages versus repetition frequency	Two volts peak to peak, DC to two megahertz; reducing to 0.4 volt peak to peak at 20 megahertz.
Polarity of operation	Positive-going signal decreases trace intensity; negative-going signal increases trace intensity.
Minimum pulse width that provides intensity modulation	30 nanoseconds at two volts.
Input resistance at DC	500 ohms \pm 10%.
Maximum input voltage	15 volts (DC + peak AC).
High Speed Input Sensitivity	60 volts peak to peak provides trace modulation over full intensity range.
Useful input voltage versus repetition frequency	60 volts peak to peak, DC to 100 megahertz.
Polarity of operation	Positive-going signal decreases trace intensity; negative-going signal increases trace intensity.
Minimum pulse width that provides intensity modulation	3.5 nanoseconds at 60 volts.
Input resistance at DC	18 kilohms \pm 20%.
Maximum input voltage	60 volts (DC + peak AC); 60 volts peak to peak AC.

SIGNAL OUTPUTS

+Sawtooth Source (selected by SWEEP switch)	A HORIZ time-base unit or B HORIZ time-base unit.
Polarity	Positive-going with baseline at zero volts \pm 1 volt (into one megohm).

TABLE 1-1. (cont)

Characteristic	Performance Requirement
Output voltage	
Rate of rise	
Into 50 ohms	50 millivolts/unit of time \pm 15%. ¹
Into one megohm	One volt/unit of time \pm 10%. ¹
Peak voltage	
Into 50 ohms	Greater than 500 millivolts.
Into one megohm	Greater than 10 volts.
Output resistance	950 ohms \pm 2%.
+Gate Source (selected by GATE switch)	A HORIZ time-base unit. B HORIZ time-base unit. Delaying time-base unit (in A HORIZ compartment).
Output voltage	
Into 50 ohms	0.5 volt \pm 10%.
Into one megohm	10 volts \pm 10%.
Risetime into 50 ohms	20 nanoseconds or less.
Output resistance	950 ohms \pm 2%.
Vertical Signal Output	
Bandwidth	Varies with vertical plug-in selected. See System Specification.
Risetime	
Source	Determined by B TRIGGER' SOURCE switch.
Output voltage	
Into 50 ohms	25 millivolts/division of vertical deflection \pm 25%.
Into one megohm	0.5 volt/division of vertical deflection \pm 25%.
Output resistance	950 ohms \pm 2%.

¹ Unit of time selected by time-base time/division switch.

TABLE 1-1. (cont)

Characteristic	Performance Requirement
CHARACTER GENERATOR	
Word Location	See Fig. 2-5
POWER SUPPLY	
Line Voltage Range AC, RMS (Selected by Line Selector assembly on rear panel).	
115-volts nominal	90 to 136 volts.
230-volts nominal	180 to 272 volts.
Line Frequency	48 to 66 hertz (48 to 66 and 360 to 440 hertz with special MOD 101K).
Maximum Power Consumption	225 watts, 2.8 amperes at 60 hertz, 115-volt line.
DISPLAY	
Graticule Type	Internal with variable edge lighting.
Area	Eight divisions vertical by 10 divi- sions horizontal. Each division equals one centimeter.
Phosphor	P31 standard. Others available on special order.
Resolution Horizontal	At least 12 lines/division.
Vertical	At least 12 lines/division.
Geometry	0.1 division or less total bowing or tilt of a display horizontal or vertical line.
Beam Finder	Limits display within graticule area when actuated.
Photographic Writing Speed (without film fogging techniques)	
Tektronix C-51 Camera with f1.2 lens and 1:0.5 object-to-image ratio	At least 3300 centimeters/micro- second with Polaroid ² Type 410 film (10,000 ASA) and P31 CRT phosphor. At least 7000 centimeters/micro- second with Polaroid Type 410 film (10,000 ASA) and P11 CRT phosphor.

TABLE 1-1. (cont)

Tektronix C-27 Camera with f1.3 lens and 1:0.5 object-to-image ratio	At least 2200 centimeters/micro- second with Polaroid Type 410 film(10,000 ASA) and P31 CRT phosphor. At least 5500 centimeters/micro- second with Polaroid Type 410 film (10,000 ASA) and P11 CRT phosphor.
--	---

TABLE 1-2.

ENVIRONMENTAL CHARACTERISTICS

Characteristic	Performance
NOTE	
<p>This instrument will meet the electrical characteristics given in Table 1-1 over the following environmental limits. Complete details on environmental test procedures, including failure criteria, etc., can be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative</p>	
Temperature Range Operating	0°C to +50°C.
Non-operating	-55°C to +75°C.
Altitude Operating	15,000 feet.
Non-operating	Test limit 50,000 feet.
Electro-magnetic Interference (EMI) as tested in MIL-I- 6181D (when equip- ped with Option 3 only)	
Radiated inter- ference	Interference radiated from the instrument under test within the given limits from 150 kilohertz to 1000 megahertz.
Conducted interference	Interference conducted out of the instrument under test through the power cord within the given limits from 150 kilohertz to 25 mega- hertz.
Transportation(pack aged instrument, without plug-ins)	Qualifies under National Safe Transit Committee test procedure 1A, Category II.

² Registered trademark of the Polaroid Corporation.

TABLE 1-3.
PHYSICAL CHARACTERISTICS

Characteristic	Performance
Ventilation	Safe operating temperature is maintained by forced-air cooling. Automatic resetting thermal cutout protects instrument from over-heating.
Warm-up Time	20 minutes for rated accuracy.
Finish	Anodized front panel and cabinet.
Overall Dimensions (measured at maximum points)	
Height	7.0 inches (17.7 centimeters).
Width	19.0 inches (48.3 centimeters).
Length	22.4 inches (56.9 centimeters) behind front panel. 24.2 inches (61.7 centimeters) over-all.
Net Weight (instrument only)	44 pounds (19.7 kilograms).

STANDARD ACCESSORIES

Standard accessories supplied with the R7704 are given in the Mechanical Parts List illustrations. For optional accessories available for use with this instrument, see the Tektronix, Inc. catalog.

INSTRUMENT OPTIONS

General

The following options are available for the R7704 and can be installed as part of the instrument when ordered, or they can be installed at a later time. Complete information on all options for this instrument is given in this manual. For further information on instrument options, see your Tektronix, Inc. catalog, or contact your local Tektronix Field Office or representative.

Option 1

This option deletes the Readout System. Operation of the instrument is unchanged except that there is no alphanumeric display on the CRT and the READOUT control is non-functional. The Readout System can be added at any time by ordering the readout conversion kit.

Option 2

The X-Y Delay Compensation Network can be added to the instrument to equalize the signal delay between the vertical and horizontal deflection systems. When this network is installed and activated, the phase shift between the vertical and horizontal channels is adjustable to less than 20 from DC to two megahertz.

Option 3

With option 3 installed, the instrument will meet the EMI interference specifications given in Table 1-2.

SYSTEM SPECIFICATIONS

Your Tektronix 7700-series 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 unit is designed (17000-series).

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

- A - Amplifier unit.
- B - "Real time" time-base unit.
- D - Digital unit.
- J - Spectrum analyzer, single width.
- K - Spectrum analyzer, single width.

L - Spectrum analyzer, double width.

M - Miscellaneous.

S - Sampling unit.

T - Sampling time-base unit.

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

An "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.

7700-SERIES OSCILLOSCOPE SYSTEM VERTICAL SPECIFICATIONS

This table 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 Catalog.

Amplifier Plug-In	Probe	BW	Tr	Vertical System Deflection Factor Accuracy*			SIG OUT	
				EXT CAL	INT CAL	INT CAL	BW	Tr
Unit				0 to 50 ° C	15 to 35°C	0 to 50°C		
7A11	Integral	150 MHz	2.4 ns	2%	3%	4%	60 MHz	5.9 ns
	None	105 MHz	3.4 ns	2%	3%	4%	55 MHz	6.4 ns
	P6053	105 MHz	3.4 ns	3%	4%	5%	55 MHz	6.4 ns
7A13	None	100 MHz	3.5 ns	1.5%	2.5%	3.5%	55 MHz	6.4 ns
	P6053	100 MHz	3.5 ns	1.5%	2.5%	3.5%	55 MHz	6.4 ns
	P6055	65 MHz	5.4 ns	1.5%	2.5%	3.5%	45 MHz	7.8 ns
7A14	P6021	50 MHz	7.0 ns	2%	3%	4%	40 MHz	8.8 ns
	P6022	105 MHz	3.4 ns	2%	3%	4%	50 MHz	7.0 ns
7A15	None	75 MHz	4.7 ns	2%	3%	4%	50 MHz	7.0 ns
	P6053	75 MHz	4.7 ns	3%	4%	5%	50 MHz	7.0 ns
7A16	None	150 MHz	2.4 ns	2%	3%	4%	60 MHz	5.9 ns
	P6053	150 MHz	2.4 ns	3%	4%	5%	60 MHz	5.9 ns
7A18	None	75 MHz	4.7 ns	2%	3%	4%	50 MHz	7.0 ns
	P6053	75 MHz	4.7 ns	3%	4%	5%	50 MHz	7.0 ns
7A22	None or any	1.0 MHz ± 10%	350 ns ± 9%	2%	3%	4%	1.0 MHz ± 10%	350 ns ± 9%

*Deflection 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.

SECTION 2 OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of this manual.

General

To effectively use the R7704, the operation and capabilities of the instrument must be known. This section describes the operation of the front-, side-, and rear-panel controls and connectors and gives first time and general operating information.

PRELIMINARY INFORMATION

Operating Voltage

WARNING

This instrument is designed for operation from a power source with its neutral at or near earth (ground) potential with a separate safety-earth conductor. It is not intended for operation from two phases of a multi-phase system, or across the legs of a single-phase, three-wire system.

The R7704 can be operated from either a 115-volt or a 230-volt 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.

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-volts to 230-volts nominal line voltage, or vice versa, pull out the Selector switch bar (see Fig. 2-1) and plug it back into the remaining holes. Change the line-cord power plug to match the power-source receptacle or use a 115 to 230-volt adapter.

Power Cord Conductor Identification

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

4. Re-install the cover and tighten the captive screws.

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.

CAUTION

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

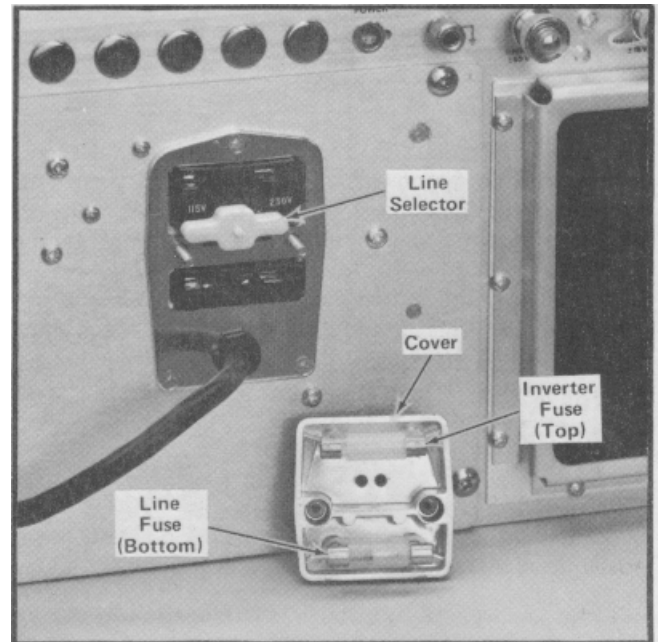


Fig. 2-1. Line Selector assembly on rear panel (shown with cover removed).

TABLE 2-1.
Regulating Ranges

Line Selector Switch Position	Regulating Range
115 V	90 to 136 volts
230 V	180 to 272 volts

The R7704 is designed to be used with a three-wire AC power system. If a three- to two-wire adapter is used to connect this instrument to a two-wire AC power system, be sure to connect the ground lead of the adapter to earth (ground). Failure to complete the ground system may allow the chassis of this instrument to be elevated above ground potential and pose a shock hazard.

Operating Temperature

The R7704 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 R7704 is cooled by air drawn in through the air filter on the rear panel and blown out through the holes on the right side. Adequate clearance must be provided at these locations (see Dimensional Drawing in Section 7). Allow at least one and one-half inches clearance behind the air filter and at least one inch on the right side.

A thermal cutout in this instrument provides thermal protection and disconnects the power to 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 for extended periods without the covers may cause it to overheat and the thermal cutout to open. Also, check the air filter occasionally; a dirty filter will prevent adequate air flow into the instrument.

Rackmounting

Complete instructions for rackmounting the R7704 are given in Section 6.

DISPLAY DEFINITIONS

General

The following definitions describe the types of displays which can be obtained with an R7704 Oscilloscope system with real-time amplifiers, time-base units, or combinations of these. Use of special purpose plug-in units may result in different types of displays,

which are defined in the instruction manuals for these special units. The following terminology will be used throughout this manual (see Simplified Operating Instructions in this section for set-up information to obtain each of these displays).

Single Trace

A display of a single plot produced by one vertical signal and one sweep.

Dual Trace

A display of two plots produced by two vertical signals and one sweep.

Dual Sweep

A display of two plots produced by one vertical signal and two sweeps. Both sweeps operate independently.

Dual Trace-Dual Sweep

A display of four plots produced by combining two vertical signals and two sweeps. Each vertical signal is displayed against each sweep. Both sweeps operate independently.

Independent Pairs

A display of two plots produced by two vertical signals, each displayed against its own sweep (LEFT versus B; RIGHT versus A). Both sweeps operate independently. This simulates a dual-beam display for most repetitive combinations.

Delayed Sweep-Single Trace

A display of a single plot produced by one vertical signal and a delayed sweep. Two sweeps are used to produce this display; the sweeps are operating with a delaying/delayed relationship where one sweep (identified as the delaying sweep) delays the start of the second sweep (identified as the delayed sweep). This display can be expanded to present two plots, produced by one vertical signal displayed against both the delaying and the delayed sweep.

Delayed Sweep-Dual Trace

A display of two plots produced by combining two vertical signals and a delayed sweep. Two sweeps are used to produce this display; the sweeps are operating with a delaying/delayed relationship. Each vertical signal is displayed against the delayed sweep. This display can be expanded to present four plots, produced by displaying

both vertical signals against both the delaying and the delayed sweep.

X-Y

A plot of two variables, neither of which represents time.

PLUG-IN UNITS

General

The R7704 is designed to accept up to four Tektronix 7-series plug-in units. This plug-in feature allows a variety of display combinations and also allows selection of bandwidth, sensitivity, display mode, etc. to meet the measurement requirements. In addition, it allows the oscilloscope system to be expanded to meet future measurement requirements. The overall capabilities of the resultant system is in large part determined by the characteristics of the plug-in unit selected. A list of the currently available plug-in units for this instrument along with their major specifications, is given in Section 1. For more complete information, see the current Tektronix, Inc. catalog.

Plug-In Installation

To install a plug-in unit into one of the plug-in compartments, align the slots in the top and bottom of the plug-in with the associated guide rails in the plug-in compartment. Push the plug-in unit firmly into the plug-in compartment until it locks into place. To remove a plug-in, pull the release latch on the plug-in unit to disengage it and pull the unit out of the plug-in compartment. Plug-in units can be removed or installed without turning off the instrument power.

It is not necessary that all of the plug-in compartments be filled to operate the instrument; the only plug-ins needed are those required for the measurement to be made. However, at environmental extremes, excess interference may be radiated into this instrument through the open plug-in compartments. Blank plug-in panels are available from Tektronix, Inc. to cover the unused compartments; order Tektronix Part No. 016-0155-00.

When the R7704 is calibrated in accordance with the calibration procedure given in this instruction manual, the vertical and horizontal gain are normalized. This allows calibrated plug-in units to be changed from one plug-in compartment to another without recalibration. However, the basic calibration of the individual plug-in units should be checked when they are installed in this system to verify their measurement accuracy. See the operating instructions section of the plug-in unit instruction manual for verification procedure.

The plug-in versatility of the R7704 allows a variety of display modes with many different plug-ins. Specific information for obtaining these displays is given under Display Combinations later in this section. However, the following information is provided here to aid in plug-in installation.

To produce a single-trace display, install a single-channel vertical unit (or dual-channel unit set for single-channel operation) in either of the vertical compartments. For dual-trace displays, either install a dual-channel vertical unit in one of the vertical compartments or install a single channel vertical unit in each vertical compartment. A combination of a single-channel and dual-channel vertical unit allows a three-trace display; likewise, a combination of two dual-channel vertical units allows a four-trace display.

For single time-base displays, the time-base unit can be placed in either horizontal compartment. However, for dual time-base displays, other considerations must be taken into account. In the ALT position of the VERTICAL MODE switch and ALT or CHOP position of the HORIZONTAL MODE switch, the plug-ins in the LEFT VERT and B HORIZ compartments are displayed together and the RIGHT VERT and A HORIZ plug-ins are displayed together (independent pairs operation). Therefore, the vertical and horizontal units must be correctly mated if a special display is desired. If delayed sweep operation is desired, a delaying time-base unit must be installed in the A HORIZ (DELAYING TIME BASE) compartment. Any compatible 7B-series unit can be used as a delayed timebase in the B HORIZ compartment.

X-Y displays can be obtained in two ways with the R7704 system. If a 7B-series time-base unit is available which has an amplifier feature, the X signal can either be routed through one of the vertical units via the internal trigger pickoff circuitry to the horizontal system, or connected to the external horizontal input connector of the time-base unit. Then, the vertical signal (Y) is connected to the remaining vertical unit. Also, a 7A-series amplifier unit can be installed in one of the horizontal compartments for X-Y operation.

Special purpose plug-in units may have specific restrictions regarding the plug-in compartments in which they can be installed. This information will be given in the instruction manuals for these plug-in units.

CONTROLS AND CONNECTORS

General

The major controls and connectors for operation of the R7704 are located on the front panel of the instrument. Some auxiliary functions are provided on the side, top, and rear panels. Fig. 2-2 shows the front and rear panels of

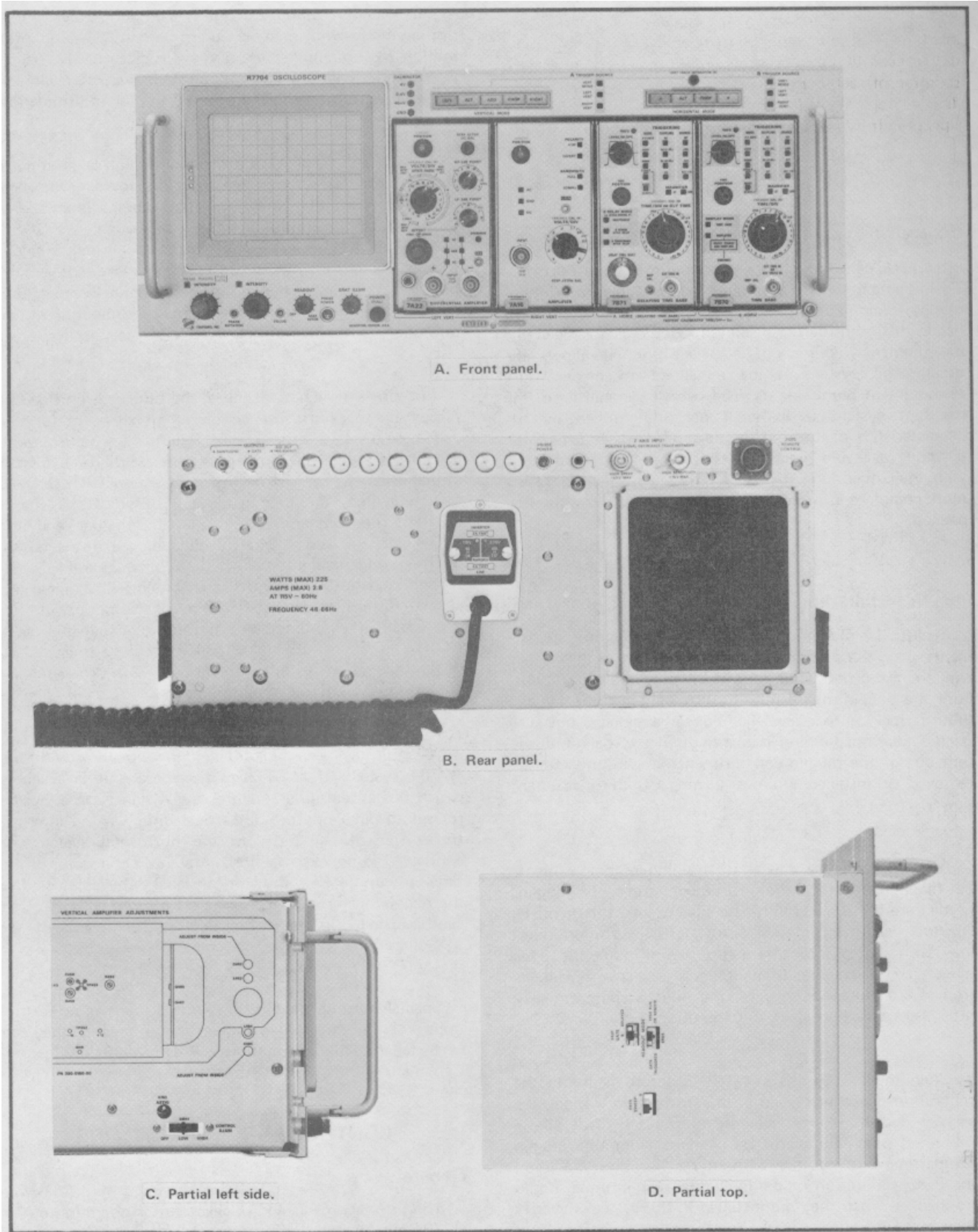


Fig. 2-2. External controls and connectors

R7704. To make full use of the capabilities of this instrument, the operator should be familiar with the function and use of each of these controls and connectors. A brief description of each control and connector is given here. More detailed operating information is given under General Operating Information.

Display Controls

- A INTENSITY** Controls brightness of the trace produced by the plug-in unit in the A HORIZ (DELAYING TIME BASE) compartment. Light behind the 'A' of A INTENSITY indicates when this control is operative. Control is inoperative (light off) when the A plug-in is not selected for display by the HORIZONTAL MODE switch or when the A HORIZ compartment is vacant.
- BEAM FINDER (PULL LOCK)** Compresses display within graticule area independent of display position or applied signals. Momentary actuation provided when button is pressed; display remains compressed when knob is pulled outward to lock it in the "find" position.
- TRACE ROTATION** Screwdriver adjustment to align trace with horizontal graticule lines.
- B INTENSITY** Controls brightness of the trace produced by the plug-in unit in the B HORIZ compartment. Light behind the 'B' of B INTENSITY indicates when this control is operative. Control is inoperative (light off) when the B plug-in is not selected for display by the HORIZONTAL MODE switch or when the B HORIZ compartment is vacant.
- FOCUS** Screwdriver adjustment to provide optimum display definition.
- READOUT** Controls brightness of the readout portion of the CRT. In the display fully counter-clockwise position, the Readout System is inoperative.
- GRAT ILLUM** Controls graticule illumination.

ASTIG (side panel)

CONTROL ILLUM (side panel)

Power

POWER

Mode Selectors

VERTICAL MODE

Screwdriver adjustment used in conjunction with the FOCUS control to obtain a well-defined display. Does not require readjustment in normal use.

Controls illumination level of push-button switches on the R7704 and the associated plug-in units.

OFF: All pushbutton lights off. A and B INTENSITY lights remain at low intensity to provide a power-on indication.

LOW: All pushbuttons illuminated at low intensity.

HIGH: Pushbuttons illuminated at maximum intensity.

Controls power to instrument. Line Selector (rear Switching assembly to select the panel) nominal operating voltage (115 or 230 volts). The assembly also includes the input power fuses.

Selects vertical mode of operation.

LEFT: Signal from plug-in unit in LEFT VERT compartment is displayed.

CHOP: Signals from plug-in units in both LEFT VERT and RIGHT VERT compartments are displayed. Display switched between vertical plug-ins at a one megahertz repetition rate.

ADD: Signals from plug-in units in both LEFT VERT and RIGHT VERT compartments are algebraically added and the algebraic sum displayed on the CRT.

ALT: Signals from plug-in units in both LEFT VERT and RIGHT VERT compartments are displayed. Display switched between vertical plug-ins after each sweep except for delayed sweep operation. Then, the display is switched between vertical

A TRIGGER SOURCE	<p>plug-ins after every second sweep. When the HORIZONTAL MODE switch is set to ALT or CHOP, independent-pairs operation is provided.</p> <p>RIGHT: Signal from plug-in unit in RIGHT VERT compartment is displayed.</p> <p>Selects source of internal trigger signal for the time-base in the A HORIZ compartment.</p> <p>VERT MODE: Trigger signal automatically follows the vertical display except in CHOP (vertical); then the trigger signal is the same as for ADD.</p> <p>LEFT VERT: Trigger signal is obtained from plug-in unit in LEFT VERT compartment.</p> <p>RIGHT VERT: Trigger signal is obtained from plug-in unit in RIGHT VERT compartment.</p>	<p>VERT MODE: Trigger signal automatically follows the vertical display except in CHOP (vertical); then trigger signal is the same as for ADD.</p> <p>LEFT VERT: Trigger signal is obtained from plug-in unit in LEFT VERT compartment.</p> <p>RIGHT VERT: Trigger signal is obtained from plug-in unit in the RIGHT VERT compartment.</p>
HORIZONTAL MODE	<p>Selects horizontal mode of operation.</p> <p>A: Signal from plug-in unit in the A HORIZ compartment is displayed.</p> <p>ALT: Signals from plug-in units in both A HORIZ and B HORIZ compartments are displayed. Display switched between horizontal plug-ins at end of each sweep.</p> <p>CHOP: Signals from plug-in units in both A HORIZ and B HORIZ compartments are displayed. Display switched between horizontal plug-ins at a 0.2-megahertz repetition rate.</p> <p>B: Signal from plug-in unit in the B HORIZ compartment is displayed.</p>	<p>VERT TRACE SEPARATION (B)</p> <p>Vertically positions the trace produced by the plug-in unit in the B HORIZ compartment up to four divisions with respect to the trace produced by the plug-in unit in the A HORIZ compartment (dual-sweep modes only).</p>
B TRIGGER SOURCE	<p>Selects source of internal trigger signal for the time-base in the B HORIZ compartment.</p>	<p>Output Connectors</p> <p>CALIBRATOR (4 V, 0.4 V, 40 mV, GND) PROBE POWER</p> <p>Calibrator output connectors.</p> <p>Power source for active probe systems. Two output connectors provided; one on front panel and one on rear panel.</p> <p>+ SAWTOOTH (rear panel)</p> <p>Provides positive-going sample of sawtooth signal. SAWTOOTH switch allows selection of sawtooth from time-base unit in the A HORIZ compartment or the B HORIZ compartment.</p> <p>+GATE (rear panel)</p> <p>Provides positive-going gate signal coincident with the respective sweep. GATE switch allows selection of one of three gate signals; the A gate from time-base unit in A HORIZ compartment, the B gate from time-base unit in B HORIZ compartment, or the delayed gate from delaying time-base unit in the A HORIZ compartment.</p> <p>SIG OUT (rear panel)</p> <p>Provides output signal from the vertical plug-in units. Source of the output signal at the SIG OUT connector is selected by the B TRIGGER SOURCE switch (see B TRIGGER SOURCE for description of sources available).</p>

Input Connectors

Z-AXIS INPUTS (rear panel) Input connectors for intensity modulation of the CRT display.

HIGH SPEED: Input connector for high-amplitude, high-frequency Z-axis signals; usable from DC to 100 megahertz.

HIGH SENSITIVITY: Input connector for low-amplitude Z-axis signals; usable for signals with repetition rates between DC and 10 megahertz; input voltage derating necessary between 2 and 10 megahertz.

J1075 REMOTE CONTROL (rear panel) Nine-pin connector which provides remote single-sweep reset and ready indication for the time-base units in the A HORIZ and B HORIZ compartments (with compatible timebase units only) and remote read-out mode and single-shot readout operation.

Miscellaneous

SAWTOOTH (top panel) Selects source of signal for + SAW-TOOTH connector.

A: Sawtooth output signal derived from time-base unit in A HORIZ compartment.

B: Sawtooth output signal derived from time-base unit in B HORIZ compartment.

GATE (top panel) Selects source of signal for + GATE connector.

A: Gate output signal derived from time-base unit in A HORIZ compartment.

B: Gate output signal derived from time-base unit in B HORIZ compartment.

DLY'D: Gate output signal derived from delaying time-base unit in A HORIZ compartment.

READOUT MODE Determines operating mode of the Readout System.

FREE RUN-REMOTE: Readout System free runs to present characters as encoded by plugin units. Free-running condition can be interrupted for remote single-shot operation through J1075.

GATE TRIG'D: Readout System is locked out so no characters are displayed during the sweep time. At the end of the sweep gate selected by the GATE switch, a single frame of all applicable readout characters is presented.

Ground (not labeled) Binding post to establish common ground between the R7704 and any associated equipment. One ground post provided on the front panel and one on the rear panel.

FIRST-TIME OPERATION

General

The following steps demonstrate the use of the controls and connectors of the R7704. It is recommended that this procedure be followed completely for familiarization with this instrument.

Set-up Information

1. Set the controls as follows:

Front panel

A INTENSITY	Counterclockwise
B INTENSITY	Counterclockwise
BEAM FINDER	Released
READOUT	OFF
GRAT ILLUM	Counterclockwise
POWER	Off
VERTICAL MODE	LEFT
A TRIGGER SOURCE	VERT MODE
HORIZONTAL MODE	A
VERT TRACE	Midrange
SEPARATION (B)	
B TRIGGER SOURCE	VERT MODE

Side panel

CONTROL ILLUM	OFF
---------------	-----

2. Connect the R7704 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 (on rear panel), see Operating Voltage in this section.

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.

6. Set both time-base units for a sweep rate of 0.5 milliseconds/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 4 V calibrator pin-jack to the input of the left vertical unit with a BNC to pin-jack cable (supplied accessory).

9. Check for a sharp, well-defined display over the entire trace length (if focused display cannot be obtained, see Display Focus in this section).

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.

11. If the trace is not parallel with the center horizontal line, see Trace Alignment Adjustment in this section.

12. 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.

Calibration Check

13. Connect the 4 V calibrator pin-jack to the input connector of either vertical unit with the BNC to pin-jack 2-8 cable (supplied accessory) and a BNC T connector. Connect the output of the BNC T connector to the input

of the other vertical unit with the 42-inch BNC cable (supplied accessory).

14. The display should be two divisions in amplitude with five complete cycles shown horizontally. An incorrect display indicates that the plug-ins need to be recalibrated. See the instruction manual of the applicable plug-in unit for complete information.

Vertical and Horizontal Mode

15. Notice that the position controls of only the left vertical unit and the A time-base unit have any effect on the displayed trace. Position the start of the trace to the left line of the graticule with the A time-base unit position control and move 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. Also press the B button of the HORIZONTAL MODE switch. Advance the B INTENSITY control until the trace is at the desired viewing level (about midrange).

17. Notice that the position controls of only the right vertical unit and the B time-base unit have any effect on the displayed trace. Position the start of the trace to the left graticule line with the B time-base position control and move the display to the bottom half of the graticule with the right vertical unit position control.

18. 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 B time-base unit. Reduce the sweep rate of the B 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 B time-base sweep rate switch throughout its range. Notice that the display alternates between vertical units at all sweep rates.

19. Press the CHOP button of the VERTICAL MODE switch. Turn the B 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 B time-base unit sweep rate switch to 0.5 millisecond/division.

20. 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.

21. 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 timebase units throughout their range. Notice that each timebase 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. Return 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 Timebase unit only. Likewise, the B INTENSITY control changes the intensity of the trace produced by the B timebase unit only. Return both intensity controls to the desired level.

22. 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 even 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.

23. Connect the BNC to pin-jack cable to the 0.4 V calibrator output. 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 VERT unit is displayed at the sweep rate of both the A HORIZ and B HORIZ time-base units and that the vertical deflection produced by the RIGHT VERT plug-in unit is also displayed at the sweep rate of both the A HORIZ and B HORIZ time-base units.

24. 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).

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

26. 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).

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

28. 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. The reason for this is that there is no input signal connected to the right vertical unit. Return the A TRIGGER SOURCE switch to VERT MODE.

29. 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.

Control Illumination

30. 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 (on left side panel) to the LOW position. Notice that the selected pushbuttons of the R7704 and the plug-in units are illuminated.

31. Change the CONTROL ILLUM switch to the HIGH position. Notice that the selected pushbuttons of the R7704 and the plug-in units are illuminated at maximum

Readout

32. Note: This step applies only to instruments equipped with the Readout System. Turn the READOUT intensity control clockwise until an alpha-numeric display is visible within the top or bottom division of the CRT (reset the FOCUS adjustment if necessary for best definition of the readout). 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.

33. 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 vertical plug-in. 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.

34. Sequentially press all of the VERTICAL MODE switch buttons and the HORIZONTAL MODE switch 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.

Beam Finder

35. Set the deflection factor of the vertical plug-in which is displayed to 0.1 volt/division. Notice that a square wave display is not visible since the deflection exceeds the scan area of the CRT.

36. Press the BEAM FINDER switch. 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.

37. With the BEAM FINDER switch locked in the outward position, increase the vertical and horizontal deflection factor until the display is reduced to about two divisions vertically and horizontally (when the time-base unit is in the time-base mode, change only the deflection factor of the vertical unit). Adjust the position controls of the displayed vertical unit and the time-base unit to center 2-10 the compressed display about the center lines of the graticule. Press the BEAM FINDER switch in

and release. Notice that the display remains within the viewing area.

Z-Axis Input

38. If an external signal is available (five volts peak-to-peak minimum), the function of the Z-AXIS INPUTS can be demonstrated. Remove the BNC cap from the HIGH SENSITIVITY connector (on rear panel). Connect the external signal to both the input connector of the displayed vertical unit and the HIGH SENSITIVITY connector. Set the sweep rate of the displayed time base 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 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.

39. Remove the BNC cap from the HIGH SPEED connector. Disconnect the external signal from the HIGH SENSITIVITY connector and reconnect it to the HIGH SPEED connector. Again increase the amplitude of the signal generator until trace modulation is apparent on the displayed waveform. Notice that a higher amplitude signal is necessary to produce trace modulation. Again, the positive peaks of the waveform should be blanked out and the negative peaks intensified. Also, notice that the setting of the intensity controls affects the amount of trace modulation. The major difference between these two methods of obtaining trace modulation is that the HIGH SENSITIVITY input is more sensitive, but that the HIGH SPEED input has a higher usable frequency range. Replace the BNC caps on both Z-AXIS INPUTS.

40. This completes the basic operating procedure for the R7704. Instrument operations not explained here, or operations which need further explanation are discussed under General Operating Information.

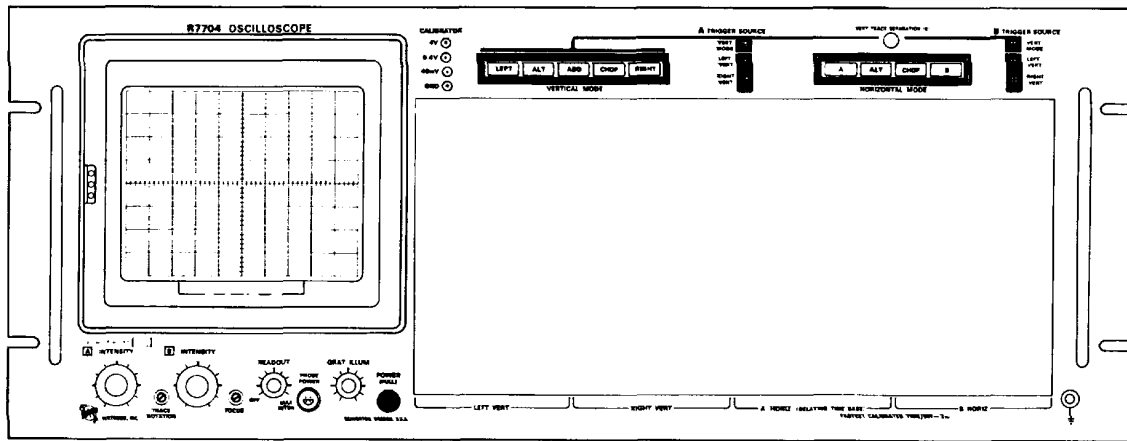
TEST SET-UP CHART**General**

Fig. 2-3 shows the front, side, top, and rear panels of the R7704. This chart may be reproduced and used as a test setup record for special measurements, applications or procedures, or it may be used as a training aid for familiarization with this instrument.

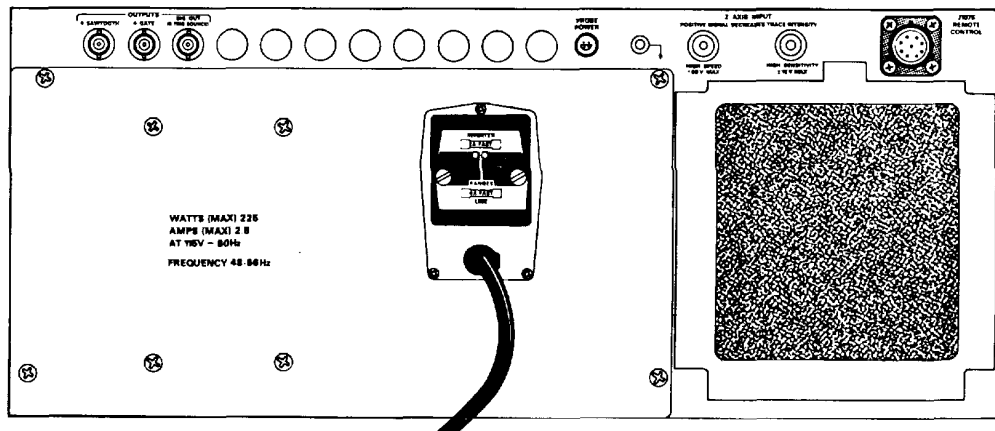
GENERAL OPERATING INFORMATION**Simplified Operating Instructions**

General. The following information is provided to aid in quickly obtaining the correct setting for the R7704 controls

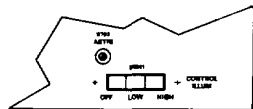
R7704 TEST SET-UP CHART



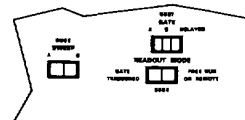
A. Front panel.



B. Rear panel.



C. Partial left side.



D. Partial top.

Fig. 2-3.

(A)

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 7A-series vertical 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 peak-to-peak auto, 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).

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

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 left 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 vertical 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 peak-to-peak auto, 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).

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 VERT position control.

14. Press the ALT or CHOP button of the VERTICAL MODE switch. A dual-trace display of the signal from the LEFT VERT and RIGHT VERT 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.

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

1. Install a 7A-series vertical 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 and B HORIZ compartments.

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

5. Press the VERT MODE buttons of the A 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 peak-to-peak auto, 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).

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 controls.

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 Displays. 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 vertical 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 DISPLAY switch.

5. Press the VERT MODE buttons of the A 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 peak-to-peak auto, 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 VERT deflection factor until display is reduced in size vertically; then center compressed display with LEFT VERT position controls; release BEAM FINDER).

11. Set the LEFT VERT 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 VERT deflection factor until display is reduced in size vertically; then center compressed display with RIGHT VERT position control; release BEAM FINDER).

16. Set the RIGHT VERT deflection factor for a display about two divisions 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 VERT unit is displayed only at the sweep rate of the B time-base unit and the RIGHT VERT 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 VERT TRACE SEPARATION (B) control 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. 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.

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-in 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 A HORIZ 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.

Intensity Controls

The R7704 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.

To protect the CRT phosphor, do not turn the intensity controls higher than necessary to provide a satisfactory display. The light filters reduce the observed light output from the CRT. When using these filters, avoid advancing the intensity controls too high. 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. Also, be careful that the intensity controls are not set too high when changing the time-base unit sweep rates from a fast to a slow sweep rate, or when changing to the X-Y mode of operation. This instrument incorporates protection circuitry which automatically reduces the display intensity to a lower level when either of the time-base units are set to a slow sweep rate. This reduces the danger of damaging the CRT phosphor at these slower sweep rates.

Display Focus

This instrument contains an automatic-focusing circuit which maintains optimum focus for all intensity settings after correct setting of the FOCUS adjustment is established. The easiest way to obtain correct setting of the FOCUS adjustment is to set the READOUT intensity control so the readout portion of the display is clearly visible. Then set the FOCUS adjustment for best definition of the readout display. If this instrument does not contain the Readout System (Option 1), set the FOCUS adjustment for best definition of a CRT display at medium intensity settings.

If a well-defined display cannot be obtained with the FOCUS adjustment, set the ASTIG adjustment (located on left side of instrument) as follows:

NOTE

To check for proper setting of the ASTIG adjustment, slowly turn the FOCUS adjustment 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 adjustment. This setting of the ASTIG adjustment should be correct for any display.

1. Connect the 4 V calibrator pin-jack to the input of the vertical unit with a BNC to pin-jack cable.
2. 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 adjustment fully counterclockwise and set the ASTIG adjustment to midrange.
6. Set the FOCUS adjustment 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 parts 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. Set the TRACE ROTATION adjustment so the trace is parallel with the horizontal graticule lines.

Graticule

The graticule of the R7704 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. Each division is one centimeter square. 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-in units 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.

Fig. 2-4 shows the graticule of the R7704 and defines the various measurement lines. The terminology defined here will be used in all discussions involving graticule measurements.

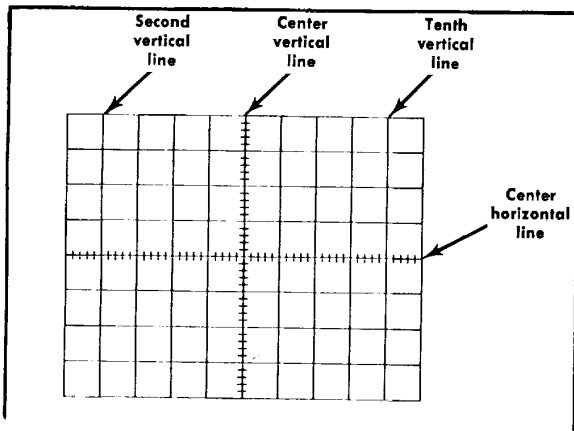


Fig. 2-4. Definition of measurement lines on R7704 graticule.

Light Filter

The tinted filter provided with the R7704 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 R7704 (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. The filter can be ordered by Tektronix Part No. 378-0603-00.

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 the R7704. 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 (located on left side of instrument) determines the illumination level of the pushbutton switches on the R7704 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-connected

sweep feature). In the OFF position all pushbutton lights on the R7704 and the associated plug-in units 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 intensity control has no effect upon instrument operation in this case.

Readout

The Readout System of the R7704 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 timeshared basis with the signal waveforms.

The READOUT MODE switch (located on top panel), determines the operating mode of the Readout System. When this switch is in the the FREE RUN REMOTE position, the Readout System operates in a free-running mode to randomly interrupt the waveform display to present 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. The trigger for the Readout System in the Gate Trig'd mode is produced from the sweep gate selected by the GATE switch (located on same board as REMOTE READOUT switch) and is the same as the gate signal connected to the rear-panel + GATE connector (time-base unit must be installed in selected horizontal compartment).

The readout information from each plug-in is called a word. Up to eight words of readout information can be displayed on the R7704 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/or 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 and/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 through the waveform is not selected for display).

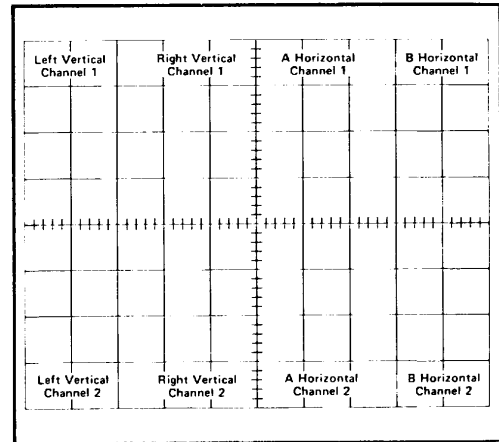


Fig. 2-5. Location of readout on the CRT identifying the originating plug-in unit and channel.

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 unit 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 intensity 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, or when the trace

interruptions necessary to display characters do not allow a satisfactory waveform display to be obtained.

NOTE

If this instrument is to be operated with the Readout System board removed, be sure to connect a jumper lead between pin ZV and pin ZW (Readout System chassis). Failure to make this wiring change will result in timing error, particularly at fast sweep rates.

Remote Readout

The operating mode of the Readout System can be remotely controlled through the rear-panel REMOTE CONTROL connector J1075. 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 independently of the waveform, such as for display photography. Requirements for remote readout operation are:

REMOTE READOUT LOCKOUT

Pin of J 1075	E
Signal required	Closure to ground (within 0.1 volt) from a positive level locks out Readout System
Maximum current required	Two milliamperes
Maximum open circuit voltage	+2 volts
Maximum input voltage	+5 volts, -1 volt (DC + peak AC)

REMOTE SINGLE-SHOT READOUT

Pin of J1075	F
Signal required	Closure to ground (within 0.4 volt) 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 volt/microsecond.
Maximum current required	Three milliamperes
Maximum open circuit voltage	+10volts
Maximum input voltage	+10 volts, -5 volts (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 following specific information applies to the R7704.

The CRT bezel of the R7704 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. It also receives control signals 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 readout portion 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 can 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 R7704 and the plug-in units which are available since the display combinations possible are dictated by the specific combination of plug-in units used. Table 2-2 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 switches see the following sections on Vertical Mode and Horizontal Mode.

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 of 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 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 the 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 independent pairs mode. Under this condition, the LEFT VERT unit is always displayed at the sweep rate of the time-base unit in the B HORIZ compartment and the RIGHT VERT 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

TABLE 2-2
Display Combinations¹

VERTICAL MODE Switch Position	HORIZONTAL MODE Switch 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.
	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	

¹Combinations given for single-channel vertical and horizontal units only.

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 VERT 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 VERT 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, the internal trigger signals from the vertical plug-ins are algebraically added and the time-base units are triggered from the resultant signal. Use of the LEFT VERT or RIGHT VERT trigger source positions triggers the time-base units on the internal trigger signal from the selected vertical unit only. 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 the R7704 is greater than 10: 1 at 150 megahertz. The rejection ratio increases to 100: 1 at 20 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 volts/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

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

(A)

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 obtaining 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 200kilohertz 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. 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 dual-sweep operation. To use the control, first establish the desired position 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 or as the display is electronically switched between the LEFT VERT and RIGHT VERT plug-ins in the ALT position of the VERTICAL MODE switch. It also provides a usable trigger signal in the ADD or CHOP positions of the VERTICAL MODE switch, since the internal trigger signal in these modes is the algebraic sum of the signals applied to the vertical plug-in units. Therefore, the VERT MODE positions ensure that the time-base units receive a trigger signal regardless of the VERTICAL MODE switch setting without the need to change the trigger source selection. However, 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 so the trigger signal can be obtained from either the LEFT VERT or RIGHT VERT plug-in unit. The internal trigger signal is obtained from the selected vertical compartment whether the plug-in unit 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 the R7704 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 unit 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 use with the R7704. This network provides close delay matching between the vertical and horizontal deflection systems up to two megahertz for use in X-Y applications which require precise phase measurements. The network can be added to the R7704 at any time. Order Tektronix Part No. 040-0529-00 from your local Tektronix Field Office or representative for a complete X-Y delay compensation network; 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 (remove power unit to reach these switches). When the Delay Disable switch is set to In (up), minimum phaseshift 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.

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 modulat-

(A)

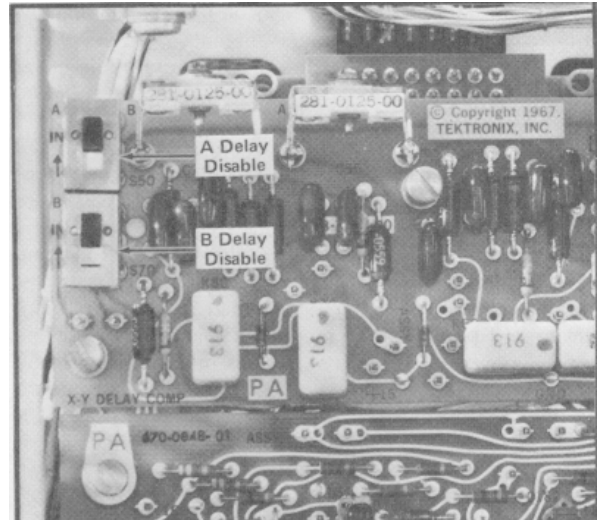


Fig. 2-6. Location of A and B Delay Disable

ing 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 upon the setting of the intensity controls.

Time markers applied to the Z-AXIS INPUTS 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.

Two modes of intensity modulation are provided in the R7704. The following discussions list the use and limitations of each mode.

High Sensitivity Input. The HIGH SENSITIVITY input (on rear panel) permits intensity modulation of the CRT display through the Z-Axis Amplifier circuit. A two-volt peak-to-peak signal will completely blank the display even at maximum intensity levels. Lower amplitude signals can be used to only change the trace brightness rather than completely blank the display. Negative-going modulating signals increase the display intensity and positive-going modulating signals decrease the display intensity. Bandwidth for this mode of intensity modulation is DC to 10 megahertz (input voltage derating necessary above two megahertz). The maximum input voltage in this mode should be limited to 15 volts (DC plus peak AC). Since this

Operating Instructions-R7704

input is the most sensitive, it can be used for all applications requiring bandwidth of 10 megahertz or less. When the HIGH SENSITIVITY input is not in use, replace the BNC cap.

High Speed Input. Intensity modulation signals connected to the HIGH SPEED connector (on rear panel) are connected primarily to the cathode circuit of the CRT. A 60-volt peak-to-peak signal will provide complete blanking of the display even at maximum intensity settings. Negative-going modulating signals increase the display intensity and positive-going modulating signals decrease the display intensity. Bandwidth for this mode is DC to 100 megahertz. Maximum input voltage for signals connected to the HIGH SPEED input is 60 volts (DC plus peak AC). Replace the BNC cap when the HIGH SPEED input is not in use.

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 saw-tooth signals. This is accomplished in the R7704 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 INPUTS 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 of the R7704.

Calibrator

General. The internal calibrator of the R7704 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 voltage of 40 millivolts, 0.4 volt, and 4 volts at the three front-panel pin-jack connectors into high-impedance loads. In addition, outputs of 20 millivolts, 0.2 volt, and 0.4 volt are available from the 40 mV, 0.4 V, and 4 V pin-jacks respectively into 50 ohms. Additional calibrator voltages of 4 millivolts and 40 volts are available internally at the Output Signal board and can be connected to the front-panel pin-jacks by changing internal circuit-board connections (see Output Signals schematic for correct pins). If the calibrator output connections are changed, the front-panel calibrator nomenclature will no longer be correct.

Current. A 40-milliampere, one-kilohertz output current is provided when the current-loop accessory is connected between the 4 V pin-jack and ground. This output can be used to check and calibrate current-measuring probe systems. The current signal is obtained by clipping the probe around the current-loop accessory. The arrow on the current-loop accessory 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.

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 (on rear-panel) provides a positive-going sample of the sawtooth signal from the time-base units in the horizontal plug-in compartments. The SWEEP switch (located on top panel; see Fig. 2-2) 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-ohm load or about one volt/unit of time into a one-megohm 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

Operating Instructions-R7704

peak output voltage is greater than 500 millivolts into a 50-ohm load or greater than 10 volts into a one-megohm load.

+ Gate. The + GATE output connector (on rear panel) provides a positive-going rectangular output pulse from the time-base units in the horizontal plug-in compartments. The GATE switch (located on top panel; see Fig. 2-2) 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 the A HORIZ 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 volts into 50 ohms or about 10 volts into one megohm.

Vertical Signal. The SIG OUT connector (on rear panel) 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. 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. In the ALT position of the VERTICAL MODE switch, the output signal at the SIG OUT connector switches between vertical units along with the CRT display. However, the vertical output signal in the CHOP position is a composite signal and is the same as obtained in the ADD position due to the requirements of the triggering system. 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-ohm load is about 25 millivolts/division of CRT display and about 0.5 volts/division of display into a one-megohm 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).

Probe Power Connectors

The two PROBE POWER connectors provide operating power for active probe systems. One PROBE POWER connector is located on the front panel and a second connector is provided on the rear panel. 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 REMOTE CONTROL connector J1075 on the rear panel of the R7704 provides input for (A)

remote operation of the instrument and the associated plug-in units. Table 2-3 lists the function of each terminal of J1075. The mating connector for J1075 is Tektronix Part No. 134-0049-00 (one mating connector supplied as standard accessory). The methods of obtaining remote Single-Sweep reset and ready indication are given under Remote Single-Sweep Reset. Remote operation of the Readout System is discussed under Remote Readout.

TABLE 2-3
Remote Connections

J1075 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 REMOTE CONTROL connector J1075. 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). Requirement for remote single-sweep reset Operation are:

REMOTE SINGLE-SWEEP RESET (A and B HORIZ)

Pin of J1075	A
Signal required	Closure to ground (within -5 to +0.5 volts) from a positive level.
Maximum current required	10 milliamperes.
Minimum pulse width	10 microseconds at 50% amplitude points.
Maximum input voltage	15 volts (DC + peak AC).

A HORIZ REMOTE READY INDICATOR

Pin of J1075	C
Output signal	Open or ground when not ready; +5 volts at 47-ohm source impedance when ready - output sufficient to light a No. 49 bulb.

B HORIZ REMOTE READY INDICATOR

Pin of J1075	D
Output signal	Open or ground when not ready; +5 volts at 47-ohm source impedance when ready - output sufficient to light a No. 49 bulb.

Fig. 2-7 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.

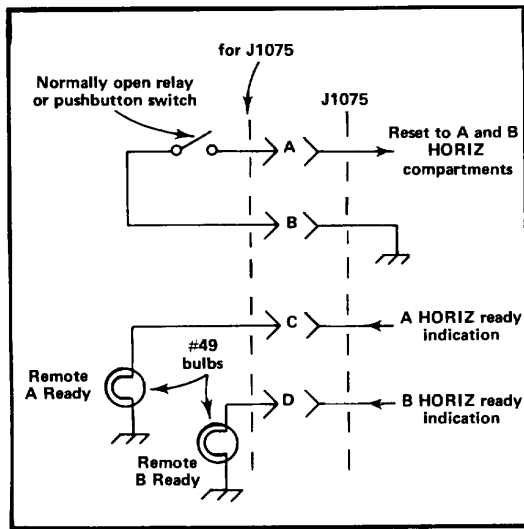


Fig. 2-7. Typical circuit for remote single-sweep reset operation

Applications

The R7704 Oscilloscope and its associated plug-in units provide a very flexible measurement system. The capabilities of the overall system, depend mainly upon the plug-in units that are chosen for use with this instrument. Specific applications for the individual plug-in units are described in the plug-in 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.

The following books describe oscilloscope measurement techniques which can be adapted for use with this instrument.

Harley Carter, "An Introduction to the Cathode Ray Oscilloscope", Phillips Technical Library, Cleaver-Hume Press Ltd., London, 1960.

J. Czech, "Oscilloscope Measuring Techniques", Phillips Technical Library, Springer-Verlag, New York, 1965.

Robert G. Middleton, "Scope Waveform Analysis", Howard W Sams & Co. Inc., The Bobbs-Merrill Company Inc., Indianapolis, 1963.

Robert G. Middleton and L. Donald Payne, "Using the Oscilloscope in Industrial Electronics", Howard W. Sams & Co. Inc., The Bobbs-Merrill Company Inc., Indianapolis, 1961.

John F. Rider and Seymour D. Uslan, "Encyclopedia of Cathode-Ray Oscilloscopes and Their Uses", John F. Rider Publisher Inc., New York, 1959.

John F. Rider, "Obtaining and Interpreting Test Scope Traces", John F. Rider Publisher Inc., New York, 1959.

Rufus P. Turner, "Practical Oscilloscope Handbook", Volumes 1 and 2, John F. Rider Publisher Inc., New York, 1964.

SECTION 3 CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

This section of the manual contains a description of the circuitry used in the R7704 Oscilloscope. The description begins with a discussion of the instrument using the basic block diagram shown in Fig. 3-1. Then, each circuit is described in detail using detailed block diagrams to show the interconnections between the stages in each major circuit and the relationship of the front-panel controls to the individual stages.

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

BLOCK DIAGRAM

General

The following discussion is provided to aid in understanding the overall concept of the R7704 before the individual circuits are discussed in detail. A basic block diagram of the R7704 is shown in Fig. 3-1. Only the basic interconnections between the individual blocks are shown on this diagram. Each block represents a major circuit within the instrument. The number on each block refers to the complete circuit diagram which is located at the rear of this manual.

Vertical signals to be displayed on the CRT are applied to the Vertical Interface circuit from both vertical plug-in compartments. The Vertical Interface circuit determines whether the signal from the left and/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 alpha-numeric readout display.

Horizontal signals for display on the CRT are connected to the Horizontal Interface circuit from both horizontal plug-in compartments. The X-Y Delay Compensation network (optional feature) provides a delay for the horizontal (X) portion of an X-Y display to match the delay of the

vertical (Y) signal due to the delay line. The Horizontal Channel Switch determines whether the signal from the A and/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 alpha-numeric 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 Trigger Selector circuit. This circuit selects the trigger signal which is connected to the horizontal plug-in units. It also provides the drive signal for the Output Signals circuit to provide an output which is a sample of the vertical signal. The Output Signals circuit also provides a sawtooth and a gate output signal. The Calibrator portion of this circuit produces a square-wave output with accurate amplitude which can be used to check the calibration of this instrument and the compensation of probes.

The Logic Circuit develops control signals for use in other circuits within this instrument and the plug-in units. These output signals automatically determine the correct instrument operation in relation to the plug-ins installed and/or selected, plug-in control settings, and R7704 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 Line to DC Converter/Regulator and Low-Voltage Regulator circuits provide the power necessary for operation of this instrument. This voltage is connected to all circuits within the instrument. The Controls and Cabling circuit shows the switching logic of the front-panel controls. It also includes the rear-panel REMOTE CONTROL connector and the output connectors to supply power to active probe systems.

(A)

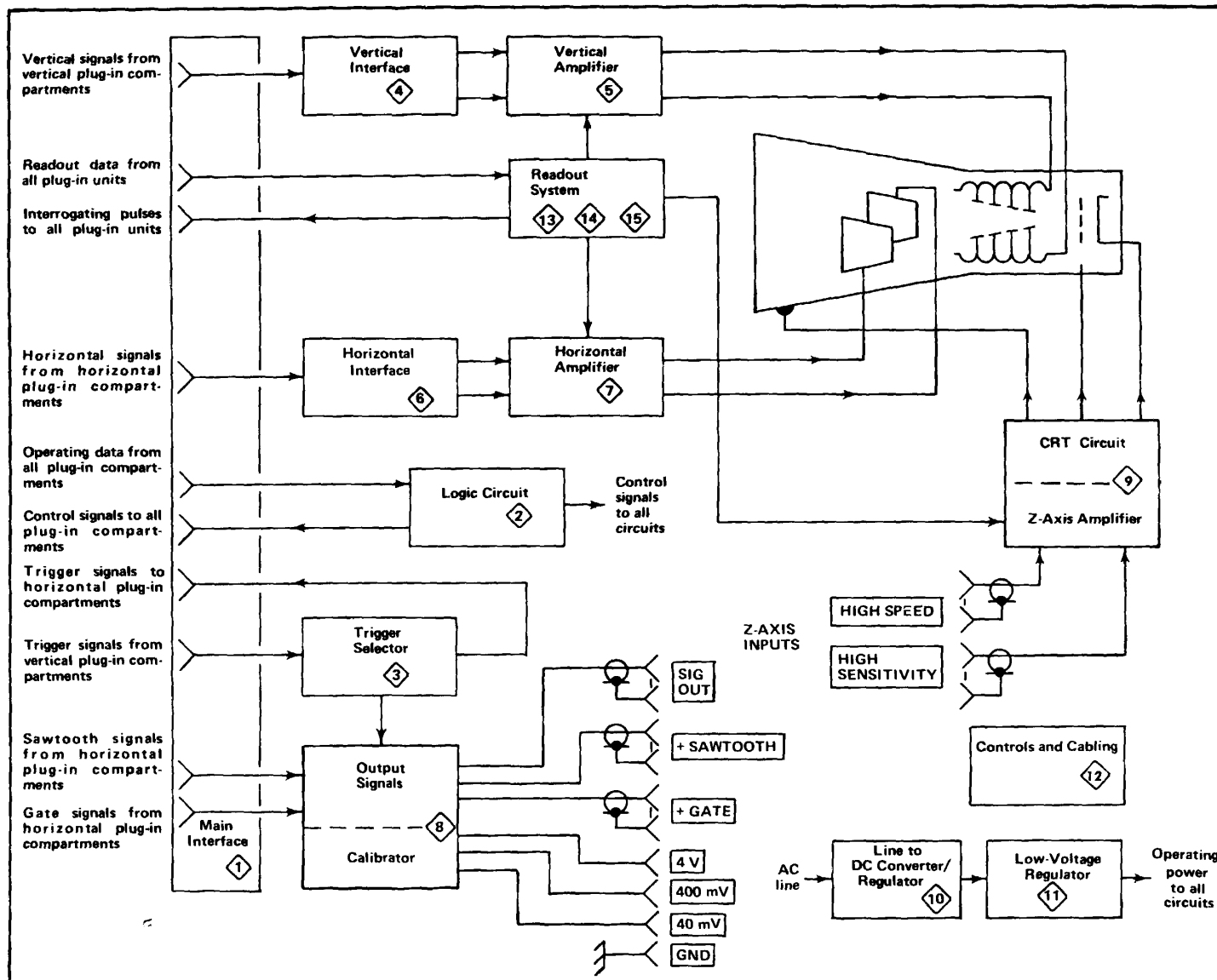


Fig. 3-1. Basic block diagram of R7704 Oscilloscope

CIRCUIT OPERATION

General

This section provides a detailed description of the electrical operation and relationship of the circuits in the R7704. The theory of operation for circuits unique to this instrument is described in detail in this discussion. Circuits which are commonly used in the electronics industry are not described in detail. If more information is desired on these commonly used circuits, refer to the following textbooks (also see books under Logic Fundamentals):

Phillip Cutler, "Semiconductor Circuit Analysis", McGraw-Hill, New York, 1964.

Lloyd P. Hunter (Ed.), "Handbook of Semiconductor Electronics", second edition, McGraw-Hill, New York, 1962.

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

The following circuit analysis is written around the detailed block diagrams which 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

General

Digital logic techniques are used to perform many functions within this instrument. The function and
REV. B, FEB. 1976

Circuit Description-R7704

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 within the R7704 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 will be described in the circuit description for the applicable device.

NOTE

Logic symbols used on the diagrams depict the logic function 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:

$$HI = 1$$

$$LO = 0$$

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, "Display B Command" means that the B Time-Base unit will be displayed

when this line is HI or true. Likewise, the line labeled "X-Compensation Inhibit" means that the X-Compensation function is inhibited or disabled 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 which are of importance 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. For examples of input/output tables for individual devices, see Table 3-1.

Non-Digital Devices

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

TABLE 3-1.

Basic Logic Reference


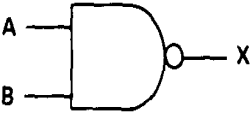
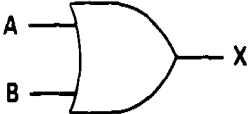
Device	Symbol	Description	Input/Output Table																		
AND gate		A device with two or more inputs and one output. The output of the AND gate is HI if and only if all of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	LO	LO	HI	LO	HI	LO	LO	HI	HI	HI
Input		Output																			
A	B	X																			
LO	LO	LO																			
LO	HI	LO																			
HI	LO	LO																			
HI	HI	HI																			
NAND gate		A device with two or more inputs and one output. The output of the NAND gate is LO if and only if all of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	HI	LO	HI	HI	HI	LO	HI	HI	HI	LO
Input		Output																			
A	B	X																			
LO	LO	HI																			
LO	HI	HI																			
HI	LO	HI																			
HI	HI	LO																			
OR gate		A device with two or more inputs and one output. The output of the OR gate is HI if one or more of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	LO	LO	HI	HI	HI	LO	HI	HI	HI	HI
Input		Output																			
A	B	X																			
LO	LO	LO																			
LO	HI	HI																			
HI	LO	HI																			
HI	HI	HI																			

TABLE 3-1. (cont.)

Basic Logic Reference

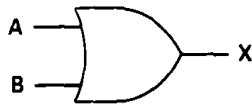
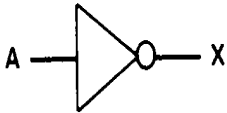



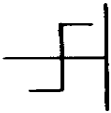
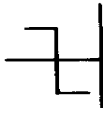
Device	Symbol	Description	Input/Output Table																		
NOR gate		A device with two or more inputs and one output. The output of the NOR gate is LO if one or more of the inputs are at the HI state	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	HI	LO	HI	LO	HI	LO	LO	HI	HI	LO
Input		Output																			
A	B	X																			
LO	LO	HI																			
LO	HI	LO																			
HI	LO	LO																			
HI	HI	LO																			
Inverter		A device with one input and one output. The output state is always opposite to the input state.	<table border="1"> <thead> <tr> <th>Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input	Output	A	X	LO	HI	HI	LO										
Input	Output																				
A	X																				
LO	HI																				
HI	LO																				
LO-state indicator	 	<p>A small circle at the input or output of a symbol indicates that the LO state is the significant state. Absence of the circle indicates that the HI state is the significant state. Two examples follow:</p> <p>AND gate with LO-state indicator at the A input.</p> <p>The output of this gate is HI if and only if the A input is LO and the B input is HI.</p>	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	LO	LO	HI	HI	HI	LO	HI	HI	HI	HI
Input		Output																			
A	B	X																			
LO	LO	LO																			
LO	HI	HI																			
HI	LO	HI																			
HI	HI	HI																			
		<p>OR gate with LO-state indicator at the A input:</p> <p>The output of this gate is HI if either the input is LO or the B input is HI.</p>	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	LO	LO	HI	HI	HI	LO	HI	HI	HI	HI
Input		Output																			
A	B	X																			
LO	LO	LO																			
LO	HI	HI																			
HI	LO	HI																			
HI	HI	HI																			
Edge symbol	 	Normally superimposed on an input line to a logic symbol. Indicates that this input (usually the trigger input of a flip-flop) responds to the indicated transition of the applied signal.																			

TABLE 3-1. (cont.)

Basic Logic Reference

Device	Symbol	Description	Input/Output Table																																				
Triggered (toggle) Flip-Flop		A bistable device with one input and two outputs (either or both outputs may be used). When triggered, the outputs change from one stable state to the other stable state with each trigger. The outputs are complementary (i.e., when one output is HI the other is LO). The edge symbol on the trigger (T) input may be of either polarity depending on the device.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th colspan="2">Output</th> </tr> <tr> <th colspan="2">Condition before trigger pulse</th> <th colspan="2">Condition before trigger pulse</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>\bar{X}</td> <td>X</td> <td>\bar{X}</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> <td>HI</td> </tr> </tbody> </table>	Input		Output		Condition before trigger pulse		Condition before trigger pulse		X	\bar{X}	X	\bar{X}	LO	HI	HI	LO	HI	LO	LO	HI																
Input		Output																																					
Condition before trigger pulse		Condition before trigger pulse																																					
X	\bar{X}	X	\bar{X}																																				
LO	HI	HI	LO																																				
HI	LO	LO	HI																																				
Set-Clear (J-K) Flip-Flop		A bistable device with two inputs and two outputs (either or both outputs may be used). The outputs change state in response to the states at the inputs. The outputs are complementary (i.e., when one output is HI the other is LO).	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th colspan="2">Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> <th>\bar{X}</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td colspan="2">No change</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td colspan="2">Changes state</td> </tr> </tbody> </table>	Input		Output		A	B	X	\bar{X}	LO	LO	No change		LO	HI	LO	HI	HI	LO	HI	LO	HI	HI	Changes state													
Input		Output																																					
A	B	X	\bar{X}																																				
LO	LO	No change																																					
LO	HI	LO	HI																																				
HI	LO	HI	LO																																				
HI	HI	Changes state																																					
Triggered Set-Clear (J-K) Flip-Flop		A bistable device with three or more inputs and two outputs (either or both outputs may be used). When triggered, the outputs change state in response to the states at the inputs prior to the trigger. The outputs are complementary (i.e., when one output is HI the other is LO). The edge symbol on the trigger (T) input may be of either polarity depending on the device.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th colspan="2">Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> <th>\bar{X}</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td colspan="2">No change</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td colspan="2">Changes state</td> </tr> </tbody> </table>	Input		Output		A	B	X	\bar{X}	LO	LO	No change		LO	HI	LO	HI	HI	LO	HI	LO	HI	HI	Changes state													
Input		Output																																					
A	B	X	\bar{X}																																				
LO	LO	No change																																					
LO	HI	LO	HI																																				
HI	LO	HI	LO																																				
HI	HI	Changes state																																					
Flip-flop with direct inputs (may be applied to all triggered flip-flops)		For devices with direct-set (S_D) or direct-clear (C_D) inputs, the indicated state at either of these inputs overrides all other inputs (including trigger) to set the outputs to the states shown in the input/output table.	<table border="1"> <thead> <tr> <th colspan="4">Input</th> <th colspan="2">Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>X</th> <th>\bar{X}</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>LO</td> <td>LO</td> <td colspan="2">NO change¹</td> </tr> <tr> <td>Φ</td> <td>Φ</td> <td>LO</td> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>Φ</td> <td>Φ</td> <td>HI</td> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>Φ</td> <td>Φ</td> <td>HI</td> <td>HI</td> <td colspan="2">Undefined</td> </tr> </tbody> </table> <p>Φ = Has no effect in this case ¹Output state determined by conditions at triggered inputs</p>	Input				Output		A	B	C	D	X	\bar{X}	1	1	LO	LO	NO change ¹		Φ	Φ	LO	HI	LO	HI	Φ	Φ	HI	LO	HI	LO	Φ	Φ	HI	HI	Undefined	
Input				Output																																			
A	B	C	D	X	\bar{X}																																		
1	1	LO	LO	NO change ¹																																			
Φ	Φ	LO	HI	LO	HI																																		
Φ	Φ	HI	LO	HI	LO																																		
Φ	Φ	HI	HI	Undefined																																			

MAIN INTERFACE

General

Diagram 1 shows the plug-in interface and the interconnections between the plug-in compartments, circuit boards, etc. of this instrument. The circuitry shown on this diagram associated with Q24 and Q28 is described in connection with the Trigger Selector circuit.

LOGIC CIRCUIT

General

The Logic Circuit develops control signals for use in other circuits within this instrument. These output signals automatically determine the correct instrument operation in relation to the plug-ins installed and/or selected, plug-in control settings, and R7704 control settings. A block diagram of the Logic Circuit is shown in Fig. 3-2. This diagram shows the source of the input control signals, the output signals produced by this stage, and the basic interconnections between blocks. The interconnections shown are intended only to indicate inter-relation between blocks and do not indicate a direct connection or that only a single connection is made between the given blocks. Details of the inter-relation between stages in this circuit are given in the circuit description which follows. A schematic of this circuit is shown on diagram 2 at the rear of this manual.

This circuit description for the Logic Circuit is written with the approach that each of the integrated circuits and its associated discrete components comprises an individual stage as shown by the block diagram (Fig. 3-2). The operation of each of these stages is discussed relating the input signals and/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 which are of importance to perform the prescribed function of an individual stage.

Horizontal Logic

General. The Horizontal Logic stage performs three separate logic functions. These functions are: A Sweep Inhibit, B Sweep Inhibit, and Alternate Pulse Generator. Fig. 3-3 identifies the three individual stages and the input and out-

put terminals associated with each. Notice that some of the input levels are used in several or all of the individual stages.

A Sweep Inhibit. The A Sweep Inhibit stage produces an output level at pin 14 which determines if the A Time-Base unit can produce a sweep. If this level is HI, the A Time-Base unit is locked out (disabled) so it cannot produce a sweep. If the level is LO, the A Time-Base unit is enabled and can produce a sweep when triggered.

Only two combinations of input conditions produce an A Sweep Inhibit level (HI); if any one of the prescribed conditions is not met, the A Sweep Inhibit level is LO and the A Time-Base unit is enabled. These conditions are:

1. Pin 1 HI-HORIZONTAL MODE switch set to ALT.

Pin 4 HI-A Horizontal unit operated in time-base mode.

Pin 5 HI-B Horizontal unit operated in time-base mode.

Pin 12 LO-A Time-Base unit in independent (non-delayed) mode.

Pin 16 HI-B Sweep is being displayed in the horizontal-alternate mode.

2. Pin 2 LO-A Time-Base unit is not already producing a sweep.

Pin 12 HI-A Time-Base unit in delayed mode.

Pin 13 HI-B Time-Base unit has just completed a sweep and is in holdoff condition.

The first combination disables the A Sweep while the B Sweep is being displayed in the horizontal ALT 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 the B Sweep can complete its holdoff before the next A Sweep begins.

A logic diagram for the A Sweep Inhibit stage is shown in Fig. 3-4A. A table of input/output combinations for this stage is shown in Fig. 3-4B. This table shows the level at each input for the two combinations that produce a HI output level.

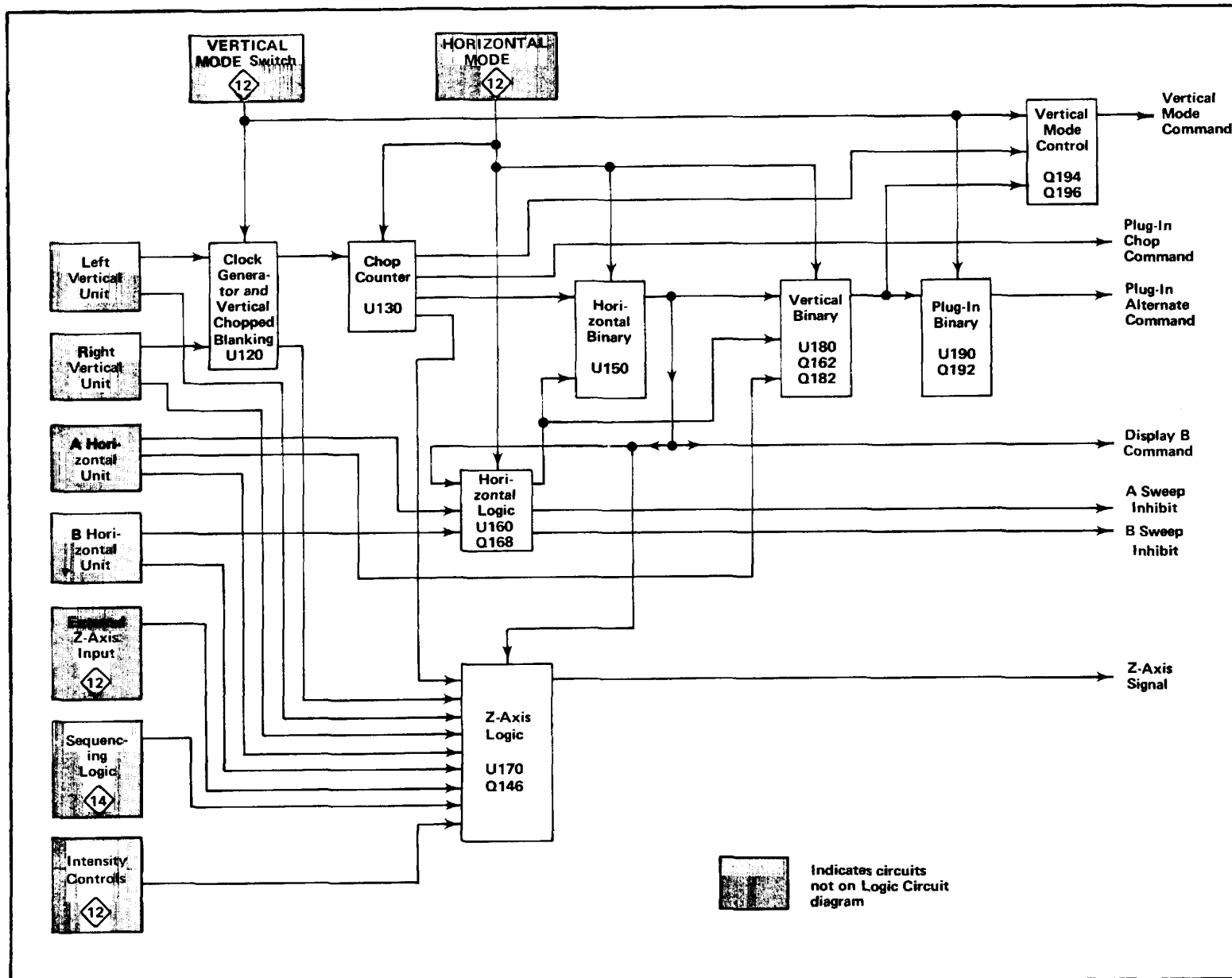


Fig. 3-2. Block diagram of Logic Circuit

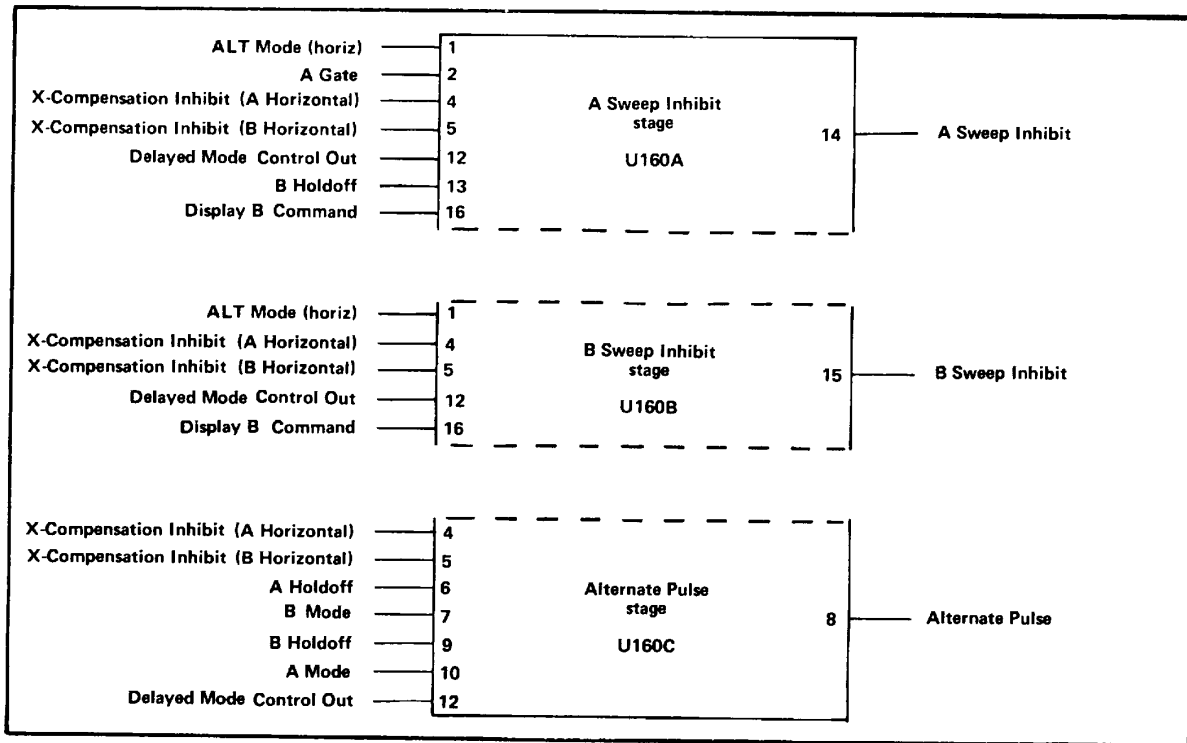


Fig. 3-3. Breakdown of separate stages within Horizontal Logic (U160) showing inputs and outputs for each stage

B Sweep Inhibit. The B Sweep Inhibit stage produces an output level at pin 15 of U160B which determines if the B Time-Base unit can produce a sweep. A HI level at this pin disables the B Sweep and a LO level provides an enabling level to the B Time-Base unit. The output at pin 15 is HI only under one set of input conditions. These conditions are:

- Pin 1 HI-HORIZONTAL MODE switch set to ALT.
- Pin 4 HI-A Horizontal unit operated in time-base mode.
- Pin 5 HI-B Horizontal unit operated in time-base mode.
- Pin 12 LO-A Time-Base unit in independent (non-delayed) mode.
- Pin 16 LO-A Sweep is being displayed in the horizontal-alternate mode.

These conditions disable the B Sweep while the A Sweep is being displayed in the horizontal ALT mode (both units must be in time-base mode) if non-delayed sweep is used. For any other combination of input conditions, the B Sweep Inhibit level at pin 15 is LO. However, the inhibit 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.

Fig. 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 located on the Main Interface diagram (a phantom-OR gate performs the OR-logic function merely by interconnection of the two signals). An input/output table for the B Sweep Inhibit stage is shown in Fig. 3-5B.

Alternate Pulse Generator. The third function performed by U160 is to produce alternate pulses for use by the horizontal and vertical alternate systems. The conditions that exist at the inputs to the Alternate Pulse Generator stage determine which time base provides the Alternate Pulse. The Alternate Pulse is a positive-going pulse (falling edge only used by following-stages) which is coincident with the leading edge of the holdoff gate from the time-base units. The holdoff gate is produced at the end of the sweep by the respective time-base unit, and differentiated by either C165 or C166 to provide a positive-going pulse to pins 6 or 9. The Alternate Pulse is produced at the end of either the A Sweep or the B Sweep, or both, depending upon the operating conditions. The following discussions describe the

(A)

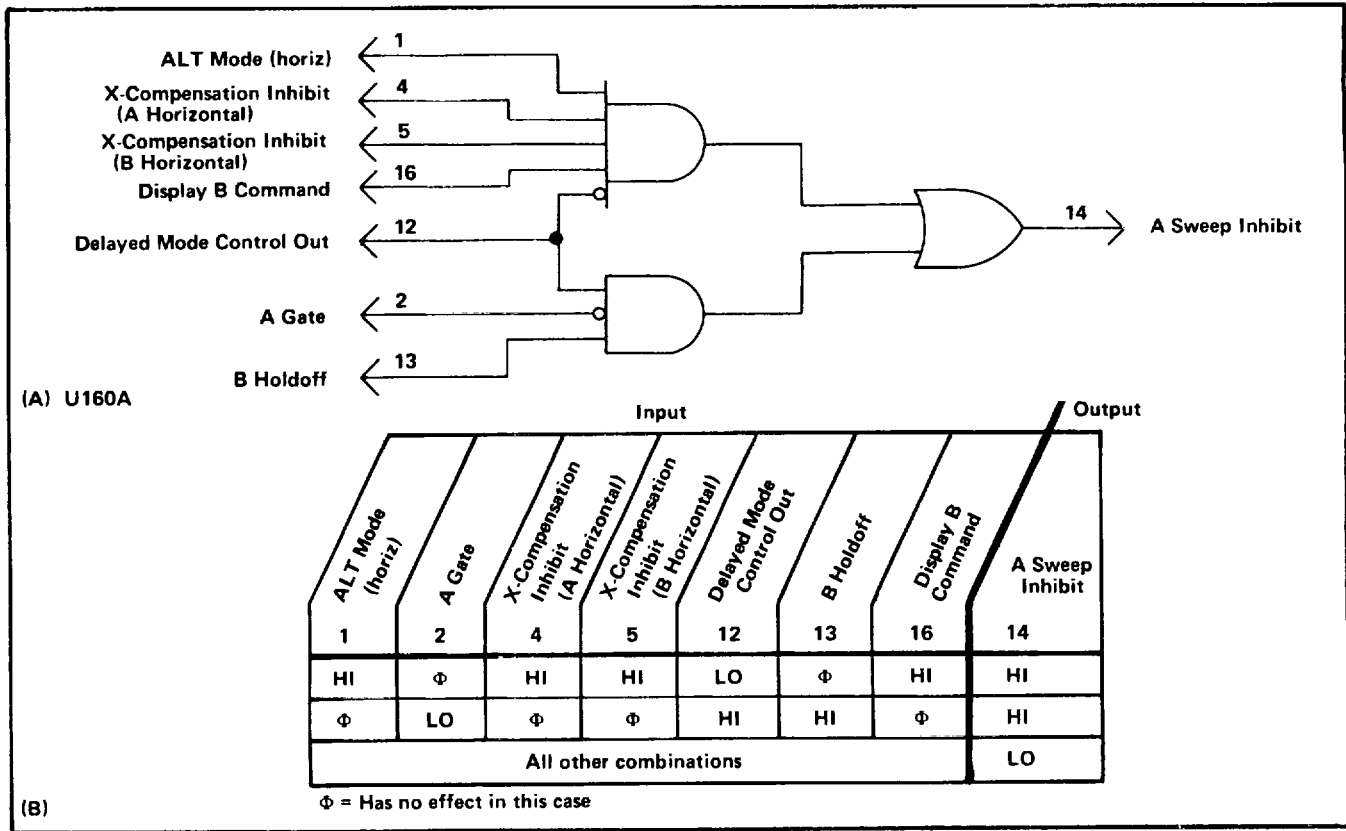


Fig. 3-4. (A) Logic diagram for A Sweep Inhibit stage, (B) Table of input/output combinations for A Sweep Inhibit stage

operation of the Alternate Pulse Generator stage in relation to various combinations of input conditions that can occur.

1. A (ONLY) MODE

The Alternate Pulse is produced only at the end of the A Sweep when the HORIZONTAL MODE switch is set to the A position. The input conditions are:

- Pin 4 HI-A Horizontal unit operated in time-base mode.
- Pin 6 HI-Holdoff pulse produced at end of A Sweep.
- Pin 7 LO-HORIZONTAL MODE switch set to any position except B.
- Pin 10 HI-HORIZONTAL MODE switch set to A.

2. B (ONLY) MODE-NON-DELAYED

In the B position of the HORIZONTAL MODE switch, the Alternate Pulse is produced only at the end of the B Sweep (A Time-Base must be in independent, non-delayed, mode). The input conditions are:

- Pin 5 HI-B Horizontal unit operated in time-base mode.

- Pin 7 HI-HORIZONTAL MODE switch set to B.
- Pin 9 HI-Holdoff pulse produced at end of B Sweep.
- Pin 10 LO-HORIZONTAL MODE switch set to any position except A.
- Pin 12 LO-A Time-Base unit in independent (non-delayed) mode.

3. ALTERNATE OR CHOPPED OPERATION-NON-DELAYED

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 first 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. The input conditions for this mode of operation are:

- Pin 4 HI-A Horizontal unit operated in time-base mode.
- Pin 5 HI-B Horizontal unit operated in time-base mode.

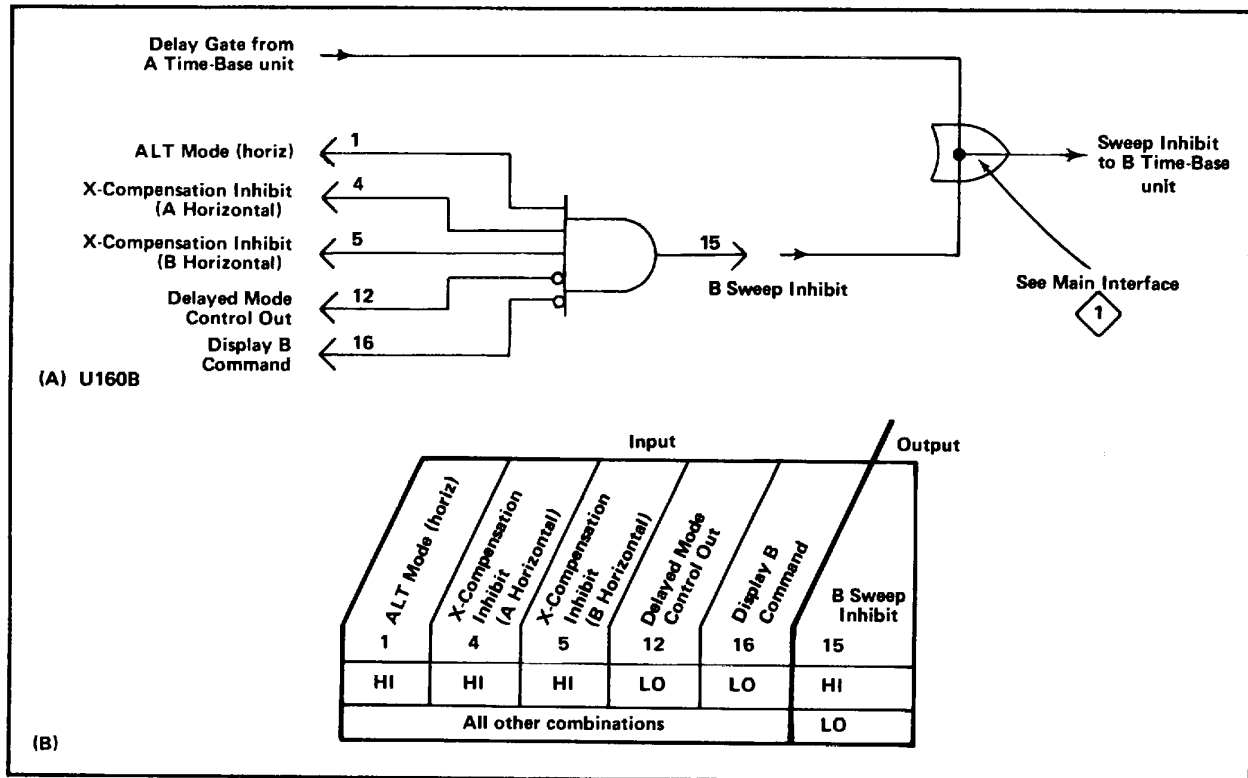


Fig. 3-5. (A) Logic diagram for B Sweep Inhibit stage, (B) Table of input/output combinations for B Sweep Inhibit stage

Pin 6 HI-Holdoff pulse produced at end of A Sweep'.
 Pin 7 LO-HORIZONTAL MODE switch set to any position except B.
 Pin 9 HI-Holdoff pulse produced at end of B Sweep'.
 Pin 10 LO-HORIZONTAL MODE switch set to any position except A.
 Pin 12 LO-A Time-Base unit in independent (non-delayed) mode.

4. DELAYED SWEEP

When the A Time-Base unit is set for delayed operation, the operation of the stage 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 whenever it is displayed. The input conditions for this mode of operation are:

Pin 4 HI-A Horizontal unit operated in time-base mode.

¹Simultaneous HI at pins 6 and 9 are not required; a HI at either input produces an Alternate Pulse if other conditions are met.

(A)

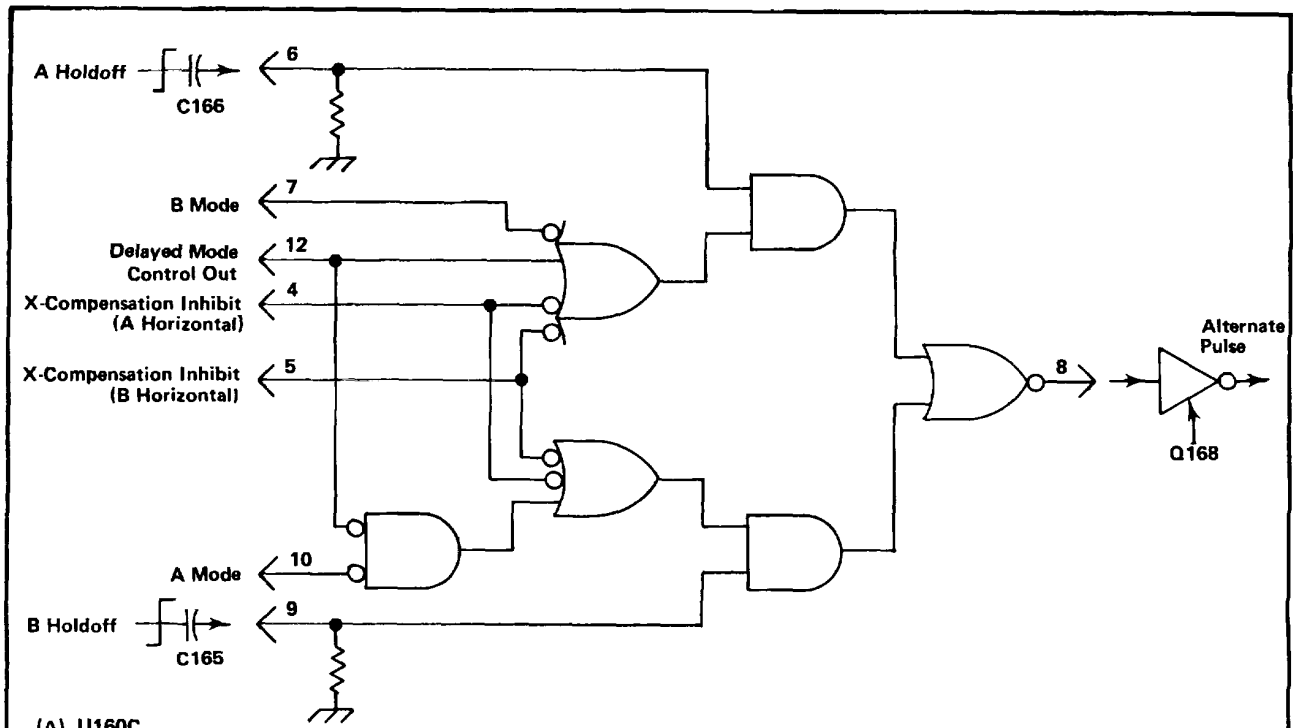
Pin 5 HI-B Horizontal unit operated in time-base mode.
 Pin 6 HI-Holdoff pulse produced at end of A Sweep.
 Pin 12 HI-A Time-Base unit in delayed mode.

5. VERTICAL UNIT IN HORIZONTAL COMPARTMENT

When a vertical 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 vertical units are installed in both horizontal plug-in compartments, an Alternate Pulse is not produced under normal operating conditions since there are no time-base units to produce a holdoff pulse.

NOTE

The conditions of the Alternate Pulse Generator with vertical units in both horizontal plug-in compartments are such that an Alternate Pulse could be produced if positive-going pulses are applied to pins 6 and 9. Although not used for normal operation, this mode may be used in special purpose plug-ins.



(A) U160C

Input							Output	
X-Compensation Inhibit (A Horizontal)	X-Compensation Inhibit (B Horizontal)	A Holdoff	B Mode	B Holdoff	A Mode	Delayed Mode Control Out	Time-Base which is source of Alternate Pulse	Horizontal Conditions
4	5	6	7	9	10	12	8 ²	
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 Holdoff 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 for the Alternate Pulse Generator stage.

6. ONE TIME-BASE REMOVED

If either time-base unit is removed from its compartment and the compartment is left vacant, an Alternate Pulse can not be produced. Although the input levels to the Alternate Pulse Generator stage will allow an output pulse to be produced by the remaining time-base unit, further operation is prevented by the A or B Sweep Inhibit stages.

A logic diagram for the Alternate Pulse Generator stage is shown in Fig. 3-6A. Note the resistors shown connected to pins 6 and 9 of U160C. These resistors, which are internal to the device, hold the level 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 from the respective time base. Fig. 3-6B shows an input/output table for the Alternate Pulse Generator stage.

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 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.

Fig. 3-7 identifies the inputs to the Z-Axis Logic circuit. 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 0 to 4 milliamperes and is determined by the applicable current source to control the output current at pin 8.

The Vertical Chopped Blanking connected to pin 6, and the Horizontal Chopped Blanking connected to both pins 6 and 7 through CR145-CR146, 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 signal is connected to pin 6 of U170 directly from pin 4 of U120. The Horizontal Chopped Blanking signal is connected to U170 from pin 4 of U130 through LR134, Q146, and CR145-CR146 (see diagram 2). Notice that this signal is connected to the

(A)

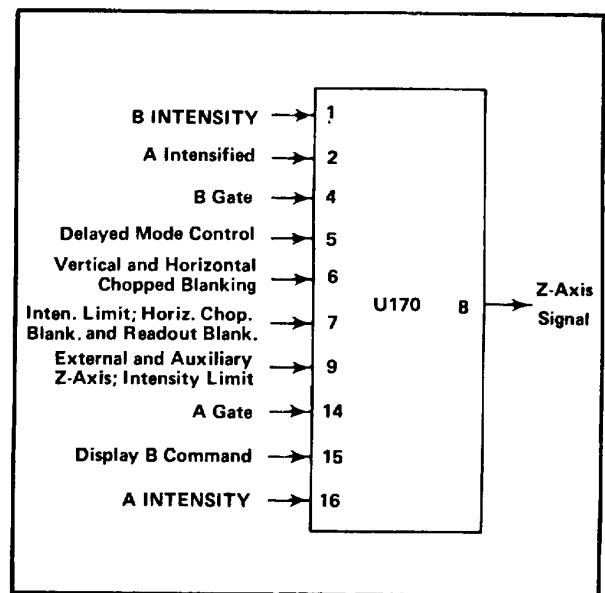


Fig. 3-7. Input and output pins for Z-Axis Logic stage

collector of Q146. This transistor is normally operating in the saturated condition and the HI Horizontal Chopped Blanking level from U130 is the collector source voltage. When the Horizontal Chopped Blanking level goes LO, the current through Q146 drops to produce a corresponding LO level at its emitter. This level is connected to both pins 6 and 7 of U170 through CR145 and CR 146.

Q146 also controls the levels at pins 6 and 7 for readout displays. The Z-Axis Logic OFF Command from the Readout Circuit is connected to the base of Q146 through VR148 and R147. This level is normally HI so Q146 operates as controlled by the Horizontal Chopped Blanking 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 Q146 through VR148 with very little voltage attenuation. Q146 is reverse-biased to produce a LO level at its emitter. This level is coupled to pins 6 and 7 of U170 through CR145 and CR146 to block the Z-Axis Logic output current during the readout display (intensity of readout display determined by a separate Readout Intensity level connected directly to the Z-Axis Amplifier; see CRT Circuit description). Diode CR147 clamps the emitter of Q146 at about -0.6 volts when this transistor is off.

The Intensity Limit input at pins 7 and 9 provides protection for the CRT phosphor at slow sweep rates or when the BEAM FINDER is actuated. For conditions that do not require limiting, R140-R141-R142-R143R144-R145-R175 establish the operating current at pins 7 and 9. When either of the time-base units is set to a sweep rate which requires intensity limiting the junction of

R143-R144-R145 is connected to ground in the time-base unit. This drops the current level at pins 7 and 9 to limit the output current from this stage. Limiting the output current of this stage in turn limits the maximum trace intensity for all CRT displays whenever either of the time-base units is set to a sweep rate that requires intensity limiting. The Max Intensity adjustment R140 is set to provide optimum writing rate on the CRT when the INTENSITY controls are set fully clockwise.

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 (see diagram 12) is connected to pin 16 through R176.

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 the portion of the A sweep which will be displayed in the delayed mode. The A Intensified current is supplied to pin 2 of U170 from the A INTENSITY control through R178. 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 Delayed 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 (see diagram 12) is connected to the Z-Axis Logic stage through R179.

The current level established by the intensity controls can be altered by the External and Auxiliary Z-Axis current level at pin 9. The current at this pin can come from the Z AXIS INPUT connectors on the rear panel through R112 or from any of the plug-in compartments through R110, R 11 1, R 113, or R 114. 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 connectors 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 CR175 and CR176 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 connectors.

Fig. 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 is to be displayed on the CRT. When this level is HI, the B Horizontal unit is displayed and when it is LO, the A Horizontal unit is displayed. The Display B Command is used in the following stages within the Logic Circuit: Horizontal Logic (A and B Lockout), Z-Axis Logic, and Vertical Binary. In addition, it is connected to the following circuits elsewhere in the instrument to indicate which horizontal unit is to be displayed: Main Interface circuit (A and B Horizontal plug-in compartments), Vertical Interface circuit (for trace separation), and Horizontal Interface circuit (for horizontal channel selection). Fig. 3-9 identifies the function of the input pins for this stage. The following discussions describe the operation of the Horizontal Binary stage in each position of the HORIZONTAL MODE switch. Notice that the levels at pins 3, 4, 7, and 10 are determined by the HORIZONTAL MODE switch (see diagram 12). 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, for U150 either pin 3, pins 4 and 7 (notice that pins 4 and 7 are tied together at U150), or pin 10 can be HI and the two unselected lines from the HORIZONTAL MODE switch remain LO.

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 Horizontal unit is to be displayed.

The input conditions are:

Pin 3 HI-HORIZONTAL MODE switch set to A.

Pin 4 and 7 LO-HORIZONTAL MODE switch set to any position except B.

Pin 10 LO-HORIZONTAL MODE switch set to any position except CHOP.

2. B MODE

Selecting the B horizontal mode provides a HI Display B

Command to all circuits. The input conditions are:

Pin 3 LO-HORIZONTAL MODE switch set to any position except A.

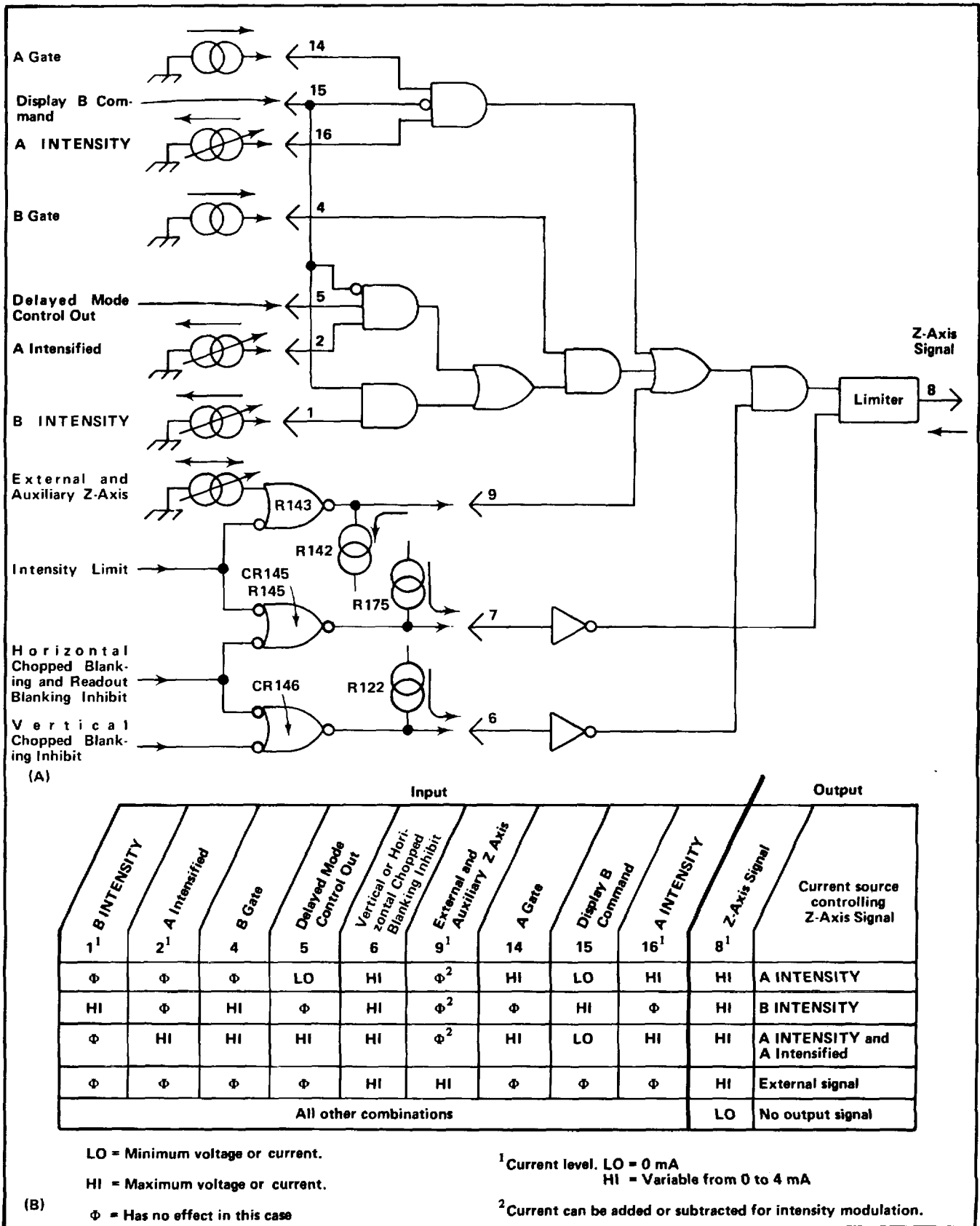


Fig. 3-8. (A) Logic diagram for Z-Axis Logic circuit, (B) Table of input/output combinations for Z-Axis Logic circuit

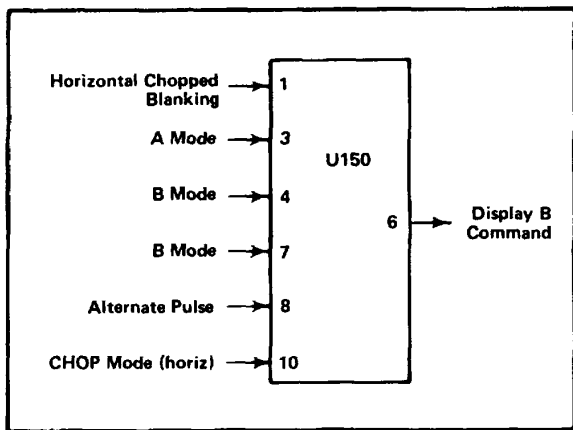


Fig. 3-9. Input and output pins for Horizontal Binary stage

Pin 4 and 7 HI-HORIZONTAL MODE switch set to B.
Pin 10 LO-HORIZONTAL MODE switch set to any position except CHOP.

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 which switches between the A and B Horizontal 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. The input conditions which cause the output to change states are:

Pin 1 LO-Horizontal Chopped Blanking pulse generated by Chop Counter stage goes negative.

Pin 3 LO-HORIZONTAL MODE switch set to any position except A.

Pin 4 and 7 LO-HORIZONTAL MODE switch set to any position except B.

Pin 10 HI-HORIZONTAL MODE switch set to CHOP.

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. The input conditions which cause the output to change states are:

Pin 3 LO-HORIZONTAL MODE switch set to any position except A.

Pin 4 and 7 LO-HORIZONTAL MODE switch set to any position except B.

Pin 8 LO-Alternate Pulse generated by Horizontal Logic stage goes negative.

Pin 10 LO-HORIZONTAL MODE switch set to any position except CHOP.

Fig. 3-10A shows a logic diagram of 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 Vertical unit is displayed and when it is LO, the Left Vertical 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 in the ALT position of the VERTICAL MODE switch and the ALT or CHOP positions of the HORIZONTAL MODE switch whereby the Left Vertical unit is always displayed at the sweep rate of the B Time-Base unit and the Right Vertical unit at the sweep rate of the A Time-Base unit to simulate dual-beam operation for repetitive sweeps.

When the A Time-Base unit is set to the delayed 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) and 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 Control. It is also connected to the following circuits elsewhere in the instrument (through Vertical Mode Control stage, ALT vertical mode only) to indicate which vertical unit is to be displayed: Main Interface circuit (Left and Right Vertical plug-in compartments and trigger selection circuitry) and Vertical Interface circuit.

Fig. 3-11 identifies the function of the input pins for the Vertical Binary stage. This stage uses the same type of integrated circuit 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 operation of the Vertical

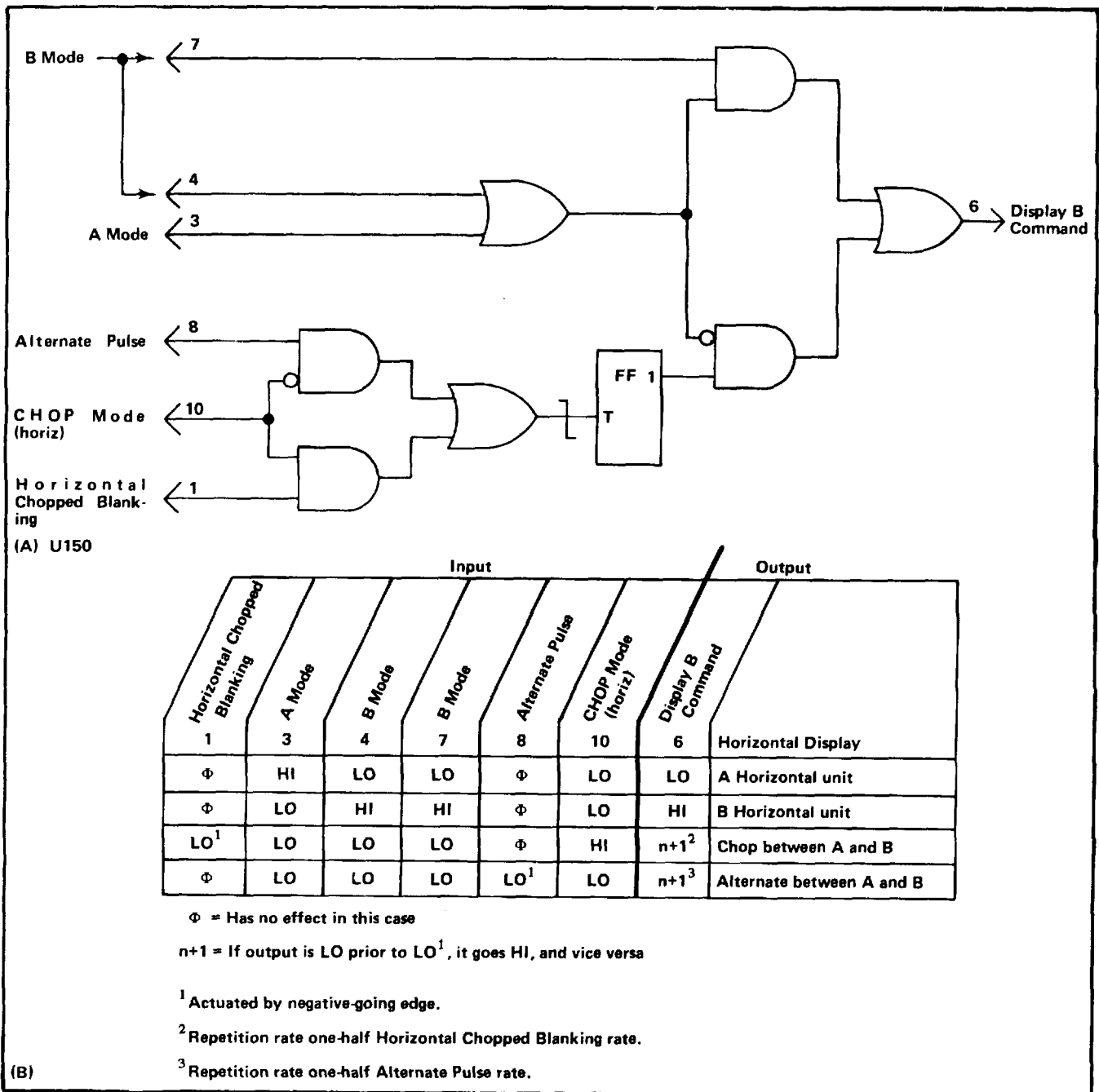


Fig. 3-10. (A) Logic diagram for Horizontal Binary stage, (B) Table of input/output combinations for the Horizontal Binary stage.

tical Binary stage in relation to the modes of operation that can occur.

NOTE

Although the output at pin 6 of U180 is always controlled by the HORIZONTAL MODE switch as described here, this level determines the Vertical Mode control level at the collector of 0196 only in

the A L T position of the V E R T I C A L M O D E switch due to AND gate CR 183-CR 184. See the discussion on the Vertical Mode Logic stage in this section for further information.

1. A OR B MODE

When the HORIZONTAL MODE switch is set to either A or B, the Display Right Command switches to the

(A)

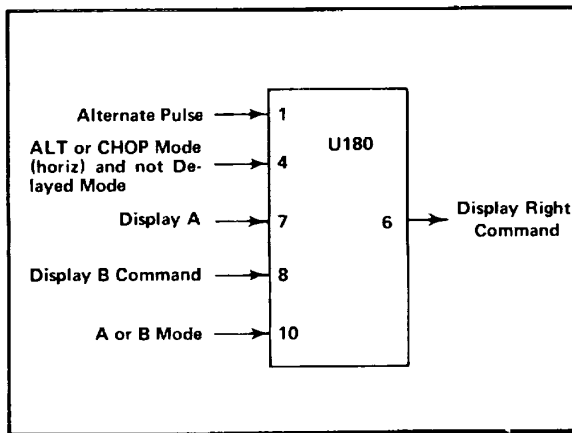


Fig. 3-11. Input and output pins for Vertical Binary stage

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 Vertical unit is always displayed at the sweep rate of the A Time-Base unit and the Left Vertical unit at the sweep rate of the B Time-Base unit (independent-pairs operation). The input conditions to provide a HI output level so that the Right Vertical 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 Vertical 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.

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 which 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 Vertical unit to be displayed first against the A Sweep (delaying) and then against the B Sweep (delayed). Then the display switches to the Left Vertical unit and it 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 Display Channel 2 Command to provide a Plug-In Alternate Command to dual-trace vertical units. Fig. 3-13 identifies the function of the input pins for the Plug-In binary stage. This stage uses the same type of integrated circuit as the Horizontal Binary and Vertical Binary stages.

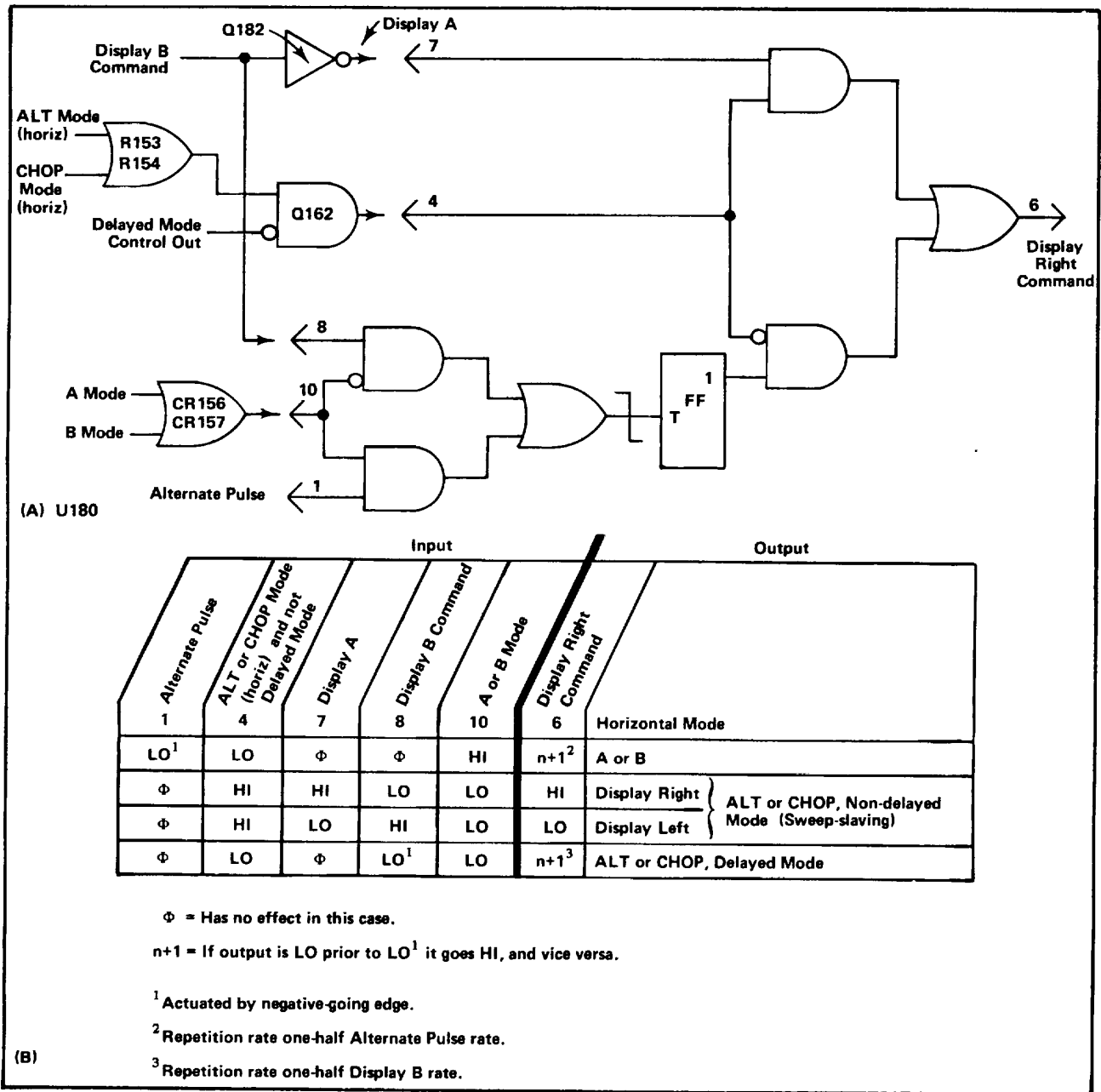


Fig. 3-12. (A) Logic diagram for Vertical Binary stage, (B) Table of input/output combinations for the Vertical Binary stage

When the Display Channel 2 Command level is HI and the vertical plug-ins are 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 Display Channel 2 Command is determined by the setting of the VERTICAL MODE switch. For all positions of the VERTICAL MODE switch except ALT, the Display Channel 2 Command is the same as the Display Right Command from the Vertical Binary stage. Since the Display Right Command was

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.

(A)

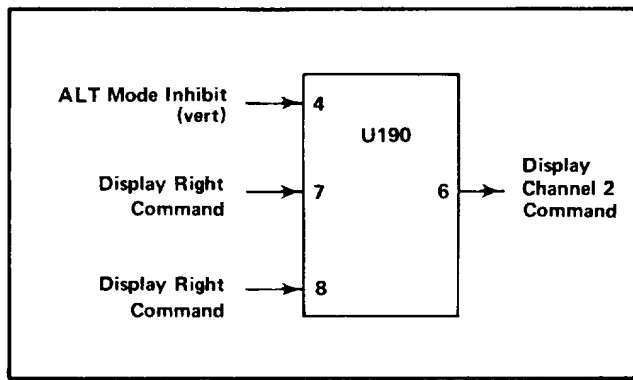


Fig. 3-13. Input and output pins for Plug-In Binary stage

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 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 Display Channel 2 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 or both 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 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 Vertical unit at sweep rate of B Time-Base units, 2) Channel 1 of Right Vertical unit at sweep rate of A Time-Base unit, 3) Channel 2 of Left Vertical unit at sweep rate of B Time-Base unit, 4) Channel 2 of Right Vertical unit at sweep rate

of A Time-Base unit. Notice that under these conditions, both channels of the Left Vertical unit are displayed at the B Sweep rate and that both channels of the Right Vertical 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.

Fig. 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.

Clock Generator

One half of integrated circuit U120 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 which is contained within U120A. This circuit along with discrete components C117-R116-R117-R118 comprise a two-megahertz free-running oscillator to provide a timing signal (clock) for vertical, horizontal, and plug-in chopping.

The stage operates as follows: Assume that Q2 is conducting and Q1 is off. The collector current of Q2 produces a voltage drop across R1 which holds Q1 off. 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). Since there is no current through Q1, C117 begins to charge towards -15 volts through R116-R117. The emitter of Q1 goes negative as C117 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, on waveforms). Since C117 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, C117 can begin to discharge through R118. The emitter level of Q2 follows the discharge of C117 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, C117 begins to charge through R116-R117 to start the second cycle.

Two outputs are provided from this oscillator. The Delay Ramp signal from the junction of R1 16-R1 17 is con-

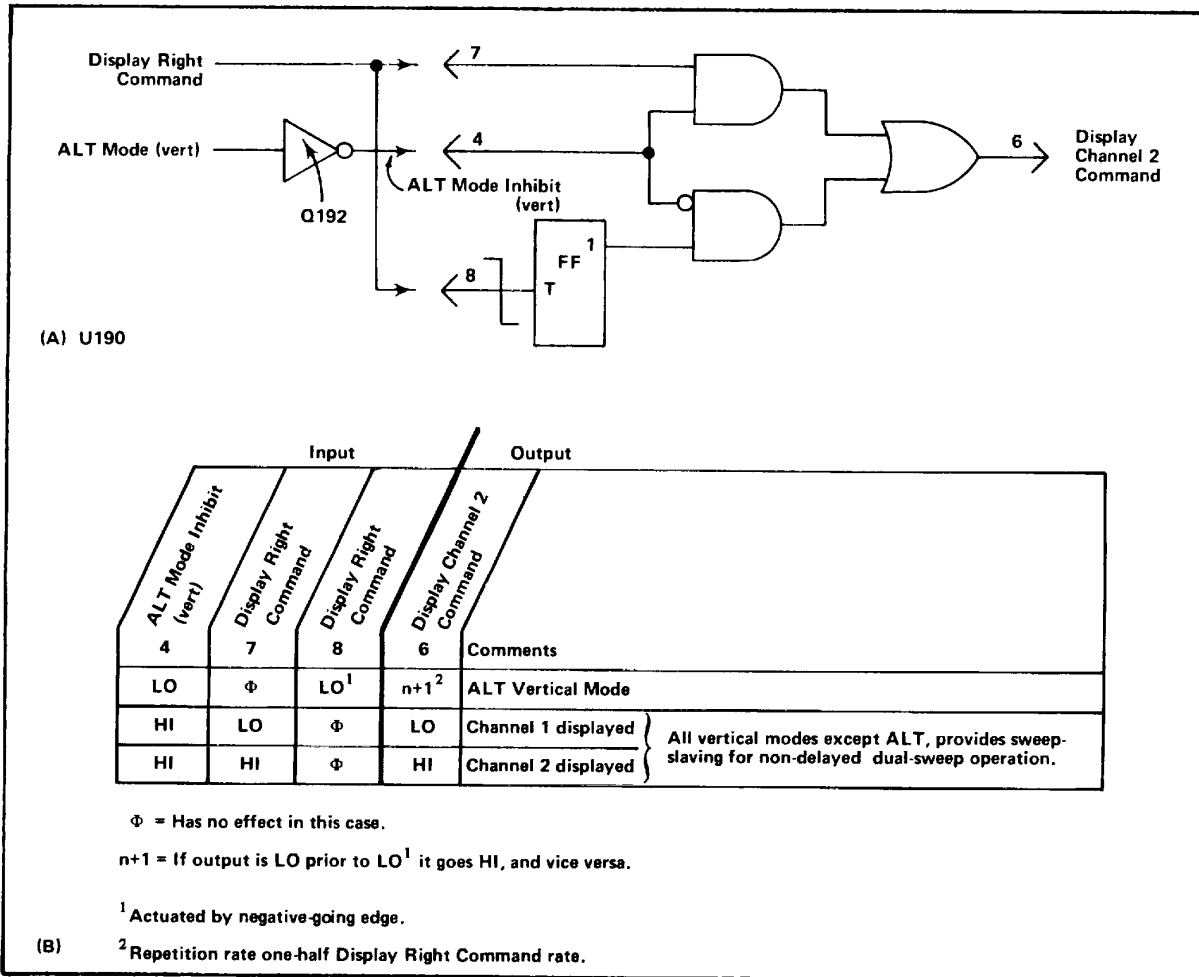


Fig. 3-14. (A) Logic diagram for Plug-In Binary stage, (B) Table of input/output combinations for the Plug-In Binary stage

to the Vertical Chopped Blanking stage. This signal has the same waveshape as shown by the waveform at pin 13, with its slope determined by the divider ratio between R116-R117. A square-wave output is provided at pin 14. The frequency of this square wave is determined by the overall RC relationship between C117-R116-R117-R118, and its duty cycle is determined by the ratio of R 116-R 117 to R118.

The square wave at pin 14 is connected to pin 16 through C1 19. C119, along with the internal resistance of U120A, 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 which is also part of U120A. The output at pin 15 is a positive-going Clock pulse at a repetition rate of about two megahertz.

Vertical Chopped Blanking

The Vertical Chopped Blanking stage is made up of the remaining half of integrated circuit U120. 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 is 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.

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

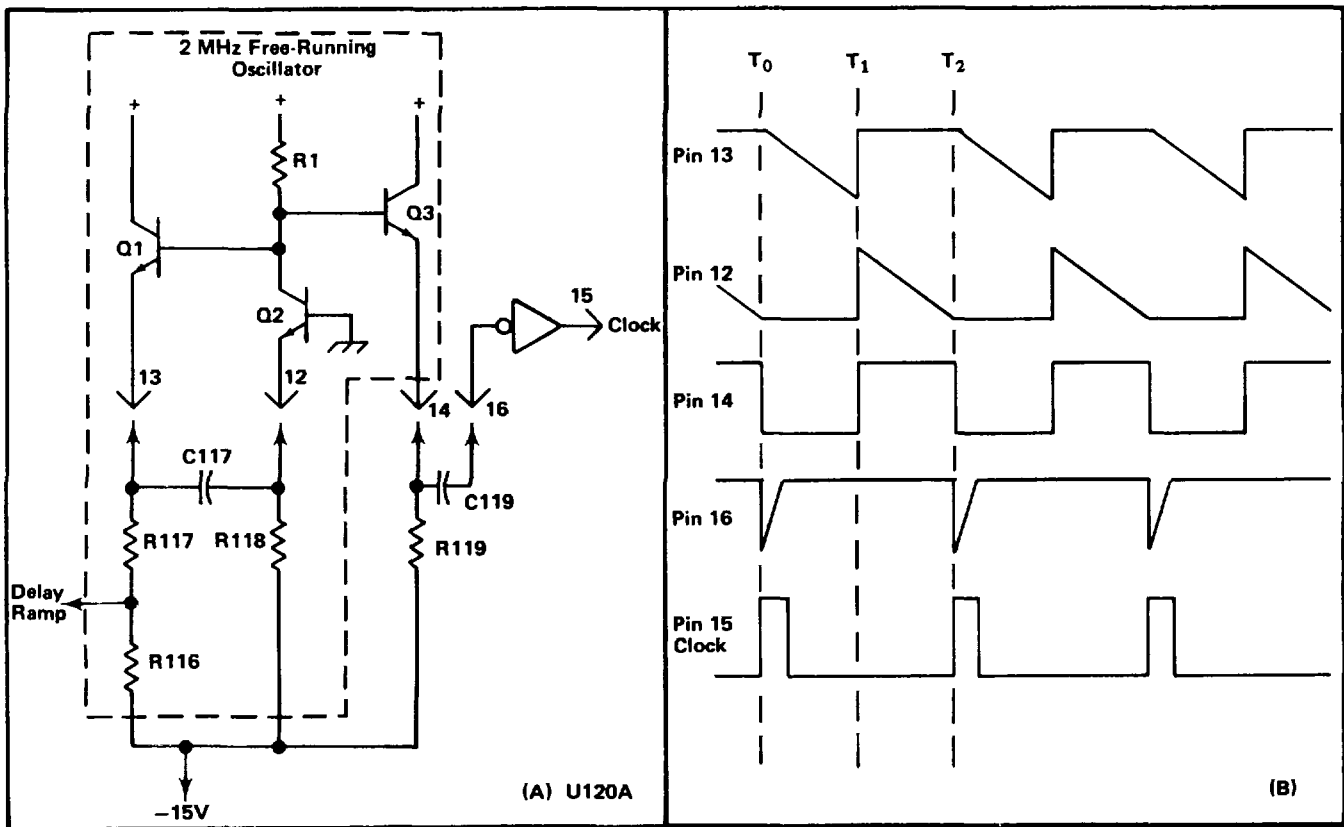


Fig. 3-15. (A) Diagram of Clock Generator stage, (B) Idealized waveforms for Clock Generator stage.

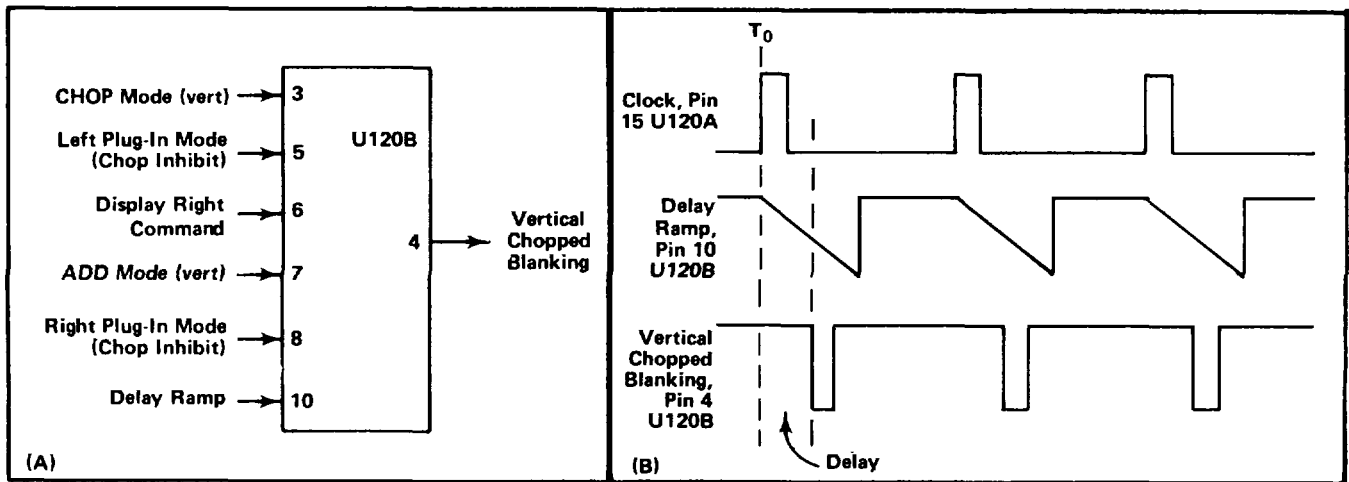


Fig. 3-16. (A) Input and output pins for Vertical Chopped Blanking stage, (B) Idealized waveforms for Vertical Chopped Blanking stage.

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. 3-16B). 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. This signal remains LO until the Delay Ramp goes HI again. Notice the delay between the leading edge of the Clock pulse generated by U120A and the leading edge of the Vertical Chopped Blanking pulses (see Fig. 3-16B). The amount of delay between the leading edges of these pulses is determined by the slope of the Delay Ramp applied to pin 10. This delay is

Circuit Description-R7704

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 discussion for more information).

Whenever this instrument is turned on, Vertical Chopped Blanking pulses are being produced at a two-megahertz rate. However, these pulses are available as an output at pin 4 only when the remaining inputs to U 120B are at the correct levels. The following discussions give the operating conditions which produce Vertical Chopped Blanking pulses to blank the CRT during vertical chopping. Fig. 3-16A identifies the function of the pins of U120B.

1. CHOP VERTICAL MODE

When the VERTICAL MODE switch is set to CHOP, Vertical Chopped Blanking pulses are available at pin 4 at all times. The input conditions necessary are:

Pin 3 HI-VERTICAL MODE switch set to CHOP.

Pin 7 LO-VERTICAL MODE switch set to any position except ADD.

Pin 10 LO-Delay Ramp more negative than about zero volts.

2. LEFT VERTICAL UNIT SET FOR CHOPPED MODE

If the Left Vertical unit is set for chopped operation, the setting of the VERTICAL MODE switch determines whether Vertical Chopped Blanking pulses are available. If the VERTICAL MODE switch is set to the CHOP position, conditions are as described in No. 1 above. Operation in the ADD position of the VERTICAL MODE switch is given later. For the LEFT position of the VERTICAL MODE switch or when the Left Vertical unit is to be displayed in the ALT mode, Vertical Chopped Blanking pulses are available at all times (two-megahertz rate). The input conditions are:

Pin 3 LO-VERTICAL MODE switch set to any position except CHOP.

Pin 5 LO-Left Vertical unit set to chopped mode.

Pin 6 LO-Left Vertical unit to be displayed (Display Right Command LO).

Pin 7 LO-VERTICAL MODE switch set to any position except ADD.

Pin 10 LO-Delay Ramp more negative than about zero volts.

Notice that the Display Right Command at pin 6 must be LO for output pulses to be available at pin 4. This means that when the VERTICAL MODE switch is set to ALT, Vertical Chopped Blanking pulses will be produced only during the time that the Left Vertical unit is to be displayed (unless Right Vertical unit is also set for chopped operation).

3. RIGHT VERTICAL UNIT SET FOR CHOPPED OPERATION

If the Right Vertical unit is set for the chopped mode, operation is the same as described above for the Left Vertical unit except that Vertical Chopped Blanking pulses are produced when the VERTICAL MODE switch is set to RIGHT or when the Display Right Command is HI in the ALT mode. The input conditions are: Pin 3 LO-VERTICAL MODE switch set to any position except CHOP.

Pin 6 HI-Right Vertical unit to be displayed (Display Right Command HI).

Pin 7 LO-VERTICAL MODE switch set to any position except ADD.

Pin 8 LO-Right Vertical unit set to chopped mode.

Pin 10 LO-Delay Ramp more negative than about zero volts.

4. ADD VERTICAL MODE

When the VERTICAL MODE switch is in the ADD position and either or both of the vertical units are operating in the chopped mode, Vertical Chopped Blanking pulses must be available to block out the transition between the traces of the vertical units. The input conditions are: Pin 3 LO-VERTICAL MODE switch set to any position except CHOP.

Pin 5 LO-Left Vertical unit set to chopped mode (can be HI if pin 8 is LO).

Pin 7 HI-VERTICAL MODE switch set to ADD.

Pin 8 LO-Right Vertical unit set to chopped mode (can be HI if pin 5 is LO).

Pin 10 LO-Delay Ramp more negative than about zero volts.

Fig. 3-17A shows a logic diagram of the Vertical Chopped Blanking stage. Notice the comparator block on this diagram (one input connected to pin 10). The output of this comparator is determined by the relationship between the levels at its inputs. If pin 10 is more positive (HI)

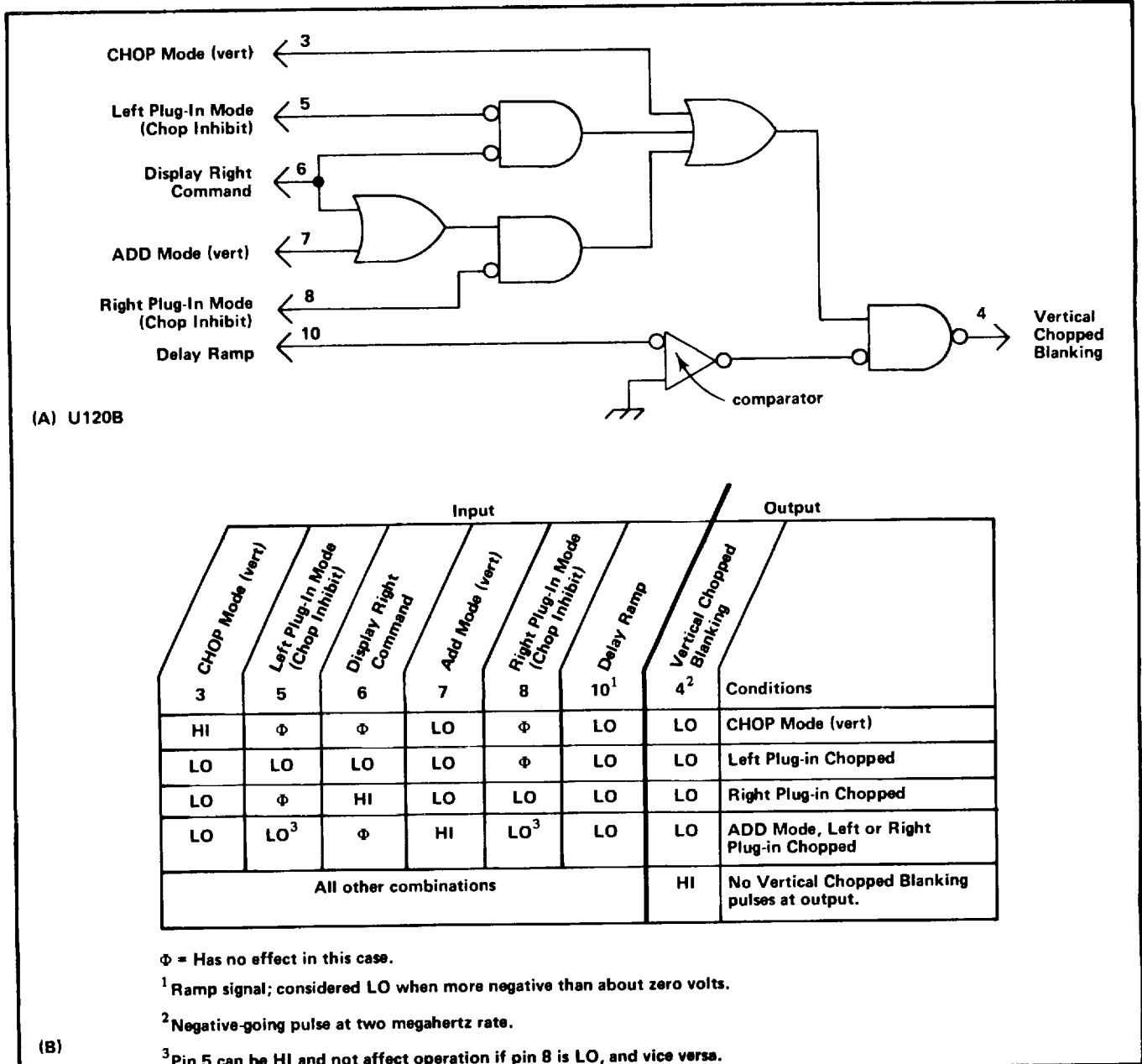


Fig. 3-17. (A) Logic diagram for Vertical Chopped Blanking stage, (B) Table of input/output combinations for Vertical Chopped Blanking stage

than the grounded input, the output is HI also; if it is more negative (LO), the output is LO. An input/output table for this stage is given in Fig. 3-17B.

Chop Counter

The Chop Counter stage 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 stage 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 (onehalf Clock rate). This determines the switching between the

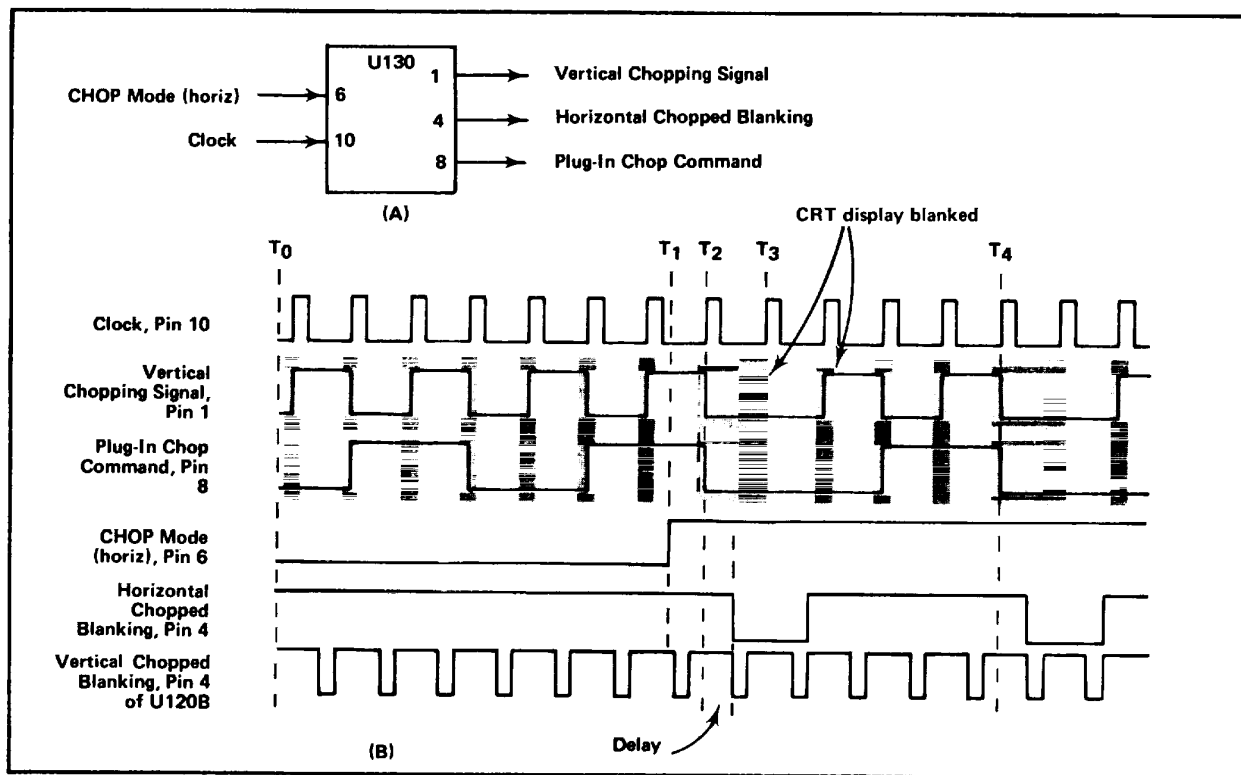


Fig. 3-18. (A) Input and output pins for Chop Counter stage, (B) Idealized waveforms for Chop Counter stage.

Left and Right Vertical 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. However, this change does not appear at pin 4 immediately due to a delay network in the circuit. The delay is necessary so the Horizontal Chopped Blanking coincides with the Vertical Chopped Blanking produced by

(A)

U120A 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 trigger 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.

The Vertical Chopping Signal at pin 1 of U130 is connected to the Vertical Mode Logic stage (see following description) through L138-R138. This signal is HI when the Right Vertical unit is to be displayed and it is LO when the Left Vertical 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 L136-R136 via the Main Interface board. When this signal is HI, Channel 2 of the plug-in units can be displayed and when this level is LO, Channel 1 can be displayed. The Horizontal Chopped Blanking signal at pin 4 is connected through LR134 to the Horizontal Binary stage U150, and to the Z-Axis Logic stage U170 by way of Q146. 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 time-base units.

A logic diagram of the Chop Counter stage is shown in Fig. 3-19. Details of operation for the flip-flops (FF) are shown in Table 3-1 at the front of this section. Use the waveforms given in Fig. 3-18B along with this diagram.

Vertical Mode Logic

The Vertical Mode Logic stage is made up of discrete components CR128-CR139, CR183-CR184, and Q194-Q196. These components develop the Vertical Mode Command which is connected to the Main Interface circuit (vertical plug-in compartments and trigger selection circuitry) and the Vertical Interface circuit to indicate which vertical unit is to be displayed. When this output level is HI, the Right Vertical unit is displayed and when it is LO, the Left Vertical unit is displayed.

The VERTICAL MODE switch located on diagram 12 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 used on this schematic). 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 Q194 through R127. This forward biases Q194 and the positive-going level at its emitter is connected to the emitter of Q196. The collector of Q196 goes HI to indicate that the Right Vertical unit is to be displayed. For the CHOP position of the VERTICAL MODE switch, a HI level is applied to the anodes of CR128-CR139 through R128. Both diodes are forward biased so that the Vertical Chopping Signal from pin 1 of U130 can pass to the base of Q194. This signal switches between the HI and LO levels at a one-megahertz rate and it produces a corresponding Vertical Mode Command output

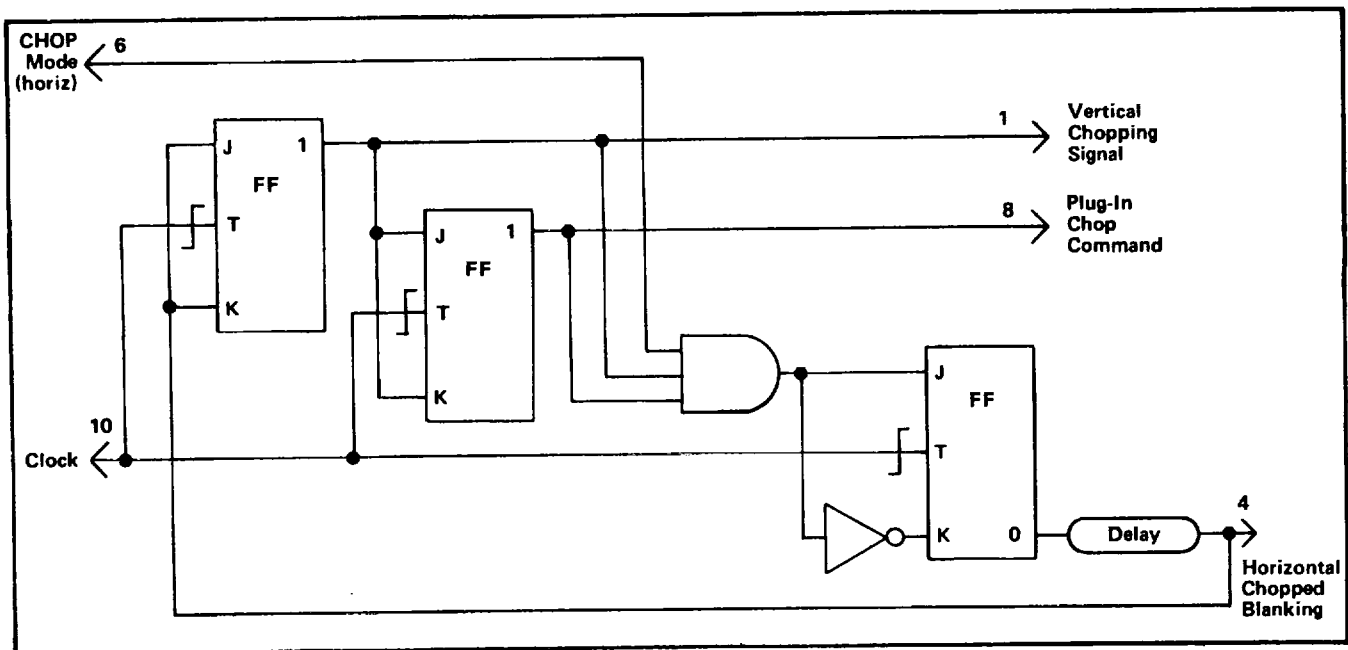


Fig. 3-19. Logic diagram of Chop Counter stage

(A)

at the collector of Q196. When the output is HI, the Right Vertical unit is displayed and when it switches to LO, the Left Vertical unit is displayed.

In the ALT position of the VERTICAL MODE switch, a HI level is applied to the anodes of CR183-CR184 through R 183. These diodes are forward biased so the Display Right Command from pin 6 of the Vertical Binary stage can pass to the base of Q194 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.

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 Q194 remains LO to produce a LO Vertical Mode Control output level at the collector of Q196.

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

TRIGGER SELECTOR

General

The Trigger Selector circuit determines the trigger signal which is connected to the A and B time-base units as controlled by the A TRIGGER SOURCE and B TRIGGER

SOURCE switches. This circuit also provides the drive signal for the Vertical Signal Amplifier stage as controlled by the B TRIGGER SOURCE switch. Fig. 3-21 shows a detailed block diagram of the Trigger Selector circuit along with a simplified diagram of all the circuitry involved in selection of the trigger source. A schematic of the Trigger Selector circuit is shown on diagram 3 at the rear of this manual. Also see diagrams 1 and 12 for the trigger selection circuitry not shown on diagram 3.

Trigger Mode and ADD Signals

General. The circuitry shown on the left side of the simplified diagram in Fig. 3-21 determines the operation of the A and B Trigger Channel Switch stages. The A TRIGGER SOURCE switch S1011 controls the A Trigger Channel Switch U304 through Q24; the B TRIGGER SOURCE switch S1001 controls the B Trigger Channel Switch U324 through Q28. When the front-panel A or B TRIGGER SOURCE switches are set to the VERT MODE positions, the setting of the VERTICAL MODE switch determines the trigger selection. In the LEFT VERT or RIGHT VERT positions, the trigger signal is obtained from the indicated vertical unit. The following discussions give detailed operation in each position of the A and B TRIGGER SOURCE switches. It is written assuming that both of these switches are set to the same position. However, the A and B TRIGGER SOURCE switches can be operated independently to control the operation of the A and B Trigger Channel Switch stages, respectively, and select the trigger output signal for the associated time-base unit.

VERT MODE. In the VERT MODE position of either the A or B TRIGGER SOURCE switch, the setting of the VERTICAL MODE switch determines the operation of the

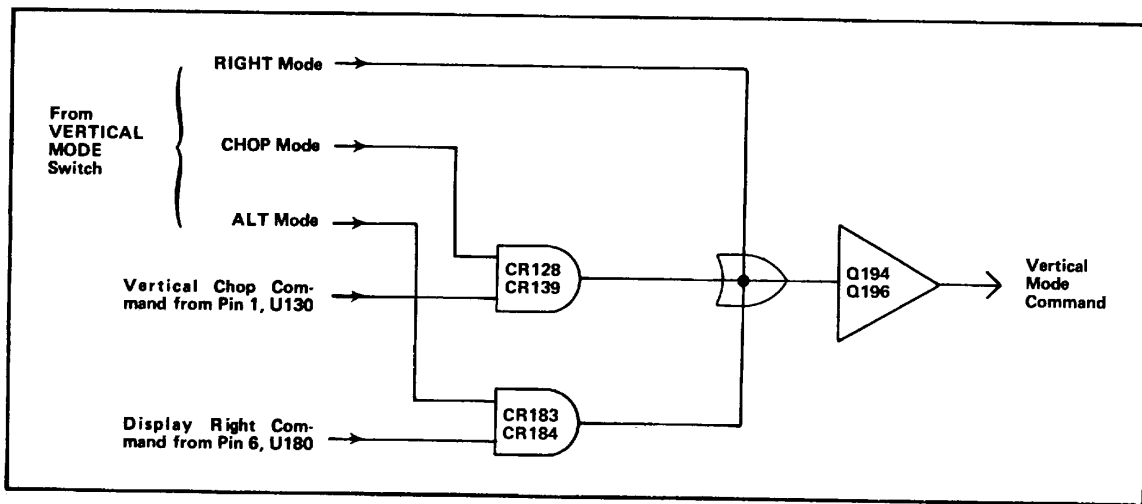


Fig. 3-20. Logic diagram of Vertical Mode Logic stage.

(A)

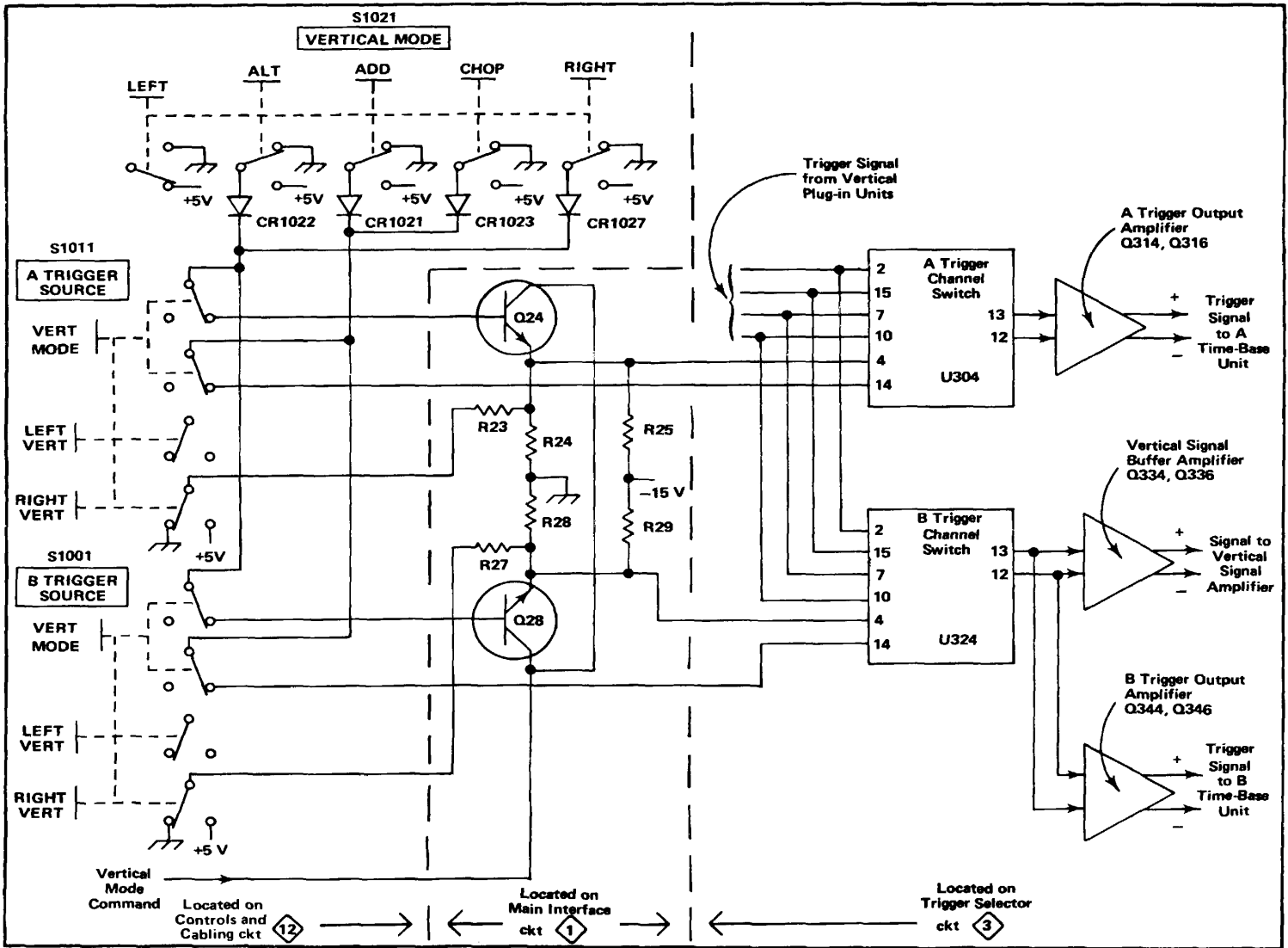


Fig. 3-21. Simplified schematic of trigger selector circuitry.

A and B Trigger Channel Switch stages (A TRIGGER SOURCE, B TRIGGER SOURCE, and VERTICAL MODE switches shown on diagram 12). In the LEFT position of the VERTICAL MODE switch, the base of Q24 or Q28 (see Main Interface schematic) is connected to ground through the ALT and RIGHT sections of S1021, CR1022 and CR1027, and S1001 or S1011. This holds Q24 or Q28 reverse biased to provide a LO level to pin 4 of U304 or U324 (see Fig. 3-22).

When the VERTICAL MODE switch is set to ALT, +5 volts is applied to the base of Q24 or Q28 through CR 1022 and S1001 or S1011. Q24 and Q28 are forward biased and their emitter level is determined by the Vertical Mode Command from the Logic Circuit applied to their collectors. This signal switches between the HI level (Right Vertical unit to be displayed) and the LO level (Left Vertical unit to be displayed) at the end of each sweep. When the Vertical Mode Command is HI, it provides a positive collector voltage to Q24 and Q28. Q24 and Q28 are saturated due to CR 1022, and their emitter levels are very near the collector level. This provides a HI output level to the Trigger Channel Switch stages. As the Vertical Mode Signal goes LO, the collector supply for Q24 and Q28 also goes negative. Q24 and Q28 remain saturated and the output again follows the collector level to supply a LO output level to U304 and U324.

For ADD and CHOP vertical mode operation, +5 volts is connected to pin 14 of U304 or U324 through CR1021 or CR1023 and S1001 or S1011. At the same time, the base of Q24 or Q28 is held LO by the ground connection through the ALT and RIGHT sections of S1021 so the level at pin 4 of the Trigger Channel Switch stages is LO also (produces an ADD mode in Trigger Channel Switches; see description of these circuits which follows). In the RIGHT position of the VERTICAL MODE switch, +5 volts is connected to the bases of Q24 or Q28 through CR1027 and S1001 or S1011 to forward bias these transistors. The Vertical Mode Command connected to the collectors of Q24 and Q28 is also HI in this mode and a HI output level is produced at the emitters of Q24 or Q28.

LEFT VERT. When the LEFT VERT trigger source is selected, the VERTICAL MODE switch is disconnected from the trigger selector circuitry. Now, the ground connection through the RIGHT VERT section of S1001 or S1011 establishes a LO output level at the emitters of Q24 and Q28.

RIGHT VERT. In the RIGHT VERT position of the A or B TRIGGER SOURCE switches, +5 volts is connected to the emitters of Q24 or Q28 through S1011-R23 or S1001-R27. This produces a HI output level to the A and B Trigger Channel Switch stages.

A and B Trigger Channel Switch

The A and B Trigger Channel Switch stages determine which input signal provides the trigger signal to the time base units as controlled by the trigger mode and ADD signals from the trigger selection circuitry. Resistors R301-R321 and R302-R322 (refer to diagram 3) establish the input resistance of this stage and provide a load for the trigger output of the Left and Right Vertical plug-in units. Resistors R303-R304-R305 and R307-R308-R309 establish the operating levels for the A Trigger Channel Switch; R303-R305 and R307-R309 set the current gain for each channel. Resistors R323-R324-R325 and R327-R328-R329 establish the operating levels for the B Trigger Channel Switch; R323-R325 and R327-R329 set the current gain for each channel. These stages are made up primarily of integrated circuits U304 and U324. An input/output table for U304 and U324 is shown in Fig. 3-23. U304-U324 provide a high impedance differential input for the trigger signal from the Left Vertical unit at pins 2 and 15 and for the trigger signal from the Right Vertical unit at pins 7 and 10. The output signal at pins 12 and 13 is a differential signal. 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 bias to the stages which follow as the A or B TRIGGER SOURCE switches or the VERTICAL MODE switch are changed.

When the level at pin 4 is LO (see Trigger Mode and ADD Signals discussion and Fig. 3-23), the trigger signal

VERTICAL MODE switch positions		A and B TRIGGER SOURCE switch positions →	
		VERT MODE	LEFT VERT
LEFT	LO (Left Vertical)	↑	↑
ALT	Switches from LO to HI, and vice versa, at end of each sweep (both; follows display)	↑	↑
ADD	LO at pin 4 of U304 and U324, HI at pin 14 ¹ (both; added algebraically)	↓	↓
CHOP		↓	↓
RIGHT	HI (Right Vertical)	↓	↓

¹ Pin 14 LO for all other conditions.

Fig. 3-22. Input levels at pin 4 of U304 and U324 (source of triggering signal is shown in parenthesis).

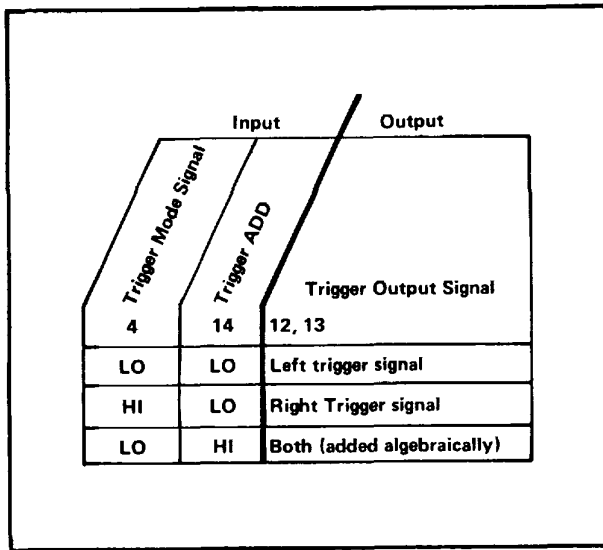


Fig. 3-23. Input/output table for A and B Trigger Channel Switch stages.

from the Left Vertical unit passes to the output while the trigger signal from the Right Vertical unit is blocked. A HI level at pin 4 connects the trigger signal from the Right Vertical unit to the output and the trigger signal from the Left Vertical unit is blocked. For VERT MODE operation in the ALT position of the VERTICAL MODE switch, the level at pin 4 switches between the LO and HI level at a rate determined by the Vertical Binary stage (see Logic Circuit description). This action obtains the trigger signal from the Left Vertical unit when the Left Vertical unit is being displayed and from the Right Vertical unit when it is being displayed.

When the level at pin 4 is LO and the level at pin 14 is HI, the trigger signal from both the Left and Right Vertical units passes to the output pins. This condition occurs only when the A or B TRIGGER SOURCE switches are set to VERT MODE and the VERTICAL MODE switch is set to either ADD or CHOP. Under this operating mode, the trigger output signal is the algebraic sum of the trigger input signals from the Left and Right Vertical units to prevent triggering on the vertical chopping transition or only on one signal of an added display.

A Trigger Output Amplifier

The trigger output signal at pins 12 and 13 of the A Trigger Channel Switch is connected to the emitters of common-base amplifier Q314-Q316 through R311-R312. These transistors provide a low-resistance load for the A Trigger Channel Switch while providing a high output impedance to the circuits which follow. The signal at the collectors of Q314 and Q316 is connected to the A Horizontal unit via the Main Interface circuit. The A Horizontal unit

provides a 50-ohm differential load for this stage. If it is removed from its compartment, the voltage-swing at the collectors of Q314-Q316 will increase substantially.

Vertical Signal Buffer Amplifier

The trigger output signal at pins 12 and 13 of the B Trigger Channel Switch is connected to the emitters of common-base amplifier Q334-Q336. The output signal at the collectors of Q334 and Q336 is connected to the Vertical Signal Amplifier (see Output Signals description) through R337 and R338. R339 provides a differential output resistance of about 100 ohms.

B Trigger Output Amplifier

The signal at pins 12 and 13 of the B Trigger Channel Switch is also connected to the bases of Q344-Q346 to provide the internal trigger signal for the B Horizontal unit (via the Main Interface circuit). This stage provides isolation between the B Horizontal unit and the Vertical Signal Buffer Amplifier stage. The B Horizontal unit provides a 50-ohm differential load for this stage. If it is removed from its compartment, the collector load for Q344-Q346 changes and the voltage swing at their collectors increases. The action of this stage prevents this change from affecting the Vertical Signal Buffer Amplifier stage. CR342-CR346 clamp the collectors of Q344 and Q346 at about +0.6 volts to prevent these transistors from saturating under this no load condition.

VERTICAL INTERFACE

General

The Vertical Interface circuit selects the vertical deflection signal from the output of the Left Vertical and/or the Right Vertical plug-in unit. This stage also accepts an input from the Readout System to block the vertical signal while readout information is displayed on the CRT. In addition, this stage contains the Trace Separation Circuit to shift the vertical position of the B-Sweep portion of a dual-sweep display. Fig. 3-24 shows a detailed block diagram of the Vertical Interface circuit. A schematic of this circuit is shown on diagram 4 at the rear of this manual.

Vertical Switching

Transistors Q202-Q206 and Q212-Q216 form differential amplifiers which determine if the signal from the left vertical plug-in or the right vertical plug-in, or both, provides the vertical deflection signal to the Vertical Amplifier. Transistor Q218 provides a constant voltage source of about -8.7 volts for the collector circuits of Q202-Q206 and Q212-Q216. The operation of this stage is controlled by the Vertical Mode Command, the ADD Mode signal, and the Vertical Channel Switch OFF Command. Fig. 3-25 shows an input/output table for the overall Vertical Interface circuit to show the output signal for the applicable input conditions.

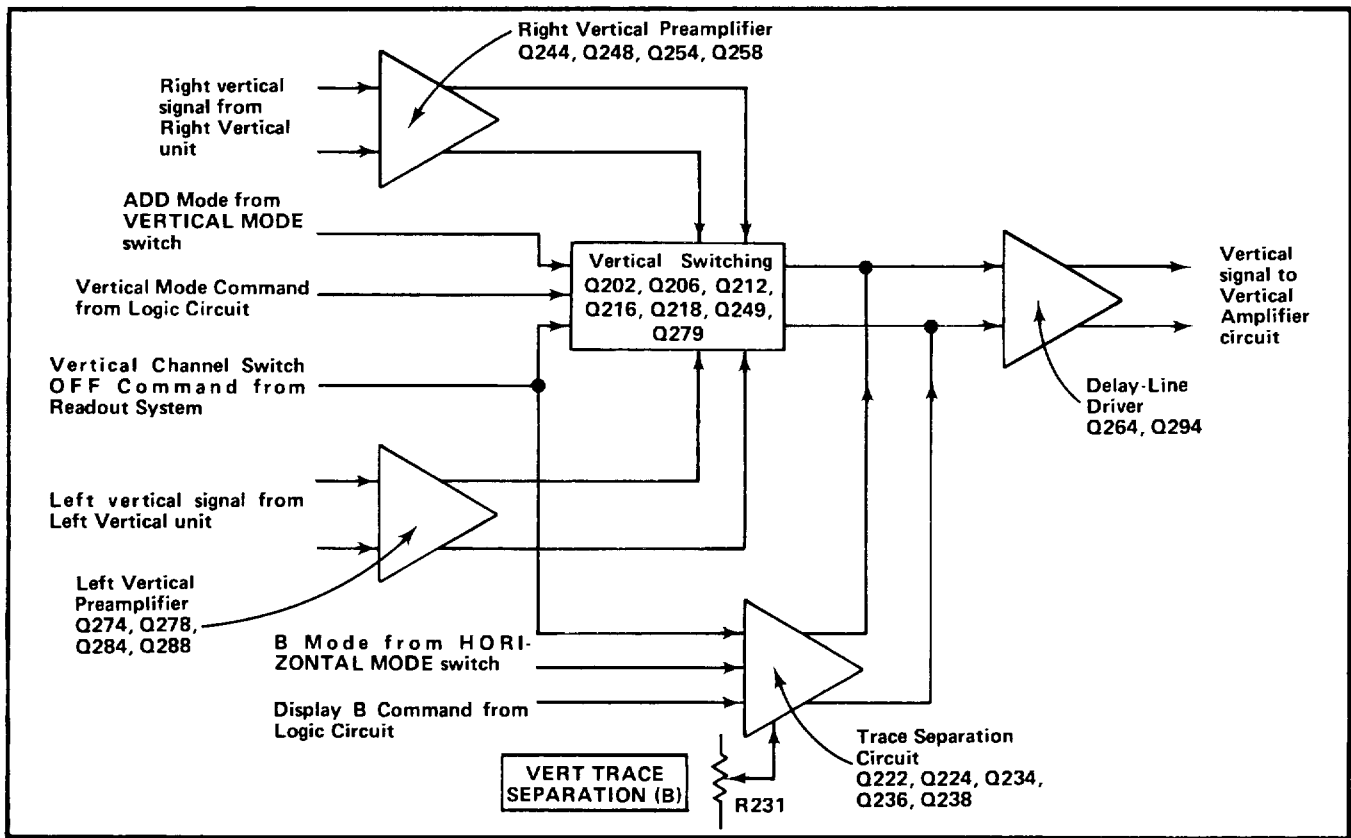


Fig. 3-24. Vertical Interface detailed block diagram.

Input			Output
Vertical Mode Command	ADD Mode (Vert)	Vertical Channel Switch 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. 3-25. Input/output table for Vertical Interface circuit.

When the VERTICAL MODE switch is set to LEFT, the Vertical Mode Command is LO. This level allows the bases of Q202 and Q212 to go negative so that these transistors are forward biased. The resulting positive-going change at the collectors of Q202 and Q212 produce different results for the Left and Right Vertical Preamplifier stages. The positive-going signal at the collector of Q212 is connected to the bases of the series transistors Q278-0288 in the Left Vertical Preamplifier stage through R212. At the same time, the other transistor in this differential amplifier, Q216, is reverse biased. The negative level at its collector reduces the conduction of Q279 to reverse bias shunt diodes CR279-CR289. As a result, the signal from the Left Vertical plug-in can pass to the Delay-Line Driver stage. The positive-going change at the collector of Q202 forward biases transistor Q249 and shunt diodes CR249-CR259 in the Right Vertical Preamplifier stage. Q206 is reverse biased and the negative level at its collector holds series transistors Q248-Q258 reverse biased to block the signal from the Right Vertical plug-in. Instead, the signal is shunted through CR249-CR259 and Q249 to the junction of R262-R292. This arrangement provides a constant DC current to the Delay-Line Driver stage as the VERTICAL MODE switch is changed by providing a signal current

either through the applicable series transistors or an equivalent DC current through the shunt diodes via R262-R292.

In the RIGHT position of the VERTICAL MODE switch, the Vertical Mode Command is HI. Now, diodes CR200 and CR209 are forward biased and the positive signal at the base of Q202-Q212 reverse biases these transistors. The previous conditions are now reversed. The collector of Q212 is negative so that series transistors Q278-Q288 are reverse biased. At the same time Q216 is forward biased to hold Q279 and the shunt diodes CR279-CR289 forward biased also. This action blocks the signal from the Left Vertical plug-in unit. On the Right Vertical side of the circuit, the negative level at the collector of Q202 reduces the conduction of Q249 to reverse bias shunt diodes CR249-CR259. The positive level at the collector of Q206 forward biases series transistors Q248-Q258 to allow the signal from the Right Vertical plug-in unit to pass to the Delay-Line Driver stage.

For either the ALT or CHOP position of the VERTICAL MODE switch, the Vertical Mode Command switches between the LO and HI levels at a rate determined by either the Chop Counter or the Vertical Binary stages (see Logic Circuit description). This action allows the signal from the Left Vertical unit to be displayed when the Vertical Mode Command is LO and the signal from the Right Vertical unit is displayed when the Vertical Mode Command is HI.

When ADD vertical mode operation is selected, a HI Vertical Mode Command level is applied to the base of Q202 through R200. The level at the collector of Q202 goes negative to reverse bias the Right Vertical shunt diodes and the positive level at the collector of Q206 forward biases the series transistors to allow the Right Vertical signal to pass to the Delay-Line Driver stage. At the same time, the Vertical Mode Command level is LO as determined by the Vertical Mode Control stage in the Logic Circuit. This allows Q212 to conduct to forward bias the Left Vertical series transistors; the shunt diodes are reverse biased by the negative level at the collector of Q216. Therefore, the signal from the Left Vertical plug-in unit can pass to the Delay-Line Driver stage. Now, the signal from both vertical units is algebraically added by the Delay-Line Driver stage and the resultant signal determines the vertical deflection.

The Vertical Channel Switch OFF Command from the Readout System has final control over the output signal from this stage. Quiescently, this signal is LO and the signal from the selected vertical unit can pass to the Delay-Line Driver stage. However, when the Readout System is ready to display readout information, the Vertical Channel Switch OFF Command goes HI. Transistor Q212 is reverse biased through CR210 and Q206 is reverse biased through R208. This reverse biases the series transistors Q248-Q258

and Q278-Q288 to block the signal from both vertical units. At the same time the remaining transistor in each differential amplifier is forward biased to shunt the vertical signal. Therefore, the signal from neither plug-in unit is displayed on the CRT so the CRT deflection can be determined by the Readout System.

Left Vertical Preamplifier

The vertical signal from the Left Vertical plug-in unit is connected to the Left Vertical Preamplifier stage by way of the strip lines on the Vertical Interconnect board. These strip lines provide an impedance of 50 ohms. The applied signal is amplified by transistors Q274-Q284. C274-C282-R274-R284 in the emitter circuit of Q274-Q284 provide high-frequency compensation; C274-R274 are variable to provide high-frequency response adjustment for this stage. The Left Vertical Centering adjustment R277 balances the quiescent DC levels at the output of the Left Vertical Preamplifier stage so the trace from the Left Vertical unit is displayed at the center of the CRT when the inputs to this stage are at the same potential. Transistors Q278-Q288 operate along with the Vertical Switching stage to determine if the Left Vertical signal is displayed on the CRT.

Right Vertical Preamplifier

The components in the Right Vertical Preamplifier stage serve the same function as the corresponding components in the Left Vertical Preamplifier stage. The only difference between the two circuits is the presence of the Right Vertical Gain adjustment, R242, in this circuit. The overall gain of the Vertical Amplifier circuit is set when the Left Vertical signal is displayed. The Right Vertical Gain adjustment compensates for any differences in gain between the Right Vertical Preamplifier stage and the Left Vertical Preamplifier stage. Gain is controlled by changing the emitter degeneration between transistors Q244-Q254.

Trace Separation Circuit

The Trace Separation Circuit provides a variable positioning voltage to offset the B Sweep display when operated in either the ALT or CHOP dual-sweep modes (horizontal). The display B Command from the Logic Circuit controls the operation of this stage through Q234. When the B Sweep is being displayed (for ALT or CHOP horizontal operation), the Display B Command is HI to forward bias Q234. The collector of Q234 goes negative to reverse bias shunt diodes CR233-CR234. Under this condition, the VERT TRACE SEPARATION (B) control determines the bias at the base of transistors Q236-Q238 through R230-R232 and the series diodes CR230-CR232. The output current at the collectors of Q236-Q238 is connected to the Delay-Line Driver stage through R261-R291 to offset the B Sweep display up to about four divisions above or below the A Sweep display. This prevents a confusing

display when using dual-sweep operation, as the A and B Sweeps would be displayed on top of each other without this feature.

When the Display B Command is LO (A Sweep displayed), Q234 is reverse biased and the shunt diodes CR233-CR234 are forward biased through R233. This applies a DC bias of about +5.1 volts to the bases of transistors Q236-Q238 to provide a quiescent DC output current from this stage to the Delay-Line Driver stage. Since the series diodes CR230-CR232 are reverse biased, the VERT TRACE SEPARATION (B) control is disconnected while the A Sweep is being displayed.

Two other signals also control the current through this stage. When the HORIZONTAL MODE switch is set to B (only), a HI level is connected to the base of Q224 through CR224 and R224. This forward biases Q224 and, since Q224-Q234 share emitter resistor R227, transistor Q234 is reverse biased even though the Display B Command at its base is HI for this mode. Therefore, the VERT TRACE SEPARATION (B) control has no effect. The Vertical Channel Switch OFF Command from the Readout System is connected to the base of Q222 through R221. This signal is quiescently LO so that Q222 is conducting through R222 to hold Q224 reverse biased by way of R223 (except when HORIZONTAL MODE switch is in B position described above). When the Readout System is ready to display readout information, the Vertical Channel Switch OFF Command goes HI to reverse bias Q222. The base of Q224 goes positive through R222-R223 and it is forward biased. Now, Q224 controls conduction and Q234 is off to disconnect the VERT TRACE SEPARATION (B) control. The output of this stage goes to its quiescent DC level so that the

Readout System has full control of the trace position (see Readout System description for more information).

Delay-Line Driver

Output of the Left Vertical Preamplifier and the Right Vertical Preamplifier stages, along with any positioning current from the Trace Separation Circuit is connected to the bases of Q264-Q294. This stage provides amplification for the selected signal as well as providing a reverse termination for the delay line. Diodes CR264-CR295 decrease the feedback resistance for Q264-Q294 as the signal is deflected towards the edges of the display area. This action reduces the gain of the stage to compensate for the inherent expansion characteristic of the CRT. The output signal from the Delay-Line Driver stage is connected to the Vertical Amplifier circuit through C266-R266 and C296-R296.

VERTICAL AMPLIFIER

General

The 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. Fig. 3-26 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.

Delay Line

Delay Line DL400 provides approximately 120 nanoseconds delay for the vertical signal to allow the horizontal

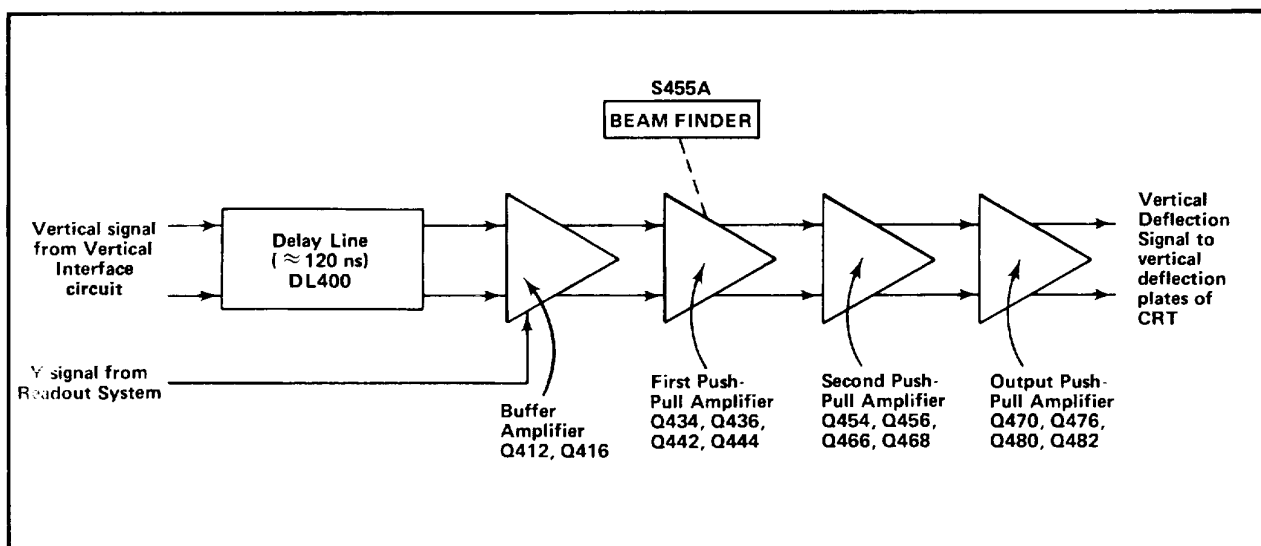


Fig. 3-26. Vertical Amplifier detailed block diagram.

(A)

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 about 50 ohms per side, or about 100 ohms differentially. It is of the coaxial type which does not produce preshoot or phase distortion in the CRT display.

Buffer Amplifier

The Buffer Amplifier stage Q412-Q416 provides a low input impedance for the Vertical Amplifier circuit to permit accurate delay-line termination. C401-R401 and C408-R408 provide the forward termination for the delay line. The output signal from the Buffer Amplifier stage is connected to the First Push-Pull Amplifier stage through C411-R411-VR411 and C417-R417-VR417. Zener diodes VR411 and VR417 limit the voltage swing across R411 and R417 to keep Q412 and Q416 out of saturation. R405 and the operating bias of Q412-Q416 provide compensation for thermal distortion produced in Q470-Q476.

For readout displays, the Y-signal from the Readout System is connected to the emitter of Q412 through R402. Since the signal from the vertical units is blocked in the Vertical Interface circuit, the readout signal provides the only vertical deflection. Although this signal is connected to the emitter of Q412 as a single-ended signal, it is converted to a push-pull signal in the following stages.

First Push-Pull Amplifier

Q434-Q442 and Q436-Q444 are connected as a pushpull cascode amplifier stage. The network C426-L421-L422-L423-R420-R421-R422-R423-R424-R425-R426 provides compensation for the delay line. R421-R422-R423 in this network are adjustable to provide mid-frequency compensation. C430-R430, connected between the emitters of Q434-Q436, provide high-frequency compensation adjustment for this stage. The network CR431-CR432-RT433 provides thermal compensation for this stage. As the temperature increases, the resistance of RT433 decreases and the capacitance of varactors CR431-CR432 increases. The output signals at the collectors of Q434-Q436 are connected to the common-base transistors Q442-Q444 through C435-R435-R436 and C438-R437-R438. The low input resistance of the Q442-Q444 common-base transistors allows this stage to provide maximum high-frequency performance. The Vertical Centering adjustment R443 balances the quiescent DC levels in the Vertical Amplifier circuit so the trace is displayed at the center of the CRT when the inputs to this circuit are at the same potential. The output signal from the First Push-Pull Amplifier stage is connected to the next stage through C447-L447 and C448-L448. Zener diode VR449 establishes a collector source voltage of about -6.2 volts for Q442-Q444.

Second Push-Pull Amplifier

The Second Push-Pull Amplifier, Q454-Q466 and Q456-Q468, operates in the same manner as the previous stage. The main difference between the stages is the compensation networks and the BEAM FINDER switch located in this circuit. C458-R458 in the emitter circuit of Q454-Q456 provide adjustable high-frequency compensation for this stage.

BEAM FINDER switch S455A switches the emitter current source for Q454-Q456 to provide the beam finder function. Normally, the emitter current for Q454-Q456 is supplied through S455A-L452. However, when S455A is pressed in, the current source through L452 is interrupted and the only emitter-current source for Q454-Q456 is through R451. This limits the dynamic range of this stage by limiting its current, so the display is compressed vertically within the graticule area. The BEAM FINDER switch can also be pulled out to lock it in the "find" position to aid in locating the traces of several plug-in units.

The signal at the collectors of Q454-Q456 is connected to common-base transistors Q466-Q468 through C460-R460-R461-R462 and C465-R463-R464-R465. Transformer T466 reduces the common-mode signal components in the push-pull signal applied to the following stages. The output signal from this stage at the collectors of Q466-Q468 is connected to the Output Push-Pull Amplifier through VR467-VR469 and LC networks C470-L470 and C471-L471. VR467-VR469 provide DC voltage matching without appreciable current loss. Vertical Gain adjustment R468 sets the resistance between the bases of Q470-Q476 in the following stage to control the current gain of this stage. This adjustment sets the overall gain of the Vertical Amplifier stage.

Output Push-Pull Amplifier

Q470-Q480 and Q476-Q482 operate in the same manner as the previous stages to provide amplification for the vertical deflection signal. The output signal from this stage provides the vertical deflection on the CRT. C472 and thermistor RT472 provide frequency compensation to maintain high-frequency response with temperature changes. Thermistor RT480 and R480 provide gain compensation with changes in temperature. The output signal is connected to the vertical deflection plates of the CRT through buffer transistors Q480-Q482. A distributed deflection plate system is used in this instrument for maximum frequency response and sensitivity. The output signal at the collectors of Q480-Q482 is connected to the integral inductors in the CRT and then to the deflection-plate termination network C483-L481-L483-R483-R485 and C484-L482-L484-R484R487. As the signal passes through the integral inductors in the CRT, its velocity is essentially the same as the velocity of the electron beam passing between the vertical deflection plates. The synchronism of the deflection signal and the

electron beam reduces the loss in high-frequency sensitivity due to electron transit time through the deflection plates. Inductors L483-L484 and capacitors C483-C484 are adjusted to minimize signal reflections by providing the correct termination for the vertical deflection plate structure.

HORIZONTAL INTERFACE

General

The Horizontal Interface circuit is made up of the X-Y Delay Compensation Network and the Horizontal Channel Switch stage. The X-Y Delay Compensation Network (optional) provides a delay for the horizontal (X) 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 Horizontal and/or the B Horizontal plug-in unit. Fig. 3-27 shows a detailed block diagram of this circuit. A schematic of this circuit is shown on diagram 6 at the rear of this manual.

X-Y Delay Compensation

Time-Base Operation. When the plug-in unit installed in the A or B horizontal 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 X Compensation Inhibit command is HI and relays K50-K60 or K70-K80 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 horizontal compartment is operated as an amplifier or if a vertical unit is installed in a horizontal compartment, the X-Compensation Inhibit command to the applicable Delay Compensation Network drops to the LO level (zero volts). This provides an actuating level to relays K50-K60 or K70-K80 to connect the Delay Compensation Network into the circuit. For example, if the X-Compensation Inhibit command from the A Horizontal Unit goes LO, K50 and K60 close to route the A Horizontal Signal through the A Delay Compensation Network. Diodes CR50 and CR70 shunt the voltage produced across the relays when the actuating level is removed. LR networks L51-R51 and L61-R61 along with capacitors C53 and C55 provide a constant input impedance. The LC network made up of C56-C58-C66-C68-L55-L56-L65-L66 provides a fixed delay from DC to about two megahertz to provide minimum phase shift between the X and Y portions of the CRT

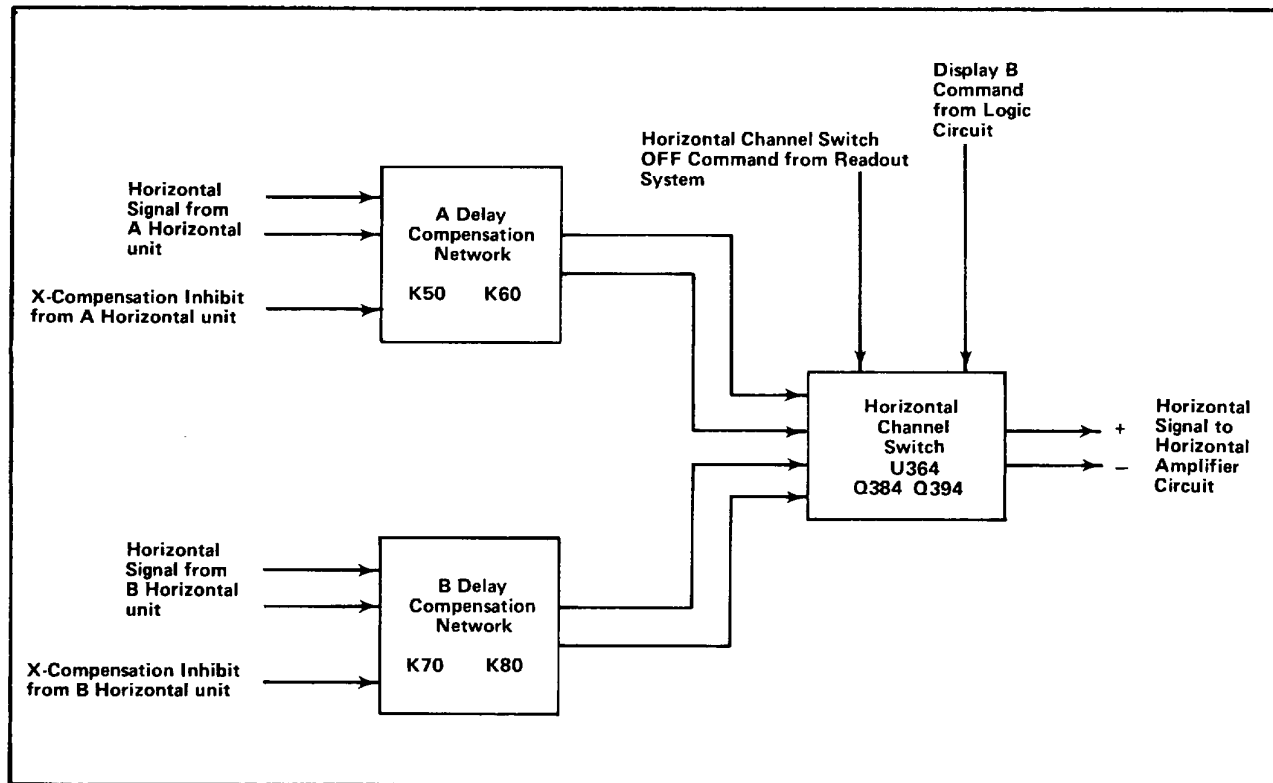


Fig. 3-27. Horizontal Interface detailed block diagram.

display. C55 is adjusted to match the horizontal and vertical signal delay up to at least two megahertz.

The Delay Compensation Network normally produces negative preshoot distortion along with some corner rounding of fast step functions. The A Delay Disable switch S50 allows selection of a display with either minimum phase-shift characteristics or optimum step response. When this switch is set to Out (down), the X Compensation Inhibit command from the A Horizontal Unit is disconnected from relays K50-K60. Now, the signal from the A Horizontal 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 stage by the Horizontal Interconnect board.

Horizontal Channel Switch

The Horizontal Channel Switch determines which input signal provides the horizontal signal to the Horizontal Amplifier circuit as controlled by the Display B Command from the Logic Circuit. Resistors R352-R354 and R356-R358 establish the input resistance of this stage and provide a load for the A and B Horizontal units. Resistors R363-R365-R367 and R373-R375-R377 establish the operating levels for this stage. R363-R365 and R373-R375 set the current gain for each channel. C361-R361 and C371-R371 provide frequency compensation.

This stage is made up primarily of integrated circuit U364 which is the same type as used for the Trigger Channel Switch stage. An input/output table for U364 is shown in Fig. 3-28. U364 provides a high-impedance differential input for the signal from the A Horizontal unit at pins 2 and 15 and the signal from the B Horizontal unit at pins 7 and 10. The output signal at pins 12 and 13 is a differential signal which is connected to the 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.

When the HORIZONTAL MODE switch is set to A, the level at pin 4 is LO. This level allows the signal from the A Horizontal unit to pass to the output while the signal from the B Horizontal unit is blocked. In the B position of the HORIZONTAL MODE switch, the level at pin 4 is HI. Now, the signal from the B Horizontal unit is connected to the output while the signal from the A Horizontal unit is blocked.

Input		Output
Display B Command	Horizontal Channel Switch OFF Command	Output signal
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. 3-28. Input/output table for Horizontal Channel Switch.

For ALT or CHOP positions of the HORIZONTAL MODE switch, the Display B Command at pin 4 switches between the LO and HI levels at a rate determined by the Horizontal Binary stage in the Logic Circuit. This action allows the signals from the A Horizontal unit to be displayed when the Display B Command is LO and the signal from the B Horizontal Unit is displayed when the Display B Command is HI.

The Horizontal Channel Switch 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.

The output signal at pins 12 and 13 is connected to the Horizontal Amplifier circuit through Q384-Q394. Resistors R381-R383 and R391-R393 establish the correct operating DC levels for U364. Buffer amplifier Q384-Q394 provides a low load impedance for U364 as well as providing DC voltage matching between the Horizontal Interface and Horizontal Amplifier circuits.

HORIZONTAL AMPLIFIER

General The Horizontal Amplifier circuit amplifies the push-pull horizontal deflection signal from the Horizontal Interface circuit and connects it 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. Fig. 3-29 shows a detailed block diagram of the Horizontal Amplifier circuit. A schematic of this circuit is shown on diagram 7 at the rear of this manual.

Input Amplifier

The horizontal signal from the Horizontal Interface circuit is connected to the bases of Q526 and Q536. The Input Amplifier is driven from an equivalent 100-ohm source. The resistive network R521-R522-R524-R531-R532-R533-RT534 between the emitters of Q526-Q536 controls the emitter degeneration of this stage to perform several functions. Horizontal Gain adjustment R522 is variable to determine the amount of emitter degeneration between Q526-Q536 to set the overall gain of the Horizontal Amplifier circuit. Thermistor RT534 provides thermal gain compensation for this circuit. As the temperature increases, the resistance of RT534 decreases resulting in less emitter degeneration between Q526-Q536. Therefore, the overall gain of this stage increases to compensate for the opposite characteristic of the transistors in the Horizontal Amplifier circuit.

Transistor Q514 is normally supplying current to the emitters of Q526-Q536 through R521-R531. However,

when the BEAM FINDER switch is actuated, Q514 is no longer forward biased so the current supplied to R521-R531 is determined only by R515. This results in less current to Q526-Q536 so their dynamic range is limited. When the BEAM FINDER switch S455B is actuated, a ground level is also connected to the Logic Circuit to provide an intensity limit. This action prevents damage to the CRT phosphor when the display is compressed.

The Horizontal Centering adjustment R529 provides adjustment for differential unbalance in the Horizontal Amplifier circuit and the CRT. The network CR528-CR538-CR544-CR554 limits the input to the next stages so they always operate within their dynamic range and are not overdriven by excessive current from the Input Amplifier stage. Since the output signal from the Input Amplifier stage is a current signal, very little voltage change occurs across the limiting network. With horizontal deflection signals which produce an on-screen display, CR544 and CR554 remain forward biased and CR528-CR538 are reverse biased. However, if high-amplitude horizontal deflection signals are applied to this circuit as a result of sweep magnification or high-amplitude external horizontal signals, either CR544 or CR554 is reverse biased, depending on the polarity of the overdrive signal. This results in a sufficient voltage change at the anode of either CR528 or CR538 to forward bias it. The shunt diodes provide a current path for

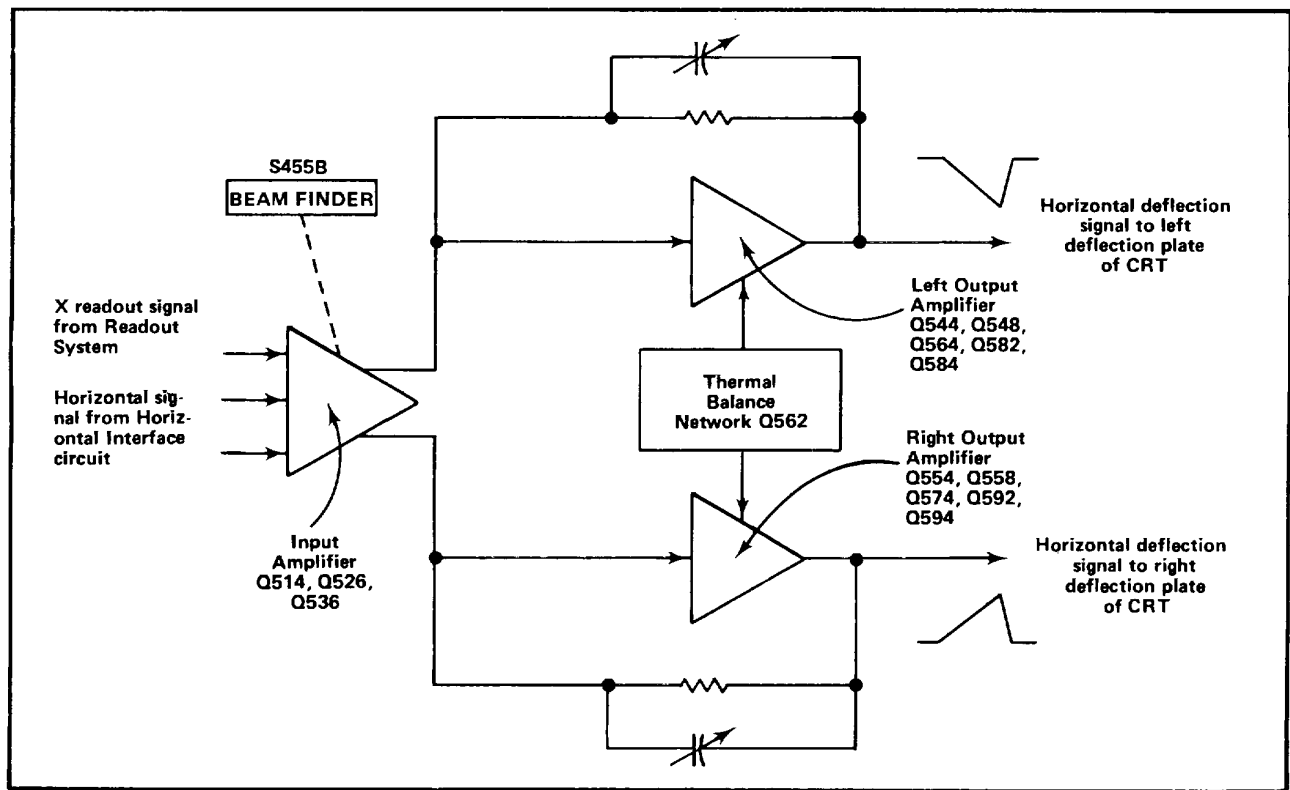


Fig. 3-29. Horizontal Amplifier detailed block diagram.

the signal current to limit the current change at the bases of Q544-Q554 during the overdrive condition.

For readout displays, the X readout signal from the Readout System is connected to the base of Q526 through R525. The signal from the A HORIZ and B HORIZ plug-in units is blocked in the Horizontal Interface circuit so the only horizontal deflection is provided by the Readout System. Q526 and Q536 operate as a paraphase amplifier to convert the single-ended readout signal at the base of Q526 to a push-pull signal at the collectors of both Q526 and Q536. For instruments which are not equipped with a Readout System, R525 is connected to ground at the Readout System chassis.

Left Output Amplifier

Transistors Q544, Q548, Q564, Q584, and Q582 are connected as a current-driven feedback amplifier. The input current is converted to a voltage output signal to drive the left horizontal deflection plate of the CRT. Input transistor Q544, an NPN transistor, responds best to positive-going input signals. The signal at the collector of Q544 is connected to the emitters of output transistors Q582-Q584 through two parallel paths. High-frequency signals are connected through capacitor C544. Low-frequency signals are connected to the output transistors through R544-Q548-R549. The output transistors Q582 and Q584 are connected in the complementary configuration to provide less resistive loading at the output. The output signal at the collector of Q582-Q584 is connected to the left deflection plate of the CRT through L589-R589.

Negative feedback is provided from the collectors of Q582-Q584 to the base of Q544 through feedback network C569-R569-Q564-C563-R563. Emitter follower Q564 in the feedback network provides current gain for the feedback signal. With this configuration, the input impedance of the Left Output Amplifier is low since the feedback network beyond the emitter followers is effectively reduced in impedance as far as the input signal is concerned. Variable capacitor C569 adjusts the transient response of the feedback network to provide good linearity at fast sweep rates. C568-R568 provide adjustment for correct high-frequency gain versus frequency response in the amplifier.

Right Output Amplifier

Basic operation of the Right Output Amplifier stage is the same as just described for the Left Output Amplifier stage. Notice that the input transistor in this stage is complementary to the corresponding transistor in the Left Output Amplifier stage. Therefore, this stage provides the best response to negative-going input signals. C579 provides linearity adjustment for the Right Output Amplifier at fast sweep rates. The output signal at the collectors of Q592-Q594 is connected to the right deflection plate of the CRT through L599-R599.

Thermal Balance Network

Q562 provides thermal balance for the Horizontal Amplifier circuit. The Thermal Balance adjustment R571 sets the bias on Q562 and thereby determines the operating voltage for Q544-Q554. This adjustment provides DC shift in the CRT display and reduces low-frequency signal cross talk. Diode CR562 provides reverse-voltage breakdown protection for Q562 when the instrument is first turned on. Diodes CR560 and CR570 establish the operating bias for Q544-Q554.

OUTPUT SIGNALS

General

The Output Signals circuit provides output voltages to the front-panel Calibrator jacks and output signals to the connectors located on the rear panel. These output signals are either generated within this instrument or are samples of signals from the associated plug-in units. Fig. 3-30 shows a detailed block diagram of the Output Signals circuit. A schematic of this circuit is shown on diagram 8 at the rear of this manual.

Vertical Signal Amplifier

The vertical signal selected by the B Trigger Channel Switch (see Trigger Selector description for more information) is connected to the bases of differential amplifier Q684-Q694. Resistors R681-R692 establish an input resistance of about 50 ohms for this stage. The amplified signal at the collectors of Q684 and Q694 is connected to buffer amplifier Q686-Q696 through RC networks C686-R686 and C695-R695. These networks provide thermal balance for this stage. The single-ended signal at the collector of Q686 is connected to the rear-panel SIG OUT connector J699. The signal at the collector of Q696 is connected to ground. CR696 and CR699 protect this stage if high-level voltages are accidentally applied to the SIG OUT connector. CR696 provides protection from positive voltages and CR699 provides protection from negative voltages.

Sawtooth Amplifier

The sawtooth signals from the A Time-Base unit and the B Time-Base unit are connected to the Sawtooth Amplifier stage through series resistors R4 and R5 respectively (on Main Interface board). The SWEEP switch S666 (on top panel) determines which sawtooth signal provides the output signal. The other sawtooth signal is terminated by R667 to provide a similar load to the signal source. Transistors Q670, Q672, and Q675 comprise an inverting feedback amplifier. Gain of this stage is about two as determined by the ratio of feedback resistor R678 to the input resistance made up of R669 and either R4 or R5, depending on which sawtooth source is selected. The signal at the collector of Q675 is connected to the rear-panel +SAWTOOTH connector J679 through R679. RC network C675-R675 provides

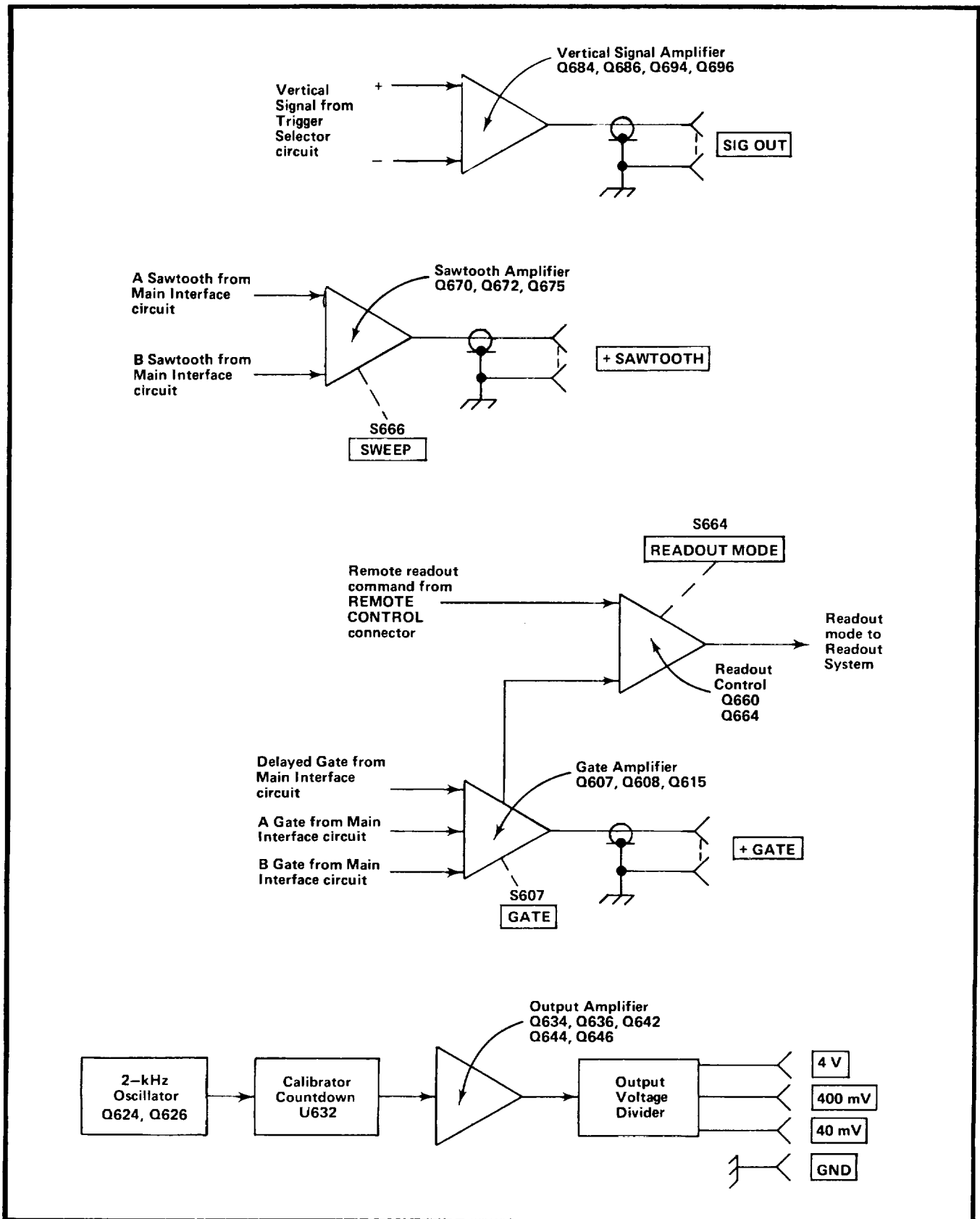


Fig. 3-30. Output Signals detailed block diagram.

frequency response stabilization for this stage. Diode CR674 provides protection from high-level positive voltages inadvertently connected to the output connector by providing a current path to the +15-volt supply through the collector-base junction of Q675. When CR674 is forward biased it clamps the base of Q675 at this level. CR676 provides protection from high-level negative voltages at the +SAWTOOTH connector by clamping the output if it attempts to go more negative than about -15.6 volts.

Gate Amplifier

The output signal at the rear-panel +GATE connector J618 is selected from three input gate signals by GATE switch S607 (on top panel). In the A position, the A Gate signal from the A Time-Base unit is connected to the base of emitter-follower Q607 through R607. The base of Q608 is connected to ground by S607 in this position so it operates as a common-base stage. Q607 provides a high input impedance for the stage while the emitter coupling between Q607-Q608 provides temperature compensation. Operation is the same in the B position of S607 except that the B Gate signal from the B Time-Base unit provides the input signal. In the DLY'D position, S607 connects the base of Q607 to ground through R607 and disconnects both the A and B Gate signals. Now, the Delayed Gate signal from the delaying time base (in A HORIZ compartment) can pass to the base of Q608 through R602. Q608 inverts this negative going input signal so the gate output signals at the +GATE connector are all positive going.

The input gate signal selected by S607 is connected to the emitter of Q615 through C612-R612. Diode CR614 provides temperature compensation for Q615. The signal at the collector of Q615 is connected to the +GATE connector through CR615 and R617. CR615 protects Q615 if a high-level positive voltage is applied to the +GATE connector and CR616 clamps the output at about -0.6 volt if a negative signal is applied to this connector.

Readout Control

Q660 and Q664 along with S664 control the operating mode of the Readout System. When READOUT MODE switch S664 is in the FREE RUN-REMOTE position, the Readout System runs continuously in a free-running manner. The emitter of Q664 has no ground return, so Q664 can not conduct and its collector rises positive (through circuitry in the Readout System) to enable the Readout System. However, in this position, the readout mode can be controlled remotely through rear-panel REMOTE CONTROL connector J1075. If a remote readout lockout command (ground level) is connected to pin E of J1075, a ground return is provided for the emitter circuit of Q664 through the shield of the interconnecting cable. The positive voltage connected to the base of Q664 through R663-R664 results in a LO level at the collector of

Q664. This LO level disables the Readout System (see Readout System for complete details). Now, the operation of the Readout System can be controlled remotely through pin F of J1075. If pin F is connected to ground, a negative-going pulse is connected to the base of Q664 through C661. The collector of Q664 momentarily rises positive to enable the Readout System so it can present one complete frame (eight words).

In the GATE TRIG'D position, the emitter of Q664 is connected to ground through R666 and S664. The base of Q664 is pulled positive through R663-R664 to produce a LO lockout level to the Readout System. The gate signal selected by GATE switch S607 is connected to the Readout Control stage from the emitter of Q615. At the end of the selected gate, a negative level is applied to the base of emitter-follower Q660. This negative level is differentiated by C660-R660, and the resultant negative-going pulse reverse biases Q664 to allow its collector to go HI momentarily. This enables the Readout System so it can produce one complete frame (eight words) each time the selected gate goes negative.

Calibrator

General. The Calibrator circuit provides accurate voltage output at the front-panel calibrator pin-jacks. Repetition rate of the output signal is one kilohertz. 2-kHz Oscillator. Q624 and Q626 are connected as a two-kilohertz square-wave oscillator to provide the drive signal for the Calibrator Countdown stage. Oscillation occurs as follows: Assume that Q624 is conducting and Q626 is off. The collector current of Q624 through R624-R625 produces a voltage level which holds the base of Q626 low. This keeps Q626 turned off, and since there is no current through it, its collector goes positive to produce the positive portion of the square wave. At the same time, C621 begins to charge toward -50 volts through R627. The emitter of Q626 goes negative also as C621 charges, until it reaches a level about 0.6 volt more negative than the level at its base. Then, Q626 is forward biased and its emitter rapidly rises positive. Since C621 cannot change its charge instantaneously, the sudden change in voltage at the emitter of Q626 pulls the emitter of Q624 positive also, to reverse bias it. The current through Q626 produces a voltage drop at its collector to produce the negative portion of the square wave.

Now, conditions are reversed. Since Q624 is reverse biased, there is no current through it. Therefore, C621 can begin to discharge through R621. The emitter level of Q624 follows the discharge of C621 until it reaches about -0.6 volt. Then, Q624 is forward biased and its collector drops negative to reverse bias Q626. This interrupts the current through Q626 and its collector goes positive again to complete the square wave. Once again, C621 begins to charge through R627 to start the second cycle. The signal

Circuit Description-R7704

produced at the collector of Q626 is a two-kilohertz square wave. C628 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, R625, sets this stage so an accurate one kilohertz square-wave is produced at the output of the Calibrator circuit.

Calibrator Countdown. Integrated circuit U632 is a triggered set-clear (J-K) flip-flop. An input/output table for this device is shown in Fig. 3-31. U632 is connected so it only operates in one mode; the output changes state with each trigger. The two-kilohertz signal from the 2-kHz Oscillator stage is connected to the trigger input of U632. This results in a one-kilohertz square-wave output signal at pin 7.

Output Amplifier. Transistors Q642 and Q644 are connected as a comparator with the reference level at the base of Q644 determined by the network R638-R646R647-R648-R649-Q646. The 0.4 V adjustment R649 is set to provide accurate output voltage at the 0.4 V Calibrator pin-jack J651.

The output of the Calibrator Countdown stage is connected to the base of Q634 through R634. Q634 acts as a switch to control the current through Q636, and the output of Q636 controls the conduction of comparator Q642-Q644. The level at the base of Q634 is switched between the LO and HI levels at the two-kilohertz rate. When the base of Q634 is LO, Q642 is off and Q644 is conducting. This produces a positive output voltage at the Calibrator pin-jacks. When the level at the base of Q634 is switched to HI, Q644 conducts and Q646 is reverse biased. Now, the voltage level at the Calibrator pin-jacks drops to zero.

resistance in all positions except 40 V, while providing accurate output voltages between 4 mV and 40 V (4 mV and 40 V levels available at internal board connections and can be connected to the front-panel by changing board connections). The output resistance in the 40 V position is about 15 kilohms as determined by R651 and the equivalent resistance of divider network R652-R659. This means that a 1.5 megohm load will produce about 1% error in output voltage for this position; error increases as the load resistance decreases. The remaining four output voltages are accurate with a one-megohm load or, at reduced output, a 50-ohm load. Output voltages into a 50-ohm load are: 4 V pin-jack, 0.4 V; 0.4 V pin-jack, 0.2 V; 40 mV pin-jack, 20 mV; 4 mV (internal), 2 mV.

CRT CIRCUIT

General

The CRT Circuit produces the high-voltage potentials and provides the control circuits necessary for the operation of the cathode-ray tube (CRT). This circuit also includes the Z-Axis Amplifier stage to set the intensity of the CRT display and the Auto-Focus Amplifier to maintain optimum focus of the CRT display. Fig. 3-32 shows a detailed block diagram of the CRT Circuit. A schematic of this circuit is shown on diagram 9 at the rear of this manual.

Z-Axis Amplifier

General. The Z-Axis Amplifier stage is a current driven, shunt-feedback amplifier with voltage output. The output voltage provides the drive signal to control the CRT intensity level through the Control-Grid Supply. Details of operation for the individual stages within this circuit follow.

Turn-On Delay. Transistors Q706, Q708, and Q712 provide a delay for the CRT Circuit to prevent it from coming into operation until the other circuits within the instrument have reached operating levels. When the instrument is turned on, C711 begins to charge through R709R711-R712. However, since C711 is completely discharged when the instrument is turned on, the base of Q712 is at -15 volts. As C711 charges, it pulls the base of Q712 positive and its emitter follows. C711 continues to charge until the emitter level of Q712 reaches about +50 volts (Q712 saturated). The emitter voltage of Q712 supplies the positive voltage for the feedback divider in the High-Voltage Regulator stage. The delay provided by the charging of C711 prevents CRT beam current for about four seconds. This protects the CRT phosphor from damage due to a high-intensity display as the instrument is first turned on.

Input		Output
3	1	Condition at pin 7 after trigger pulse
LO	LO	Output changes state with each trigger pulse
LO	HI	HI
HI	LO	LO
HI	HI	No change

Fig. 3-31. Input/output table for U632.

Output Voltage Divider. The collector current of Q644 in the Output Amplifier stage is applied across the voltage divider made up of resistors R652 through R659. This divider is designed to provide a low output

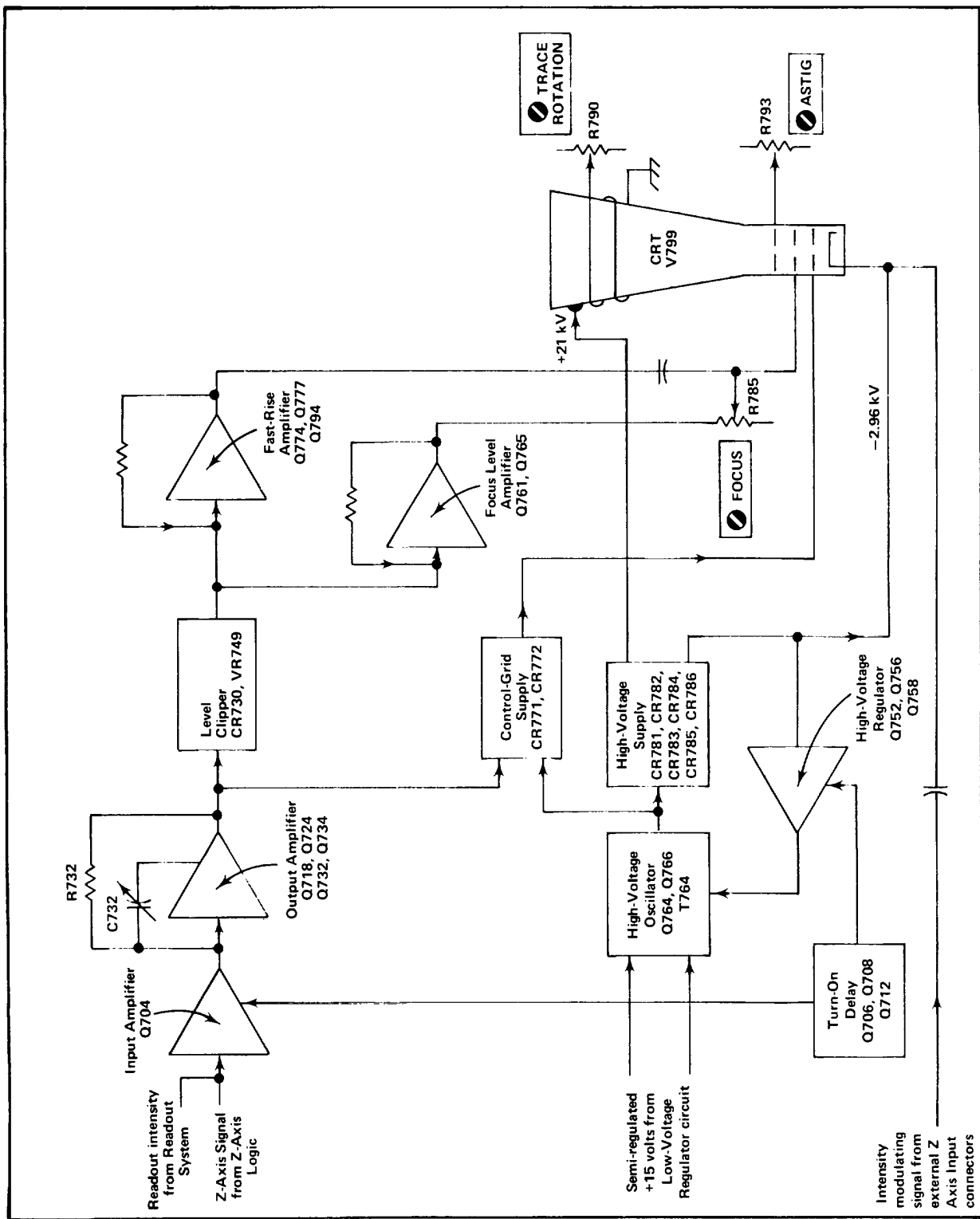


Fig. 3-32. CRT Circuit detailed block diagram.

The current flow through R709 as C711 charges also forward biases transistor Q708. This holds Q706 reverse biased so it does not supply current to Input Amplifier Q704. The result of this reduction in current to Q704 is that the Z-Axis Amplifier output remains at its low level regardless of the input from either the Z-Axis Logic stage or the Readout System. When C711 reaches full charge, the current flow through R709 ceases and Q708 is reverse biased. Q706 is now forward biased and it supplies about four milliamperes of bias current to Q704. Diode CR708 protects Q708 as C711 discharges when the instrument is turned off.

Input Amplifier. Transistor Q704 is a common-base amplifier to establish a low input impedance for the Z-Axis Amplifier. The operating bias for Q704 is established by Q706 as described in the previous paragraph. The output level of this stage is determined by the input current from either of two circuits. For normal operation, the Z-Axis Signal from the Logic Circuit sets the input current as determined by the front-panel A and B INTENSITY controls, the chopped blanking logic, or an external signal connected to either of the rear-panel Z-Axis Inputs (see Logic Circuit description for details). For readout displays, the Z-Axis Signal is blocked in the Logic Circuit. Now, the input current is provided from the Readout System as determined by the READOUT intensity control on the front panel.

Output Amplifier. The output stage is a shunt-feedback operational amplifier with feedback connected from the output to the input through C732-R732. The output voltage is determined by the input current multiplied by the feedback resistor and is expressed by the formula: $E_{out} = I_{in} \times R_{fb}$ where R732 is Rfb. The signal current change at the base of Q704 for maximum intensity is about four milliamperes. The maximum output voltage change is set for 64 volts (about 4 mA X 15.4 kQ). AC feedback is provided from the output to the base of Q718 by C732. This capacitor is adjusted for optimum step response to provide a fast rise unblanking gate output signal with minimum overshoot or ringing. Otherwise, the CRT display would vary in intensity level following sudden changes in blanking.

The signal from the Input Amplifier stage is amplified by Q718-Q724. Variable resistor R719 in the collector circuit of Q718 provides transient response adjustment for this stage. The signal at the collector of Q724 is connected to the base of transistor Q732 through C730 and to the base of Q734 through R722-C723-R723. These transistors are connected as a collector-coupled complementary amplifier to provide a linear, fast output signal while consuming minimum quiescent power. The signal at the collector of Q724 is connected to the base of Q734 through R722. This transistor maintains the low-frequency response of the input signal and provides a fast falling edge on the output signal.

(A)

Only the fast-changing portions of the input signal are coupled to the base of Q732 through C730. Since Q732 is a PNP-type transistor, it responds faster to negative-going changes at its base than to positive-going changes. This action provides a fast rising edge on the output signal (fast falling edge provided by Q734, an NPN-type transistor). The signal at the collectors of Q732-Q734 is connected to the Control Grid Supply stage through R735-R736.

Diodes CR718, CR734, and CR735 provide protection for the Z-Axis Amplifier circuit. CR735 protects this stage from damage due to high-voltage surges connected back into this circuit from the high-voltage supply. CR734 protects Q734 by clamping its base at -0.6 volt if Q724 fails or is removed from its socket while the instrument is on. CR718 protects Q718 against excess reverse base-emitter voltage.

Auto Focus

General. The Auto Focus stage develops 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, this stage will maintain optimum focus for all portions of the display as it switches between readout, A sweep, B sweep, and high or low intensity displays.

Level Clipper. The voltage requirements at the Focus Grid of the CRT to maintain a focused display are fairly constant for low and medium intensity level settings. However, for displays which require intensity control settings beyond midrange, the voltage requirement at the Focus Grid increases linearly with the increase in intensity drive at the output of the Z-Axis Amplifier stage. CR730 and zener diode VR749 clip the output level of the Z-Axis Amplifier stage so the Auto Focus stage is not activated for low or medium intensity displays. Quiescently, the anode of VR749 rests near zero volts. The positive voltage applied to VR749 through R730 sets the cathode of VR749 at about +30 volts. Therefore, CR730 is held reverse biased until its anode rises above about +30.5 volts. Then, the portion of the Z-axis drive signal which exceeds the 30-volt level is coupled to the Auto-Focus amplifier stages.

Fast-Rise Amplifier. The portion of the Z-axis drive signal which exceeds the clipping level is coupled to the base of Q774 through C767-R767-R768-R769. Focus Gain adjustment R769 determines the amount of signal connected to the base of Q774 to set the overall gain of the Fast-Rise Amplifier. C767 adjusts the high-frequency attenuation of the input signal to determine the step response of the stage. Q774, Q777, and Q794 are connected as a feedback amplifier to provide fast response to the high-frequency components of the auto-focus control signal. The output signal at the emitter of Q794 is connected to the Focus Grid of

the CRT through R798 and C798. This capacitor blocks the DC component so only the fast changing portions of the signal at the emitter of Q794 are coupled to the Focus Grid.

Focus Level Amplifier. Q761 and Q765 make up a DC-coupled amplifier to determine the amplitude of the low-frequency components of the auto-focus control signal. The portion of the Z-axis drive signal which exceeds the clipping level is also coupled to the base of Q761 through R760 and R761. Focus Level adjustment R761 determines the gain of this stage to provide optimum focus at all intensity levels. Typical gain of this stage is about 10.

The output at the collector of Q765 is coupled to the Focus Grid through R740E, R785, and R784. Therefore, this stage determines the source voltage for the FOCUS adjustment. The FOCUS adjustment is adjusted for best focus for low to medium intensity displays (if the instrument is equipped with readout, the FOCUS adjustment should be set for best definition of the readout display). Then, the auto-focus stages automatically control the voltage at the Focus Grid to maintain optimum focus of the remaining portions of the display.

High-Voltage Oscillator

Unregulated voltage for operation of the high-voltage supply is provided from the semi-regulated +15 volts in the Low-Voltage Regulator circuit. The starting bias current for the High-Voltage Oscillator is supplied from the positive side of the +15 volt input through R759. As the High Voltage Oscillator begins to operate, the emitter of Q758 goes negative and further bias current is available through CR759 from the negative side of the semi-regulated +15 volts. This configuration provides a controlled starting current for the High-Voltage Oscillator at turn-on and at the same time allows the High-Voltage Regulator stage to control the current of the High-Voltage Oscillator to regulate the output level after the stage reaches operating potential.

Q764-Q766 and the associated circuitry comprise an oscillator to drive high-voltage transformer T764. When the instrument is turned on, assume that Q764 comes into conduction first. The collector current of Q764 produces a corresponding current increase in the base-feedback winding of T764 to further increase the bias on Q764. At the same time, the voltage developed across the base feedback winding connected to Q766 reverse biases it.

As long as the collector current of Q764 continues to increase, a voltage is induced into the base-feedback windings of T764 which holds Q764 forward biased. However, when the collector current of Q764 stabilizes, the magnetic field built up in T764 begins to collapse. This induces an opposite current into the base windings

Circuit Description-R7704

which reverse biases Q764, but forward biases Q766. When the induced voltage at the base of Q766 exceeds the bias set by Q758, Q766 is forward biased and the amplified current at its collector adds to the current flowing through T764 due to the collapsing field. Then, as the current through T764 stabilizes again, the magnetic field around it once more begins to collapse. This reverses the conditions to start another cycle.

The signal produced across the primary of T764 is a sine wave at a frequency of 35 to 45 kilohertz. C764-L764 shape the signal in the primary of T764 to improve regulation of the high-voltage supply. The amplitude of the oscillations in the primary of T764 is controlled by the High Voltage Regulator stage to set the total accelerating potential for the CRT. Filter network C762-L762 decouples high peak operating currents from the +15-Volt Supply.

High-Voltage Regulator

A sample of the secondary voltage from T764 is connected to the High-Voltage Regulator stage through divider R740A-R740B-R740C. Q752 and Q756 are connected as an error amplifier to sense any change in the voltage level at the base of Q752. The -15-Volt Supply, connected to the emitter of Q752 through R753-R755, and the +50 volts connected to R740A from the emitter of Q712 provide the reference level for this stage. High Voltage adjustment R743 sets the quiescent level at the base of Q752 to a level which establishes a -2.96 kilovolt operating potential at the CRT cathode. CR747 protects Q752 from excessive reverse emitter-base voltage.

Regulation occurs as follows: If the output voltage at the -2960 V test point starts to go positive (less negative), a sample of this positive-going change is connected to the base of Q752. Both Q752 and Q756 are forward biased by this positive change which in turn increases the conduction of Q758. This results in a greater bias current delivered to the bases of Q764-Q766 through Q758. Now, the bases of both Q764 and Q766 are biased closer to their conduction level so that the feedback voltage induced into their base feedback windings produces a larger collector current. This results in a larger induced voltage in the secondary of T764 to produce a more negative level at the -2960 V test point to correct the original error. In a similar manner, the circuit compensates for output changes in a negative direction. Since the amplitude of the voltage induced into the secondary of T764 also determines the output level of the positive High-Voltage Supply and the Control-Grid Supply, the total high-voltage output is regulated by sampling the output of the negative High-Voltage Supply.

High-Voltage Supplies

High-voltage transformer T764 has three output windings. One winding provides filament voltage for the

cathode-ray tube. Two high-voltage windings provide the negative and positive accelerating potential for the CRT and provide the bias voltage for the control grid. All of these outputs are regulated by the High-Voltage Regulator stage to maintain a constant output voltage as previously described.

Positive accelerating potential for the CRT anode is supplied by voltage quintupler C782-C783-C784-C785-C786-CR782-CR783-CR784-CR785-CR786. This rectified voltage is filtered by C787-R786-R787 to provide an output of about +21 kilovolts. All of these components are included in encapsulated assembly U786. The negative accelerating potential for the CRT cathode is also obtained from the same secondary winding. Half-wave rectifier CR781 provides an output voltage of about -2.96 kilovolts which is connected to the CRT cathode through L781 and L788. The cathode and filament are connected together through L788 to prevent cathode-to-filament breakdown due to a large difference in potential between these CRT elements. Neon bulbs DS781 and DS785 protect L781 and L788 if the CRT cathode is shorted to chassis ground. Diode CR780 and neon bulb DS780 protect the +50-Volt Supply from damage under this condition. A sample of the negative accelerating voltage is connected to the High-Voltage Regulator stage to maintain a regulated high-voltage output.

Half-wave rectifier CR772 provides a negative voltage for the control grid of the CRT. Output level of this supply is set by the CRT Grid Bias adjustment R739. Rectifier CR771 provides rectified low-potential voltage to R739 so that it can perform its function without being enclosed in the high-voltage compartment. Neon bulbs DS786-DS787-DS788 protect the CRT by limiting the voltage difference between the cathode and control grid to a maximum of about 165 volts. The unblanking gate from the Z-Axis Amplifier circuit is connected to the positive side of the Control-Grid Supply. As the unblanking gate level changes, it shifts the overall supply level to change the bias on the CRT which controls the intensity of the display.

High speed intensity modulating signals from the rear panel HIGH SPEED connector J1055 are applied to the CRT cathode through C790-C791-R788. This signal changes the CRT bias, and thereby the intensity of the display, by changing the level of the cathode. RC divider C 1056-C 1057-R 1056-R 1057 provides a cross-over network between the HIGH SPEED and HIGH SENSITIVITY inputs. The HIGH SENSITIVITY connector provides an input for low-frequency, low-amplitude intensity modulating signals. This signal is connected to the Z-Axis Logic stage through R 1060 (see Logic Circuit description for further information).

CRT Control Circuits

The ASTIG adjustment R793, which is used in conjunction with the FOCUS adjustment to obtain a well

Circuit Description-R7704

defined display, varies the positive level on the astigmatism grid. Geom adjustment R792 varies the positive level on the horizontal deflection plate shield to control the overall geometry of the display.

Two adjustments control the trace alignment by varying the magnetic field around the CRT. Y Axis Align adjustment R795 controls the current through L795 which affects the CRT beam after vertical deflection but before horizontal deflection. Therefore, it affects only the vertical (Y) components of the display. TRACE ROTATION adjustment R790 controls the current through L790 and affects both the vertical and horizontal rotation of the beam.

LINE TO DC CONVERTER/REGULATOR

General

The Line to DC Converter/Regulator circuit provides the operating power for this instrument from an AC line voltage source. This circuit also includes the Line Selector assembly to allow selection of the nominal operating voltage for the instrument. Fig. 3-33 shows a detailed block diagram of the Line to DC Converter/Regulator circuit. A schematic of this circuit is shown on diagram 10 at the rear of this manual.

Line Input

Power is applied to this circuit through Line fuse F800, EMI (electro-magnetic interference) filter FL801, POWER switch S800, and thermal cutout S801. The EMI filter is made up of C800-C801-C803-L800-L801-T800. This filter is designed primarily to filter out the 25 kilohertz interference originating within this circuit. L800-L801 provide differential and common-mode inductance; T800 provides additional common-mode inductance. C803 along with the differential inductance of L800-L801 provides differential EMI filtering. R803 provides differential resonance damping for C803-L800-L801. R804 provides a discharge path for C803 when the POWER switch is turned off. Common-mode EMI filtering is provided by C800-C801 along with the common-mode inductance of T800. R801 provides common-mode resonance damping for C800-C801 - T800.

Thermal cutout S801 provides thermal protection for this instrument. If the internal temperature of the instrument exceeds a safe operating level, S801 opens to interrupt the applied power. When the temperature returns to a safe level, S801 automatically closes to re-apply the power. Cooling is provided by fan B801. Line power is connected directly to B801 in the 115 V position of the Line Selector switch. In the 230 V position, power is connected to B801 through step-down auto-transformer T801 to provide the required 115-volts operating potential for B801.

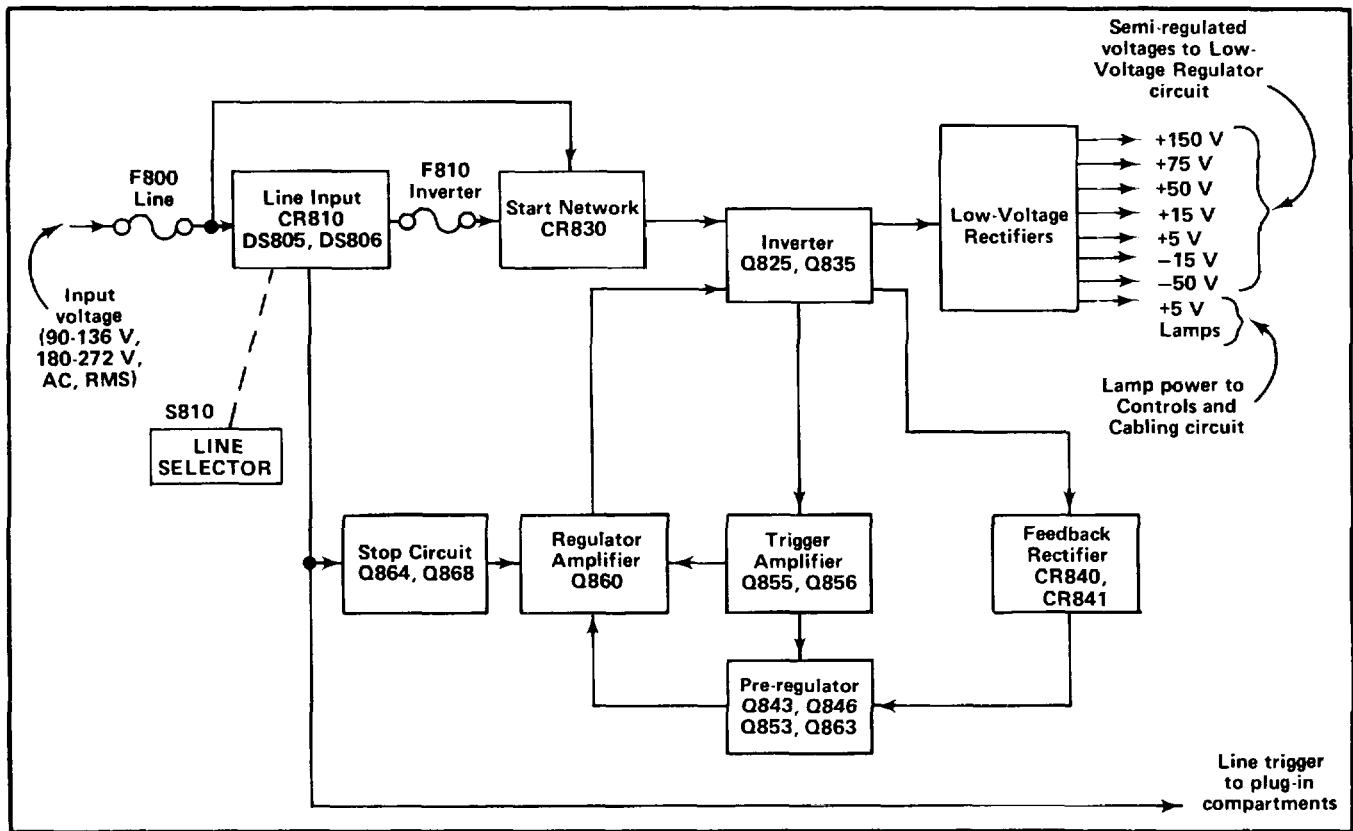


Fig. 3-33. Detailed block diagram of Line to DC Converter/Regulator circuit.

Line Selector switch S810 allows this instrument to operate from either a 115-volt nominal line or a 230-volt nominal line. In the 115 V position, rectifier CR810 operates as a full-wave doubler along with capacitors C813-C814. For 230 V operation, S810 connects rectifier CR810 in the bridge configuration and C813-C814 operate as series energy-storage capacitors. With this configuration, the output voltage applied to the Inverter stage from the Line Input stage is about the same for either 115-volt or 230-volt operation.

C810-L810 and C811-L811 form a 25 kilohertz filter to provide further EMI filtering. Thermistors RT810 and RT811 limit the surge current demanded by the power supply when it is first turned on. After the instrument is in operation, the resistance of the thermistors drops so they have very little power loss and have little effect on the operation of this stage. The stored charge on C813 and C814 limits the surge current if the POWER switch is quickly turned off and back to ON after the resistance of these thermistors has dropped to their low value. The discharge of capacitors C813-C814 is controlled by R813, and it is so designed that the discharge time constant of C813-C814-R813 is about equal but opposite to the thermal time constant of RT810-RT811. This arrangement provides surge-current limiting for the Line Input stage at all

times. Since C813-C814 discharge slowly, dangerous potentials can exist within this supply for several minutes after the POWER switch is turned off. C812-DS812-R812 form a relaxation oscillator to indicate the presence of voltage across C813-C814. Neon bulb DS812 will blink until the potential across these capacitors drops to about 80 volts.

The rectified output voltage from this stage is connected to the Start Network through Inverter fuse F810. This fuse protects the Inverter stage if it demands too much current due to a malfunction.

DS805 and DS806 are surge voltage protectors. When the Line Selector switch is in the 115 V position, only DS805 is connected across the line input. If a peak voltage surge in excess of about 230 volts is present on the line, DS805 will break down and demand high current. This excess current will quickly open Line fuse F800 to interrupt the input power before the circuit can be damaged. In the 230 V position, DS805 and DS806 are connected in series across the line input to provide surge voltage protection for peak voltage surges in excess of about 460 volts.

Transformer T805 provides a sample of the line voltage to the plug-in connectors in the Main Interface circuit for

internal triggering at line frequencies or for other applications. In the 115 V position of S810, the line input voltage i_s is connected across the primary of T805 and R805. For the 230 V position, the line voltage is connected across the primary of T805 and R805-R806 in series. This arrangement provides an output line trigger signal of about one volt RMS for both nominal line voltages. This trigger signal is also connected to the Stop Circuit to indicate when line voltage is connected to the Line Input stage and the POWER switch is ON.

Start Network

Rectified DC power for the Inverter stage is supplied through EM I filter C820-C821-C822-T820. C820-C822-T820 provide common-mode filtering and C821 provides differential filtering. Resistors R820 and R821 provide common-mode and differential resonance damping respectively. The positive input voltage is connected directly to power transformer T870. The negative input voltage provides the negative reference for the Inverter stage; the negative voltage to the power transformer is determined by the Inverter stage.

The input line voltage to this instrument is connected to divider R823-R824. This voltage charges C824 on each half cycle. When the charge on C824 reaches about 32 volts, trigger diode CR830 conducts to provide a turn-on trigger current to transistor Q835 through C835. This current allows the Inverter stage to start operating. After the Inverter stage is operating, the recurrent waveform at the collector of Q835 keeps C824 discharged through CR831.

Inverter

A simplified schematic of the Inverter stage is shown in Fig. 3-34. After the circuit has been placed into operation by the Start Network, LC circuit C1-L1 oscillates at its resonant frequency. The resulting current through the one turn winding of T1 induces a bias current into the base circuit of either Q1 or Q2, depending upon the polarity. The 1:4 turns ratio of T1 results in a current in the transistor base circuits which is one-fourth the current in the one turn feedback winding. Since the current in the feedback winding must flow through the conducting transistor, the transistors operate at a forced beta of four. A sine-wave current is produced across the primary of power transformer T2; the voltage is a square-wave with a peak-to-peak amplitude equal to the input DC voltage. The voltage induced into the secondary of T2 is rectified by diodes CR1 and CR2, filtered by capacitor C2 and applied across load R2.

Now, refer to the complete Line to DC Converter/Regulator diagram. The LC circuit is made up of C870 and L870. After the circuit has been started by the Start Network as discussed previously, C870-L870 resonate at a frequency of 25 kilohertz. The feedback to the base circuits of Q825-Q835 through T825 alternately turns Q825 and Q835 on. These transistors operate at a forced beta of four due to the turns ratio of T825, and their output current sustains resonance in C870-L870. The 60-turn center tapped winding of T825 is used to delay the turn-on of Q825 or Q835 to provide pre-regulation of the voltages produced in the secondary of T870. This operation will be discussed in more detail under Pre-Regulator.

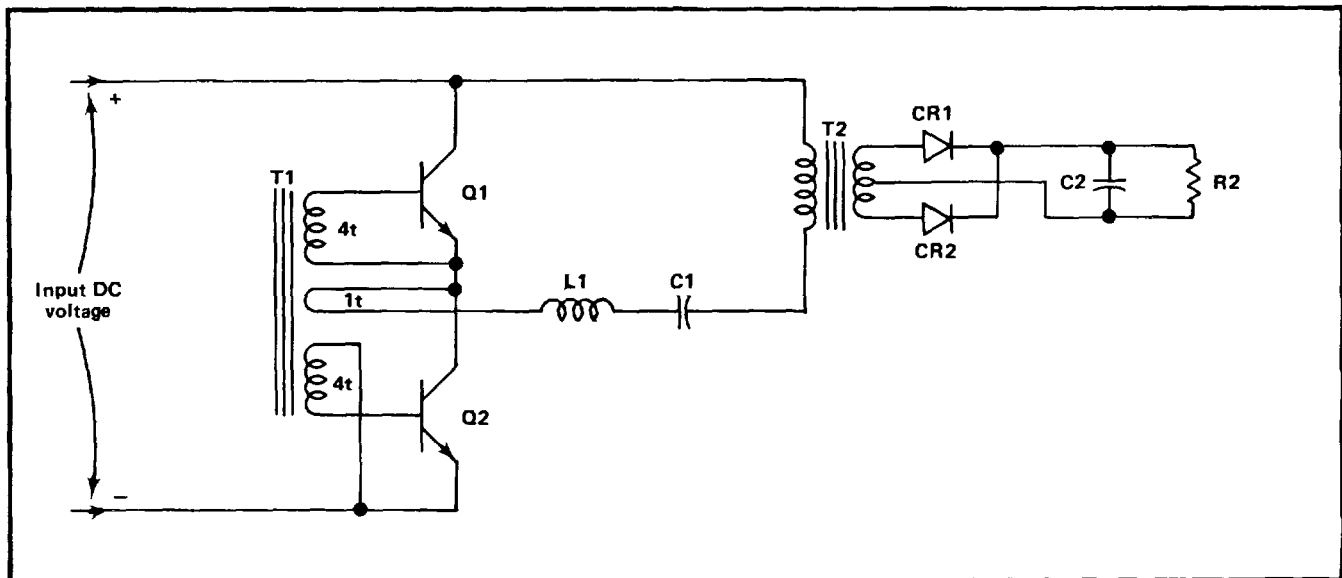


Fig. 3-34. Simplified schematic of Inverter stage.

Diodes CR828 and CR838 provide reverse conduction paths across Q825 and Q835 respectively when these transistors are held off for pre-regulation purposes. Inductors L826-L836 minimize turn-on losses in the transistors by reducing the voltage on Q825-Q835 during their turn-on interval. CR826-R826 and CR836-R836 protect Q825 and Q835 from excessive voltage due to stored energy in the associated inductors when the transistors are turned off. Diodes CR825 and CR835 aid in the turn off of the associated transistors by connecting the collector potential back to the base of each transistor. This feedback does not turn the transistor off but eliminates excess base current to reduce the turn-off time when the current from feedback transformer T825 reverses. The networks C825-R825 and C835-R835 develop voltage biases in response to the average base currents of Q825 and Q835 which help to hold Q825 and Q835 in cutoff during their respective off intervals.

Trigger Amplifier

The primary current of power transformer T870 also flows through the one-turn primary winding of T839. The voltage induced into the secondary of T839 is differentiated by C855-R855 and C856-R856 and connected to the bases of Q855 and Q856. Notice that the differentiated signals at the bases of these transistors is opposite in polarity and this polarity changes on each half-cycle of the induced voltage. Therefore, on each half-cycle the transistor which receives a positive-going pulse at its base is momentarily forward biased. This results in a negative-going pulse at the collector of either Q855 or Q856 which is connected to the Pre-Regulator multivibrator.

CR857 and CR858 rectify the voltage in the secondary of T839. Under normal conditions, the rectified voltage developed across C858-R858 is not sufficient to forward bias CR859. However, if excess current is demanded from the Inverter stage, the current through the primary of T839 increases to result in a larger current in its secondary. This results in a larger voltage drop across R858 and, when it is sufficient to forward bias CR859, Q860 in the Regulator Amplifier circuit is turned on to limit the output current of the Inverter stage.

Feedback Rectifier

Diodes CR840 and CR841 form a center-tapped fullwave rectifier. The rectified output of these diodes is filtered by C840-R840 to provide a feedback voltage of about +16 volts to the Pre-Regulator stage. The exact output level depends upon the voltage applied to the primary of transformer T870. This feedback is used to provide preregulation of the output voltage from T870.

Pre-Regulator

Q853 and Q863 form a monostable multivibrator. The circuit conditions are such that Q863 is conducting in the stable state. When a negative-going trigger pulse is received

from the Trigger Amplifier stage, Q863 turns off and Q853 turns on. The amount of time that Q853 remains in conduction is determined by the recharge time of C852. This time is, in turn, determined by Q843-Q846 and the feedback voltage from the Feedback Rectifier. Q843 and Q846 are connected as a comparator. Zener diode VR848 sets a level of about +9 volts at the base of Q846. The output voltage of the Feedback Rectifier stage is connected across divider R842-R843-R844. The +75 Volts adjustment R843 in this divider is adjustable to set the output voltages produced by this circuit. If the feedback voltage from the Feedback Rectifier stage should increase after R843 has been adjusted properly, the collector current of Q843 will decrease. Therefore, C852 will recharge more slowly and Q863 will remain off for a longer period of time (further explanation of regulation will be given under Regulator Amplifier, which follows). Likewise, if the feedback voltage decreases, the collector current of Q843 increases and C852 recharges more rapidly so Q863 is off for a shorter period of time.

Regulator Amplifier

The actual pre-regulation of the voltages produced by this circuit is controlled by transistor Q860. This transistor is connected so it is always on when Q863 is off (note exceptions for current limiting and Stop Circuit operation). Therefore, when multivibrator Q853-Q863 has been triggered so Q863 is off, Q860 is on. The collector of Q860 drops negative and it conducts current away from the secondary of T825 through CR823 and CR824. Due to the turns ratio of T825, this action does not allow any current from the feedback winding of T825 to reach the bases of either Q825 or Q835. As a result, the inverter transistors remain off as long as Q860 is on, and they do not conduct current through the primary of T870. When the Pre Regulator multivibrator resets so Q863 is again conducting, Q860 turns off. Now, Q860 no longer conducts current away from T825 so feedback current can reach the base windings of this transformer. As a result, the Inverter transistors operate as described previously for the remainder of this half cycle. By controlling the amount of time that Q860 is in conduction, the voltage that is delivered to power transformer T870 can be controlled. The amount of time that Q860 conducts is controlled by comparator Q843-Q846 and the feedback voltage as described under Pre-Regulator.

The network C860-CR860-R860-R861 in the collector circuit of Q860 protects this transistor from the positive voltage which is developed across the 60-turn winding of T825 when Q860 is turned off. C858-CR857-CR858-CR859-R858 in the Trigger Amplifier stage, provide a current limiting network to protect the supply when excess current is demanded from the inverter stage. When this condition occurs, the base of Q860 is pulled positive so that it conducts to limit the output current from this circuit as long as excess current is flowing through the primary of T839.

Stop Circuit

Transistors Q864 and Q868 provide a circuit to stop the operation of the Inverter stage when the POWER switch is turned off or the line voltage is disconnected from this instrument. When the POWER switch is turned on and line voltage is available, line-trigger pulses from transformer T805 in the Line Input stage are connected to the base of Q868 through R868. Each time a trigger pulse is received, Q868 conducts and its collector goes negative to discharge C867. However, when there are no line triggers at the base of Q868, C867 begins to charge towards the feedback voltage through R867. As C867 charges, the base of Q864 is pulled positive to a level where it conducts. Then, the emitter of Q864 pulls the base of Q860 positive also to bring it into conduction. The conduction of Q860 takes all of the feedback current away from T825 so the Inverter stage ceases operation.

Low-Voltage Rectifiers

The rectifiers and associated filter components in the secondaries of T870 provide rectified, pre-regulated voltages for re-regulation by the Low Voltage Regulator circuit for operation of this instrument or for connection to the plug-in compartments. Zener diode VR876 and silicon controlled rectifier Q876, connected from the +150 Volt output to ground, provide over-voltage protection for this circuit. If the output voltage across this secondary of T870 increases to about 180 volts, VR876 conducts to turn on Q876. This effectively provides a direct short across this winding of T870 and demands high current from the circuit. A high current demand in the secondary of T870 results in Inverter fuse F810 opening to interrupt the power to the Inverter stage.

LOW-VOLTAGE REGULATOR**General**

The Low-Voltage Regulator circuit contains five regulated supplies. Electronic regulation converts the semiregulated input voltages from the Line to DC Converter/ Regulator circuit to stable, low-ripple output voltages. Each supply contains a short-protection circuit to prevent instrument damage if a supply is inadvertently shorted to ground or to another supply. Fig. 3-35 shows a detailed block diagram of the Low-Voltage Regulator circuit. A schematic of this circuit is shown on diagram 11 at the rear of this manual.

-50-Volt Supply

The following discussion includes the description of the -50 V Series Regulator, -50 V Feedback Amplifier, -50 V Reference, and -50 V Current Limiting stages. Since these stages are closely regulated in the production of the -50-volt regulated output voltage, their operation is most easily understood when discussed as a unit.

Semi-regulated -50 volts from the Line to DC Converter/Regulator circuit provides the unregulated voltage source for this supply. Transistors Q984, Q992, Q994, and Q998 operate as a feedback-stabilized regulator circuit to maintain a constant -50-volt output level. Q984 is connected as a differential amplifier to compare the feedback voltage at the base of Q984B against the reference voltage at the base of Q984A. The error output at the collector of Q984A reflects the difference, if any, between these two inputs. The change in error-output level at the collector of Q984A is always in the same direction as the change in the feedback input at the base of Q984B (in phase).

Zener diode VR982 sets a reference level of about -9 volts at the base of Q984A. A sample of the output voltage from this supply is connected to the base of Q984B through divider R985-R986-R987. R986 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. Fig. 3-36 illustrates the reason for this configuration. The inherent resistance of the interconnecting wire between the output of the -50-Volt Supply and the load produces a voltage drop which is equal to the output current multiplied by the resistance of the interconnecting wire. Even though the resistance of the wire is small, it results in a substantial voltage drop due to the high output current of this supply. Therefore, if the feedback voltage were obtained ahead of this drop, the voltage at the load might not maintain close regulation. However, the -50 V Sense configuration overcomes this problem since it obtains the feedback voltage from a point as close as practical to the load. Since the current in the -50 V Sense line is small and constant, the feedback voltage is an accurate sample of the voltage applied to the load.

Regulation occurs as follows: If the output level of this supply decreases (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 R985-R986-R987 decreases also. This results in a more positive feedback level at the base of Q984B than established by the -50 V Reference stage at the base of Q984A. Since the transistor with the more positive base controls the conduction of the differential amplifier, the output current at the collector of Q984A decreases. This decrease in output from Q984A allows more current to flow through Q992 and Q994 to result in increased conduction of the -50 V Series Regulator Q998. The load current increases and the output voltage of this supply also increases (more negative). As a result, the feedback voltage from the --50 V Sense line increases and the base of Q984B returns to the same level as the base of Q984A. Similarly, if the output level of this supply increases (more negative), the output current of Q984A increases. The feedback through Q992 and Q994 reduces the conduction of the -50 V Series Regulator to decrease the output voltage of this supply.

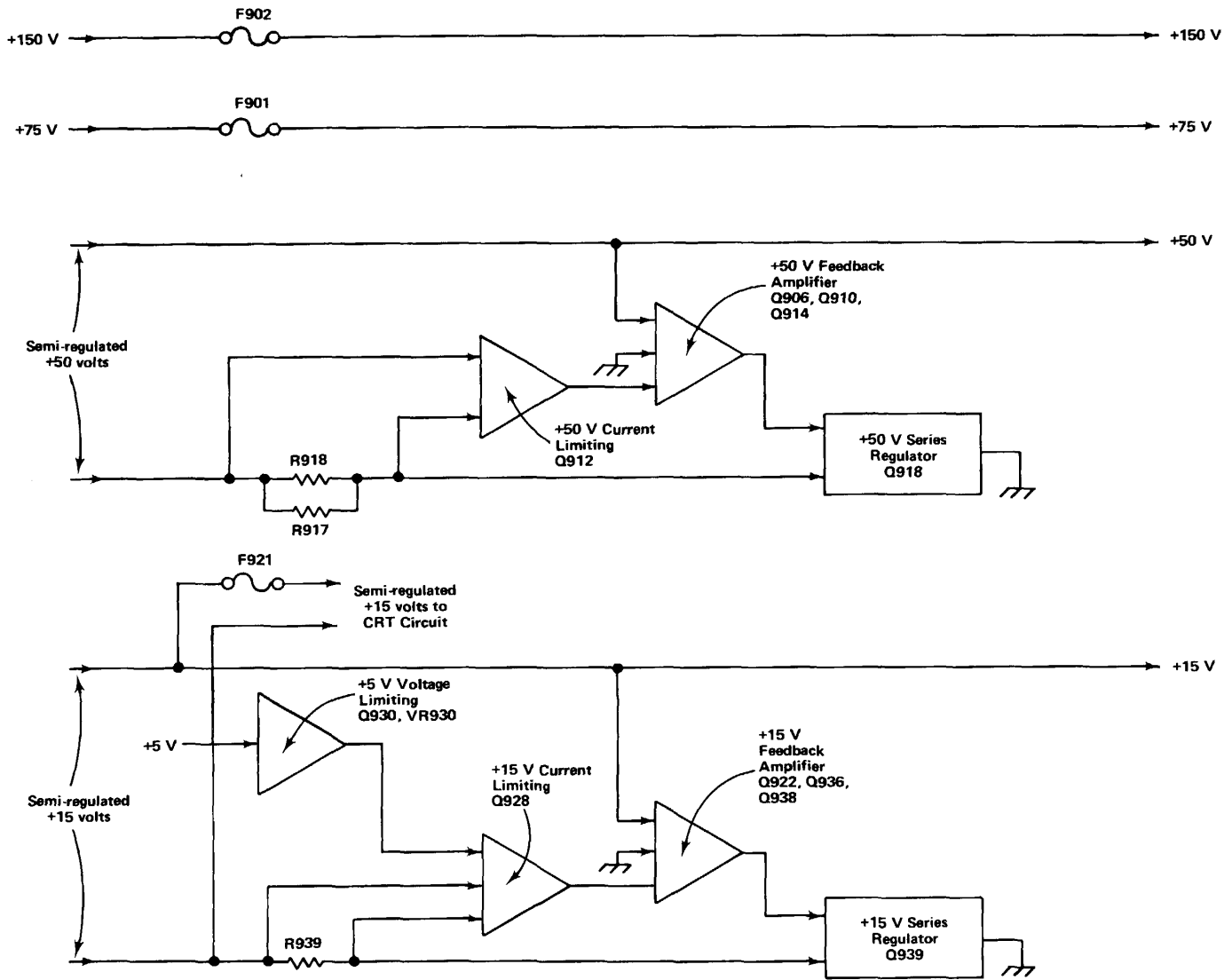


Fig. 3-35. Detailed block diagram of Low-Voltage Regulator circuit.

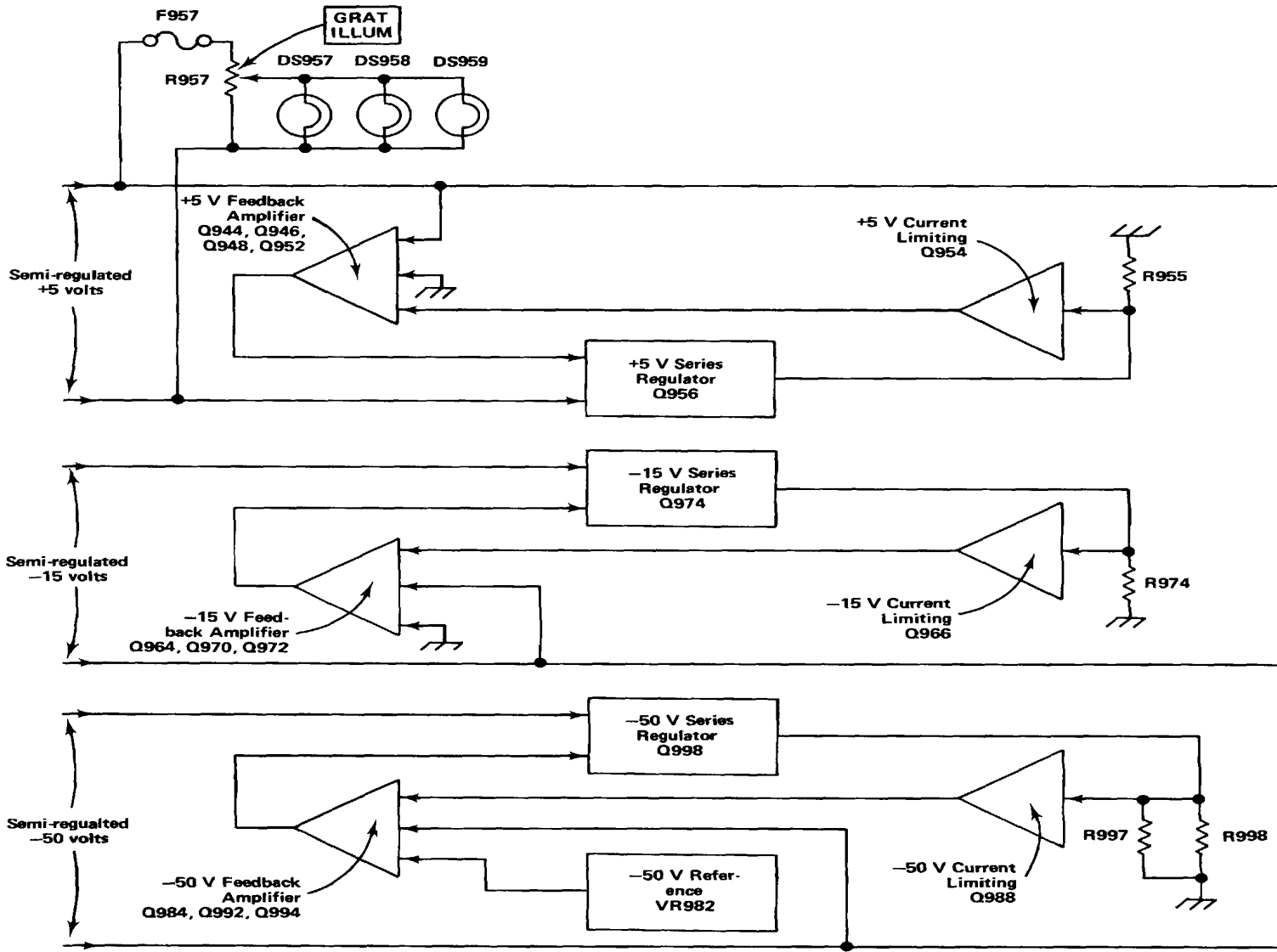


Fig. 3-35. (cont).

(A)

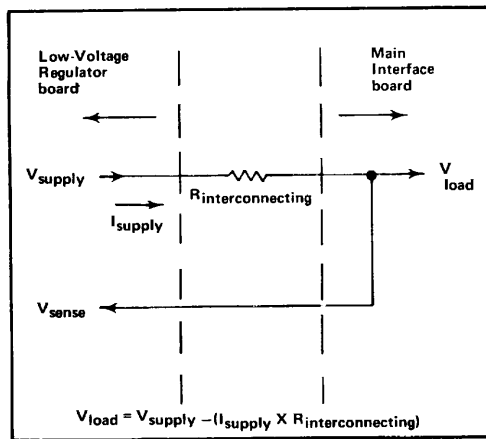


Fig. 3-36. Schematic illustrating voltage drop between power supply output and load due to resistance of interconnecting wire.

C990-R990 and C992-R992 provide stabilization for the feedback network by reducing the response time of the feedback network so it can not oscillate.

The -50 Volts adjustment R986 determines the divider ratio to the base of Q984B and thereby determines the feedback voltage. This adjustment sets the output level of the supply in the following manner: If R986 is adjusted so the voltage at its variable arm goes less negative (closer to ground), this appears as an error signal at the base of Q984B. In the same manner as described previously, this positive-going change at the feedback input of the differential amplifier increases the conduction of the -50 V Series Regulator to produce more current through the load and thereby increase the output voltage of this supply. This places more voltage across divider R985-R986-R987 and the divider action returns the base of Q984B to about -9 volts. Notice that the feedback action of this supply forces a change in the output level which always returns the base of Q984B to the same level as the base of Q984A. In this manner, the output level of the -50-Volt Supply can be set to exactly -50 volts by correct adjustment of R986.

The -50 V Current Limiting stage Q988 protects the -50-Volt Supply if excess current is demanded from this supply. Since the ground return for the -50 Volt Supply is through R997-R998, all current from the -50-Volt Supply must flow through these resistors. Transistor Q988 senses the voltage drop across R997-R998. Under normal operation, there is about 0.3-volt drop across R997-R998 which is not sufficient to forward bias Q988. However, when excess current is demanded from the -50 V Series Regulator due to a short circuit or similar malfunction at the 3-52

output of this supply, the voltage drop across R997-R998 increases until it is sufficient to forward bias Q988. The

collector current of Q988 results in a reduction of current through Q992 and Q994 to limit the conduction of Q998. As the output voltage of this supply decreases due to current limiting, the level of the positive semi-regulated voltage increases. More current flows through R988-R989 to increase the voltage drop across R989. As a result, the bias on Q998 increases so the Series Regulator supplies less current. This current limiting protects Q998 from damage due to excess power dissipation.

Several protection diodes are also included in this circuit. CR981 prevents the output of this supply from going more positive than about +0.6 volt if it is shorted to a positive supply. CR984 protects Q984A from reverse voltage breakdown. CR991 protects transistor Q994 by disconnecting the +50-Volt Supply if it is more negative than the base of Q994, such as when the instrument is turned on, or if the +50-Volt Supply is shorted to a less positive supply. CR994 protects Q994 from reverse-voltage breakdown.

-15-Volt Supply

Basic operation of all stages in the -15-Volt Supply is the same as for the -50-Volt Supply. Reference level for this supply is established by divider R962-R963 between ground and the -50 V Sense voltage. The divider ratio of R962-R963 sets a level of -15 volts at the base of Q964A. The level on the -50 V Sense line is held stable by the -50 Volt Supply. Any change at the output of the -15-Volt Supply appears at the base of Q964B as an error signal. The output voltage is regulated in the same manner as described for the -50-Volt Supply. Diode CR972 insures a conduction path between the collector of -15 V Current Limiting transistor Q966 and the -15 V Series Regulator Q974 when current limiting is required. CR961 limits the output of this supply from going more positive than about +0.6 volts when it is shorted to one of the positive supplies. Diode CR964 and CR965 provide reverse-voltage protection for transistors Q964A and Q964B respectively.

+5-Volt Supply

Basic operation of the +5 V Series Regulator and +5 V Current Limiting stages are the same as described for the previous supplies. The +5 V Feedback Amplifier operates in the same manner as described previously except that Q948 provides inversion in the feedback path. The reference level for this supply is established by the ground connection at the base of Q944. Feedback voltage to the base of Q946 is provided by divider R946-R947 between the +5 V Sense line and the -50 V Sense line. The divider ratio of R946-R947 is 10:1 so that the base of Q946 is at zero volts when the supply is operating properly. The level on the -50 V Sense line is held stable by the -50-Volt Supply. Therefore, any change at the output of the +5-Volt Supply®

appears at the base of Q946 as an error signal. The output voltage is regulated in the manner described previously for the -50-Volt Supply. Diode CR941 limits the output of this supply to about -0.6 volt if it is shorted to one of the negative supplies. Diode CR942 provides a current path to limit the output of the +5-Volt Supply to about +7.6 volts if this supply is shorted to the +50-Volt Supply. Diode CR948 establishes a level of about +0.6 volt at the emitter of Q948. CR949 along with the forward drop across the base-emitter junction of Q948 establishes sufficient voltage drop for correct operation of the +5 V Current Limiting stage Q954.

The output of this supply is also connected across the GRAT ILLUM control R957 through fuse F957. R957 controls the current through the graticule illumination lights DS957, DS958, DS959 to change the illumination of the graticule lines. Fuse F957 protects the +5-Volt Supply if a short-circuit condition occurs in the graticule light network.

Elapsed-time meter M941 is connected to the +5-volt output. This meter records the amount of time that this instrument has been operating. R941 establishes the current through M941 which determines the rate at which the meter records time.

+15-Volt Supply

The semi-regulated voltage applied to the +15-Volt Supply is also connected to the High-Voltage Oscillator stage in the CRT Circuit through F921. This fuse protects the +15-Volt Supply from damage due to failures in the High-Voltage Oscillator stage. The +15 V Series Regulator and +15 V Current Limiting stages operate in the same manner as described for the previous supplies. The +15 V Feedback Amplifier stage is connected in the inverting configuration. The ground connection at the base of Q922A provides the reference for this supply. Feedback voltage to the base of Q922B is provided through divider R925-R926 between the +15 V Sense line and the -50 V Sense line. The divider ratio of R925-R926 sets the base of Q922B to zero volts. Any change in the output level of the +15-Volt Supply appears at the base of Q922B as an error signal. This results in an opposite change at the collector of Q922B which is connected to the base of Q936 through zener diode VR927. This diode provides voltage-level shifting between Q922B and Q936. The change at the base of Q936 is connected to the +15 V Series Regulator stage through Q938 to correct the error in the output voltage.

Diodes CR922 and CR924 provide reverse-voltage breakdown protection for transistors Q922A and Q922B respectively. Diode CR923 protects Q922B against negative voltages when the +15-Volt Supply is shorted to ground. CR938 provides a connection between the +15 V Current Limiting stage Q954 and the +15 V Series Regulator stage Q938.

Limiting stage and the +15 V Series Regulator stage when current limiting is required. Diode CR935 disconnects the emitter circuit of Q936 from the -50-Volt Supply if the -50-Volt Supply is shorted to a positive supply.

The +5 V Voltage Limiting stage Q930 provides protection for the integrated circuits which are powered from the +5-Volt Supply if the +5-Volt and +15-Volt supplies are shorted together. The output of the +5-Volt Supply is connected across zener diode VR930 through R929 and R930. Under normal conditions, Q930 does not conduct. However, if the output of the +5-Volt Supply rises positive because it is shorted to the +15-Volt Supply, the base of Q930 is clamped at about +5.1 volts by zener diode VR930. As the output voltage of the +5-Volt Supply increases to about +5.7 volts, Q930 is forward biased and its collector current turns on the +15 V Current Limiting stage through R931. This limits the output level of the +15-Volt Supply so it drops to about +5.7 volts. Since the output level of the +15-Volt Supply is now limited, it can not pull the +5-Volt Supply more positive than about +5.7 volts.

+50-Volt Supply

Operation of the +50 V Series Regulator and the +50 V Current Limiting stages are the same as described previously for the other supplies. The +50 V Feedback Amplifier operates in the same manner as described previously except that Q910 provides inversion in the feedback path. Reference voltage for this supply is established by the ground connection at the base of Q906A. Feedback voltage to the base of Q906B is provided by divider R907-R908 between the +50 V Sense line and -50 V Sense line. The divider ratio of R907-R908 sets the base level of Q906B to zero volts when the output of this supply is correct. The protection diodes in this circuit operate similarly to the other supplies.

+75 and +150-Volt Supply

The +75-Volt and +150-Volt levels produced by the Line to DC Converter/Regulator circuit are connected to fuses F901 and F902, respectively, in this circuit. These fuses protect the Line to DC Converter/Regulator circuit if the output of these supplies is shorted.

CONTROLS AND CABLING

General

Diagram 12 shows the front-panel switches and controls of the R7704 and the interconnections between these controls and the circuits within this instrument. To use the cabling diagram, note the number on the wire at the point where an individual wire joins the cable. Then follow the cable around until a break-out is found with the same number. This is the source/location of the desired wire.

READOUT SYSTEM

Switch Logic

The VERTICAL MODE and HORIZONTAL MODE switches determine the operating mode of the Vertical Interface and Horizontal Interface circuits respectively. Each of these switches is designed so that it is self-canceling (i.e., only one button can be pressed at a time). Specific operation of these switches is described in connection with the circuits that they control.

The A TRIGGER SOURCE and B TRIGGER SOURCE switches control the operation of the Trigger Selector circuit. These switches are also self-canceling so that only one of the buttons can be pressed at a time. Operation of these switches is discussed in connection with the Trigger Selector circuit.

Indicator Lights

The indicator lights shown in connection with the VERTICAL MODE and HORIZONTAL MODE switches indicate which mode has been selected. When one of the buttons of these switches is pressed, it completes the circuit between the associated bulb and the lamp-common line. Notice that a separate bulb is used for each mode switch position. Bulbs DS1035 and DS1037, located beside the B INTENSITY and A INTENSITY controls respectively, are actuated by the HORIZONTAL MODE switch to indicate which of the intensity controls is active for the selected horizontal mode. The selected button of the A TRIGGER SOURCE and B TRIGGER SOURCE switches is also illuminated to indicate the trigger source. Notice that only one bulb is associated with each of the trigger source switches. The source switches are mechanically designed so that the button which is pressed receives light from the bulb, but the remaining buttons remain un-illuminated.

The CONTROL ILLUM switch S1040B determines the illumination level of the pushbutton switches on the R7704 and the associated plug-in units. In the HIGH position of this switch, lamp power from the Line to DC Converter/Regulator circuit is connected directly to the light bulbs. In the LOW position, lamp power is connected to the bulbs through diodes CR1040 and CR1041. The forward drop across these diodes reduces the current available to the bulbs so they operate at a lower intensity level. In the OFF position, lamp power to all of the pushbutton switches is disconnected. However, lamp power is still connected to the bulbs associated with the A and B INTENSITY controls through CR1040 and CR1041 to provide an indication that the POWER switch is ON. Fuse F1040 protects the +5-Volt Lamp Supply if the lamp power circuit is shorted to ground.

This diagram also shows the wiring for the Camera Power Connector on the CRT bezel, the PROBE POWER connectors J1080-J1085, and the REMOTE CONTROL connector J1075.

Introduction to Readout System

General. The Readout System in the R7704 provides alpha-numeric 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. Schematics for the total Readout System are shown on diagram 13, 14, and 15 at the rear of this manual.

The definitions of several terms must be clearly understood to follow this description of the Readout System. These are:

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

Word-A word is made up of a related group of characters. In the R7704 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. Fig. 3-37 shows one complete frame (simulated readout) and the position at which each of the eight words is displayed.

Column-One of the vertical lines in the Character Selection Matrix (see Fig. 3-38). Columns C-0 (column zero) to C-10 (column 10) can be addressed in the R7704 system .

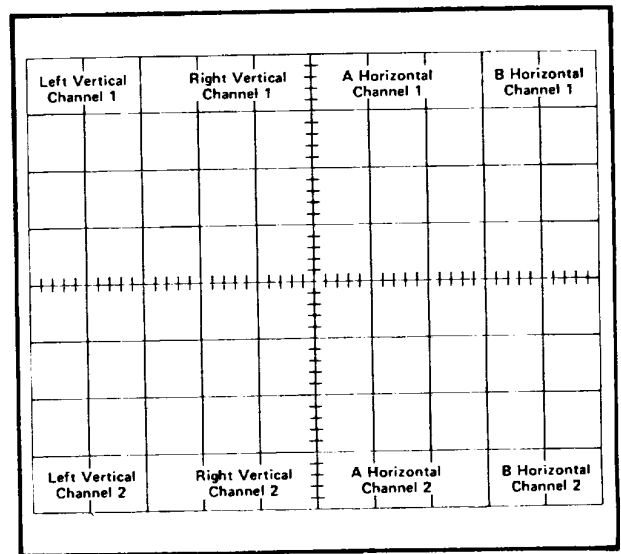



Fig. 3-37. Location of readout words on the CRT identifying the originating plug-in and channel (one complete frame shown, simulated readout).

Column Number → Row Number ↓		C-0	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10	
		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	≥1.0	
R-1	0	SKIP* ↑ ↓	0	1	2	3	4	5	6	7	8	9	
R-2	0.1		/	<	I	/	+	-	+	C	Δ	>	
R-3	0.2		Add* one zero	Add* two zeros	Reduce* prefix	Reduce* prefix and add one zero							IDENTIFY*
R-4	0.3		m	μ	n	p	X	K	M	G	T	R	
R-5	0.4		S	V	A	W	H	d	B	c	Ω	E	
R-6	0.5		U	N	L	Z	Y	P	F	J	Q	D	
R-7	0.6				Decimal* point location No. 3	Decimal* point location No. 4	Decimal* point location No. 5	Decimal* point location No. 6	Decimal* point location No. 7				
R-8	0.7												
R-9	0.8												
R-10	0.9		Add Space In Display*										

 Unused locations. Available for future expansion of Readout System

Operational address.

Fig. 3-38. Character Selection Matrix for R7704 Readout System.

(A)

Row-One of the horizontal lines in the Character Selection Matrix (Fig. 3-38). Rows R-1 (row 1) to R-10 (row 10) can be addressed in the R7704 system.

Time-Slot-A location in a pulse train. In the R7704 Readout System, the pulse train consists of 10 negative-going pulses. Each of these time-slots 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 R7704 CRT. The position of each word is fixed and is directly related to the plug-in unit from which it originated. Fig. 3-37 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. Fig. 3-39 shows a typical display where only channel 1 of the Right Vertical and B Horizontal units is selected for display.

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. 3-38. Any one of the 50 separate characters can be addressed and displayed on the CRT. In addition, 12 operational addresses are provided for special instructions to the

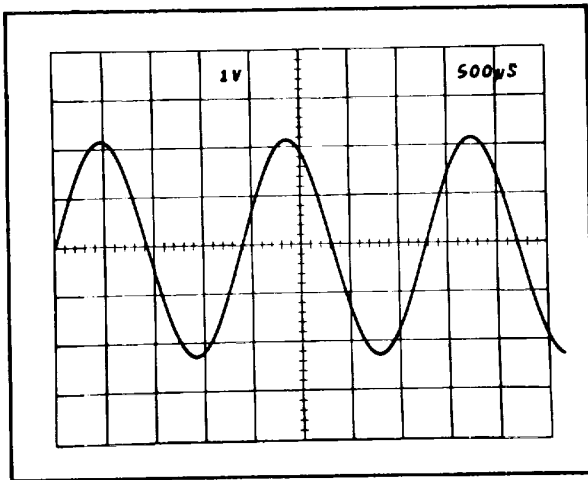


Fig. 3-39. Typical readout display where only channel 1 of the Right Vertical and B Horizontal units is displayed.

3-56 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. 3-40. 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 which 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 Timing stage for further information). This stage also produces control signals for other stages within this circuit and interrupt signals to the Vertical Interface, Horizontal Interface, CRT Circuit, and Z-Axis Logic stage 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. When the Time-Slot Counter stage has completed 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 which range from zero to one milliamperes (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. 3-38. The standard format in which information is encoded onto the output lines is given in Table 3-2 (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 single time multiplexed analog voltage output which contains all of the

TABLE 3-2
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	1-2-5 scaling.
TS-5	Not encoded by plug-in unit. Left blank to allow addition of zeros by Readout System.
TS-6	
TS-7	
TS-8	
TS-9 TS-10	Defines the prefix which modifies the units of measurement. Define the units of measurement of the plug-in unit. May be standard units of measurement (V, A, S, etc.) or special units selected from the Character Selection Matrix.

column or row information from the plug-ins. The Column Data Switch and Row Data Switch are sequenced by the binary Channel Address No. 1 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 which should be displayed. Whenever information is not encoded in a timeslot, the Display-Skip Generator produces an output level to prevent the Timer stage from producing the control signals which 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 to C-10 (column 1 to 10) which correspond to the column information encoded by the plug-in unit. Likewise, the outputs of the Row De®

coder stage are identified as R-1 to R-10 (row 1 to 10) which correspond to the row information encoded by the plug-in unit. 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. However, 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 there is no display during this time-slot (as defined by Standard Readout Format; see Table 3-2). When time-slots 5, 6, and 8 occur, the memory is addressed and any information stored there during time-slot 1 is transferred out and connected to the input of the Column Decoder stage to modify the analog data during the applicable time-slot.

Another operation of the Zeros Logic and Memory stage is to produce 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 stage produces the characters which are displayed on the CRT. Any of the 50 characters shown on the Character Selection Matrix of Fig. 3-37 can be addressed by proper selection of the column and row current. Only one character is addressable in any one timeslot; 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 how many characters have been 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 2 (normal/invert) or time-slot 3 (cal/uncal) which precedes 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 row 7 and columns 3 through 7 (see Character Selection Matrix for location of these decimal points). The Decimal Point Logic and Character Position Counter stage is reset after each word by the Word Trigger pulse.

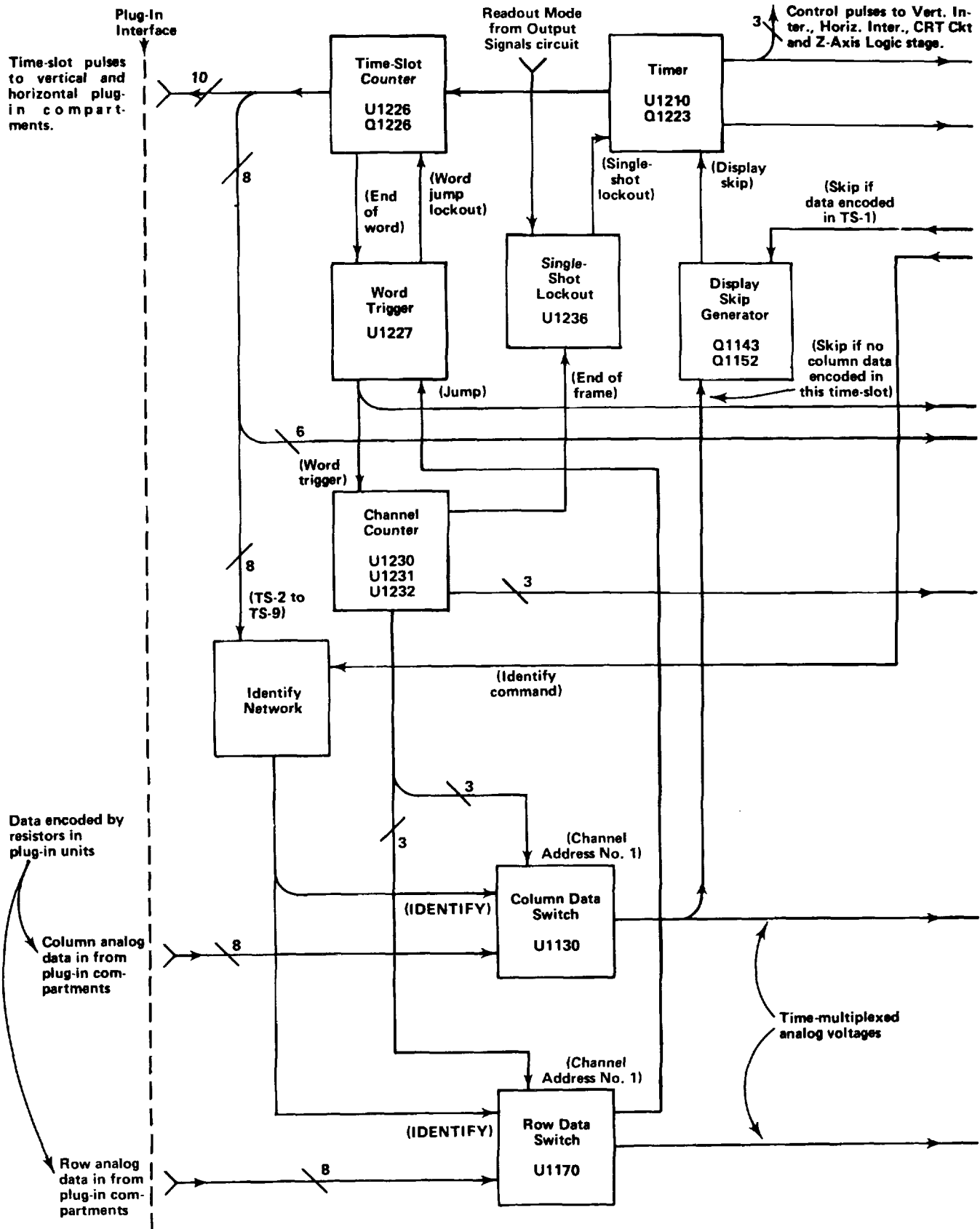


Fig. 3-40. Detailed block diagram of Readout System.

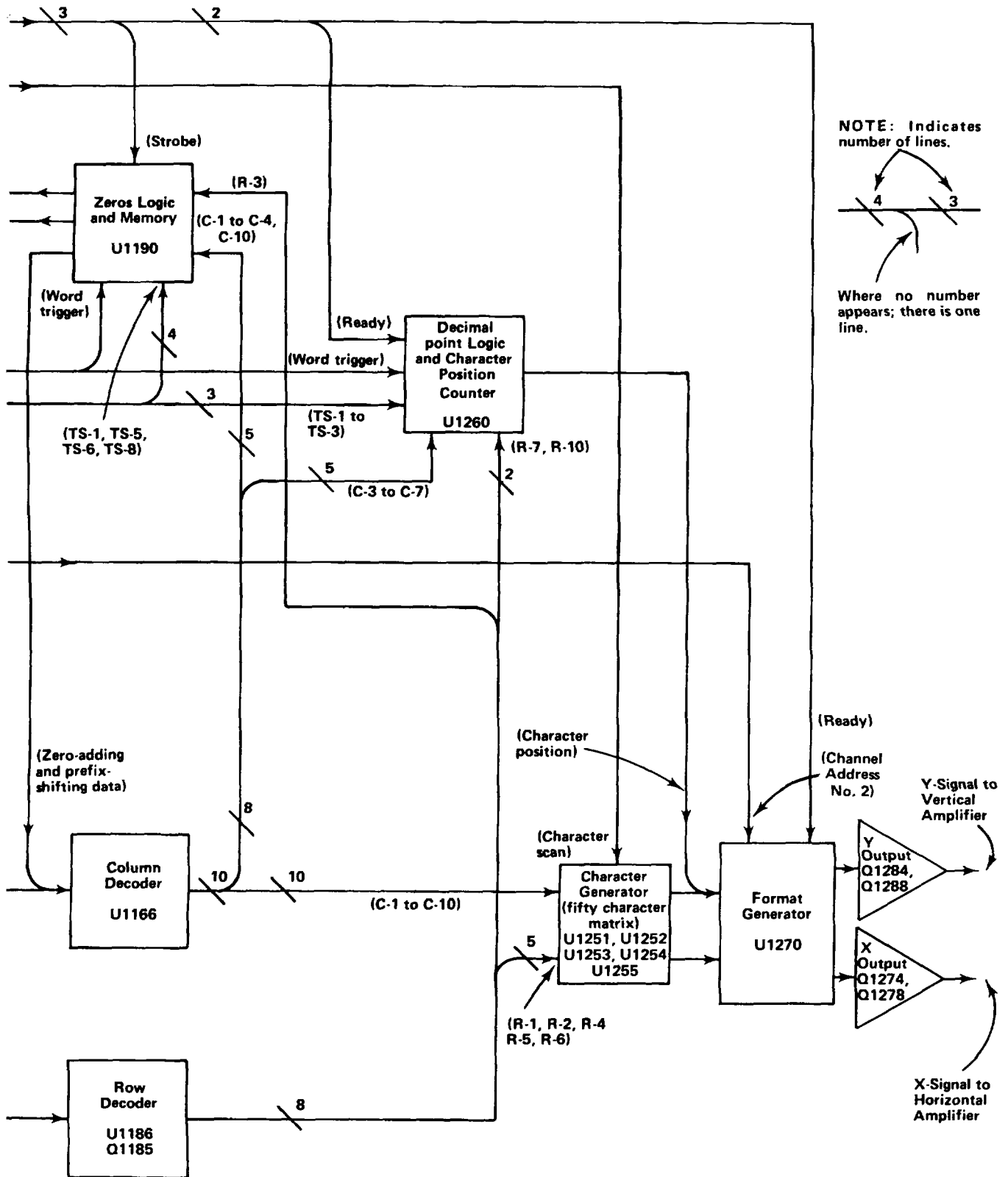


Fig. 3-40. (cont).

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 No. 2 code from the Channel Counter stage is connected to this stage so the display from each channel is positioned to the area of the CRT which is associated with the plug-in and channel originating the word (see Fig. 3-36). 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-output signals are connected to the Horizontal Amplifier and Vertical Amplifier through the Horizontal Output and Vertical Output stages respectively.

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 to 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 Decoder 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 input from the Output Signals circuit determines the operating mode of the readout system.

Circuit Analysis of Readout System

The following analysis of the Readout System discusses the operation of each stage in detail. Complete schematics of the Readout System are shown on diagram 13, 14, and 15 at the rear of this manual.

Timer

Timer U1210 establishes the timing sequence for all circuits within the Readout System. This stage produces seven time-related output waveforms (see Fig. 3-41). 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 C1214-R1214. The triangle waveform is clipped and amplified by U1210 to form the trapezoidal output signal

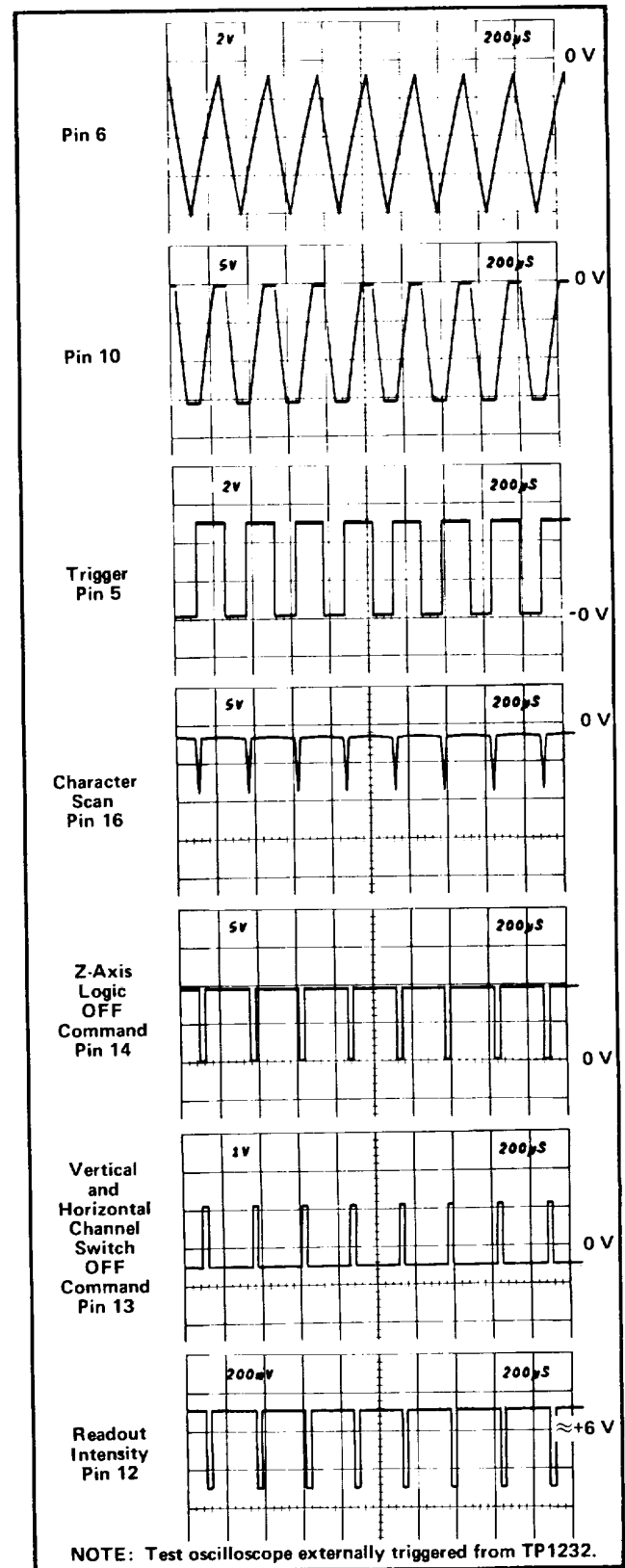


Fig. 3-41. Output waveforms of Timer stage.

at pin 10. The amplitude of this output signal is exactly 15 volts as determined by U1210 (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 very important to the correct operation of the Readout System (see expanded waveforms in Fig. 3-42). 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 2) to blank the CRT before the display is switched to the Readout System. It also produces the Strobe pulse through R1221, Q1223, and CR1224 to signal other stages within the Readout System to begin the sequence necessary to produce a character. The collector level of Q1223 is also connected to Character Generator No. 2, U1252, through C1222-CR1222. This activates U1252 during the quiescent period of the Strobe pulse (collector of Q1223 negative) and diverts the output current of Row Decoder U1186 to row 2. The purpose of this configuration is to prevent the

Zeros Logic and Memory stage U1190 from storing incorrect data during the quiescent period of the Strobe pulse. When the Strobe pulse goes positive, CR1222 is reverse biased to disconnect O1223 from U1252 and allow the Row Decoder to operate in the normal manner.

The next signal to be produced is the Vertical/Horizontal Channel Switch OFF Command at pin 13. This positive-going signal disconnects the plug-in signals in 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 (see diagram 15). 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 READOUT intensity control R1040. 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 negatively from about -2 volts to about -8.5 volts and then returns back to the original level. This waveform provides the scanning signal for the Character Generator stages (see diagram 15). Full Character Scan adjustment R1219 sets the DC level of the Character Scan ramp to provide complete characters on the display.

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 which 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 U1210 through CR1207 from the Display-Skip Generator stage (diagram 14). This signal causes the Timer to shorten its period of operation to about 210 microseconds. The waveforms in Fig. 3-43 show the operation of the Timer stage when the Display-Skip condition 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 Single-Shot Lockout level at pin 2 also controls the operation of U1210. 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).

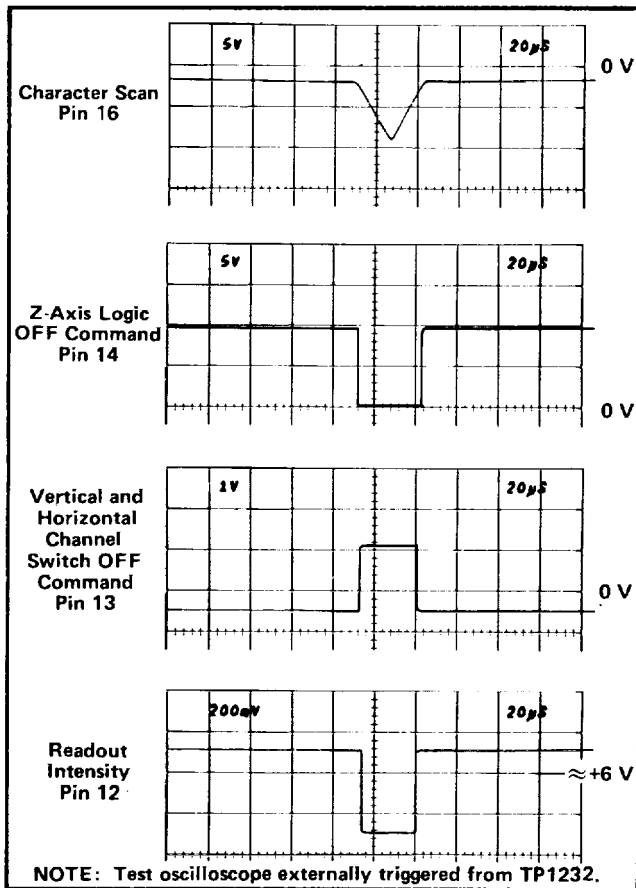


Fig. 3-42. Detail of output at pins 12, 13, 14, and 16 of U1210.

Circuit Description-R7704

READOUT intensity control R 1040 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 R 1040 is turned fully counterclockwise, switch S1040 opens. The current to pin 11 of U1210 is interrupted and at the same time a positive voltage is applied to pin 4 through R1206 and CR1206. This 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 U1226 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. Fig. 3-44 shows the time-relationship of the time-slot pulses. Notice that only one of the lines 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 timeslot 1. The Time-Slot Counter can be reset in this manner only when a Jump Command is received by U1227A (see following discussion).

Word Trigger

The Word Trigger stage is made up of the 4 two-input NOR gates contained in U1227. Quiescently, pin 2 of U1227C is LO as established by the operating conditions of U1227A-U1227B. Therefore, the LO End-of-Word pulse produced by the Time-Slot Counter results in a HI level at pin 1 of U1227C. This level is inverted by U1227D to provide a negative-going advance pulse to the Channel Counter.

An advance pulse is also produced by U1227D when a Jump Command is received at pin 8 of U1227A. This condition can occur during any time-slot (see Row Decoder for further information on origin of the Jump Command). U1227A and U1227B are connected as a bistable flip-flop. The positive-going Jump Command at pin 8 of U1227A produces a LO at pin 10. This LO is inverted by U1227B to produce a HI at pin 13 which allows pin 9 of U1227A to be pulled HI through R1227. The flip-flop has now been set

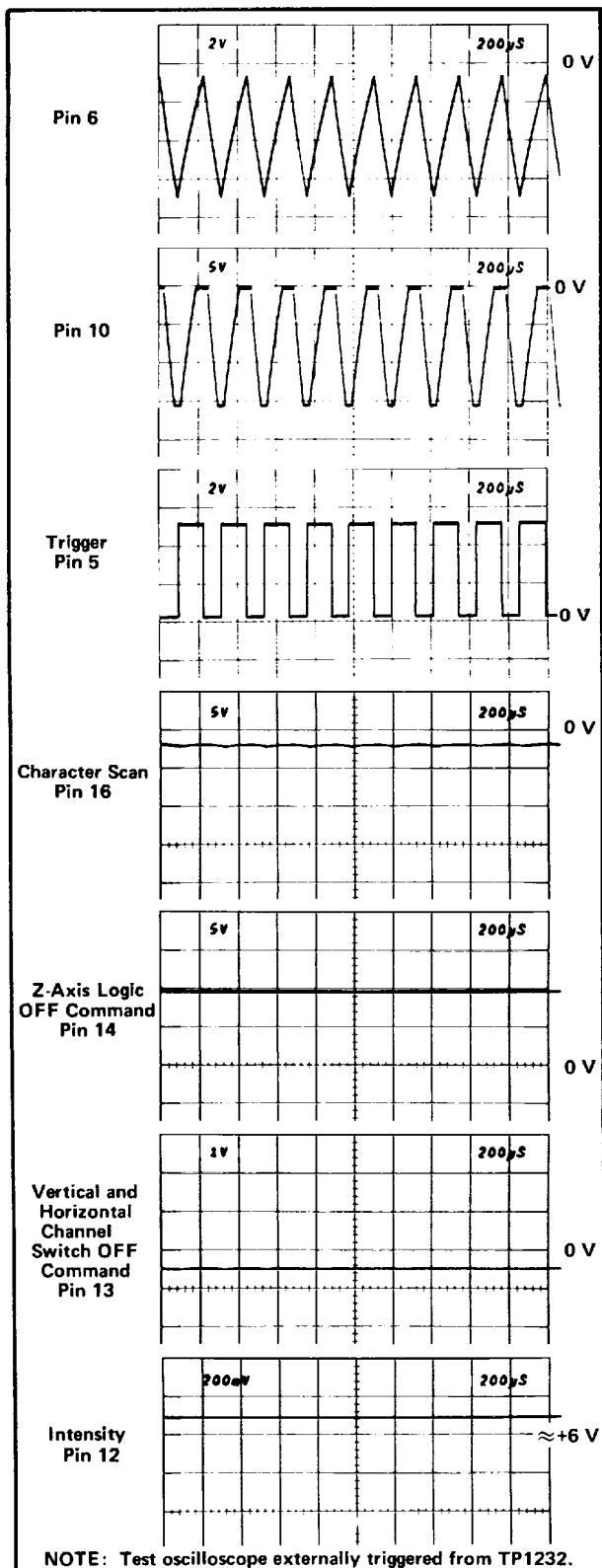


Fig. 3-43. Timer stage operation when Display-Skip condition occurs.

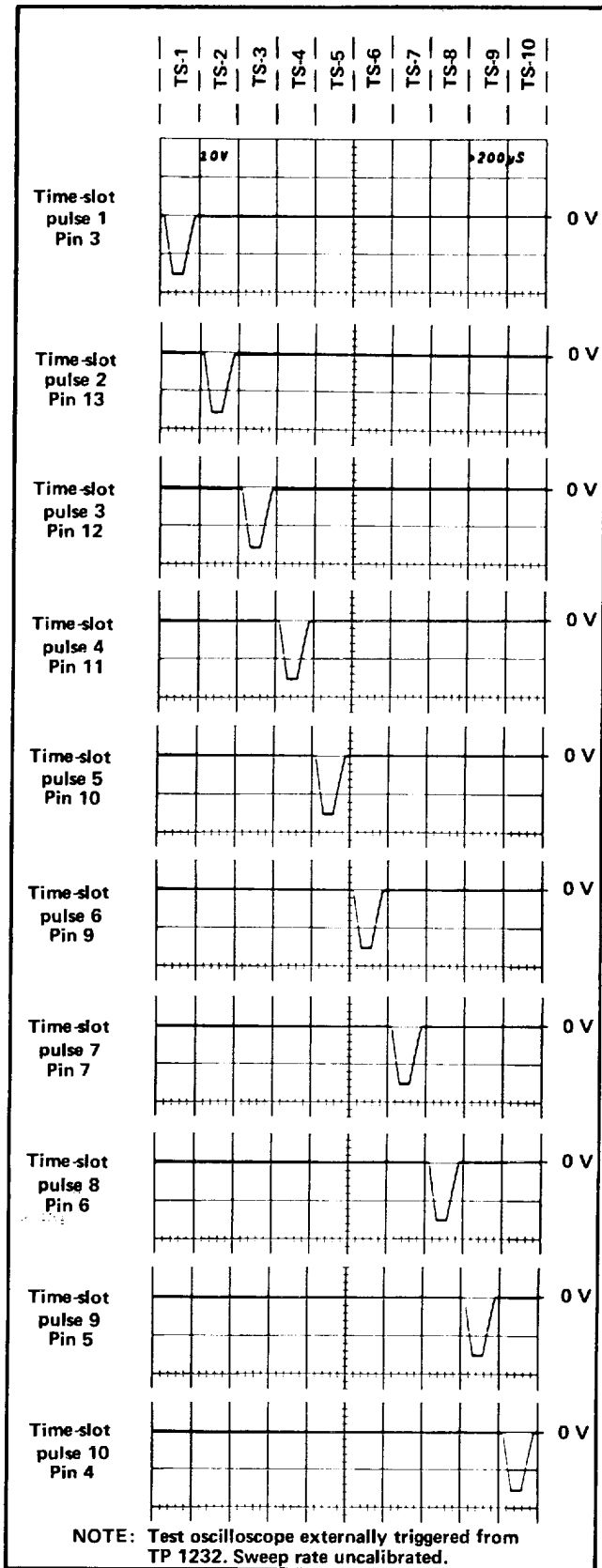


Fig. 3-44. Time relationship of the time-slot (TS) pulses produced by U1226.

and it 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 Q1226 through R1226 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 U1227 is reset. At the same time, a HI level is applied to pin 4 of the Timer through CR1208 and CR1207. This HI level causes the Timer to operate in the display-skip mode so that a character is not generated.

The next Trigger pulse is not recognized by the Time Slot Counter, since U1226 is locked in time-slot 1 by U1227. However, this Trigger pulse resets the Word Trigger stage through C1227. Pin 13 of U1227B goes LO to enable the Time-Slot Counter and Timer stages for the next timeslot pulse. At the same time, the negative-going edge produced as U1227B switches output states is connected to pin 2 of U1227C. This results in a negative-going Word Trigger output at pin 4 of U1227D 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 timeslot 1 line.

Channel Counter

The Channel Counter, made up of integrated circuits U1230-U1231-U1232 is a binary counter which produces the Channel Address code for the Column and Row Decoder stages (diagram 14) and the Format Generator stage (diagram 15). This code instructs these stages to sequentially select and display the eight channels of data from the plug-ins. The input channel which is displayed with each combination of the Channel Address code is given in the discussion for the applicable stages.

Single-Shot Lockout

U1236 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. U1236A and U1236B are connected to form a bistable flip-flop. For normal operation, pin 3 of U1236A is pulled HI through R1235. This activates U1236A to result in a LO output level at pin 6 which enables the Timer stage so it can operate in the free-running manner as described previously. The LO at pin 6 of U1236A is also applied to pin 2 of U1236B. Since pin 1 is LO due to the ground connection through R1237. U1236B is disabled and its output goes HI.

The output of this stage remains LO to allow U1210 to operate in the free-running mode until a LO is received at pin 3 of U 1236A. When this occurs, the output level at pin 6 of U1236A 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 2 of B Horizontal unit), the Readout System continues to operate in the normal manner. However, when word eight is completed, the positive-going End-of-Frame pulse is produced at pin 5 of U1232 as the Channel Counter shifts to the code necessary to display word one. This pulse is coupled to pin 1 of U1236B through C1237. The momentary HI at pin 1 activates U1236B and its output goes LO to disable U1236A (pin 3 already LO). The output of U1236A goes HI to disable the Timer so it operates in the display-skip mode. The HI at pin 6 of U1236A also holds U1236B 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 3 of U1236A. This trigger pulse produces a LO at pin 6 of U1236A which enables U1210 and disables U1236B. 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 Output Signals description.

Encoding the Data

Data is conveyed from the plug-in units to the Readout System in the form of an analog code having up to 11 current levels (from zero to one milliampere in 100 microampere steps). The characters which can be selected by the encoded data are shown on the Character Selection Matrix (see Fig. 3-38). Each character requires two currents to define it; these currents are identified as the column current and the row current which correspond to the column and row of the matrix. The column and row data is encoded by resistive programming in the plug-in units. Fig 3-45 shows a typical encoding scheme for a voltage-sensing amplifier plug-in unit. Notice that the 10 time-slot (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 3-2 for Standard Readout Format) The amplitude of the time-slot pulses is

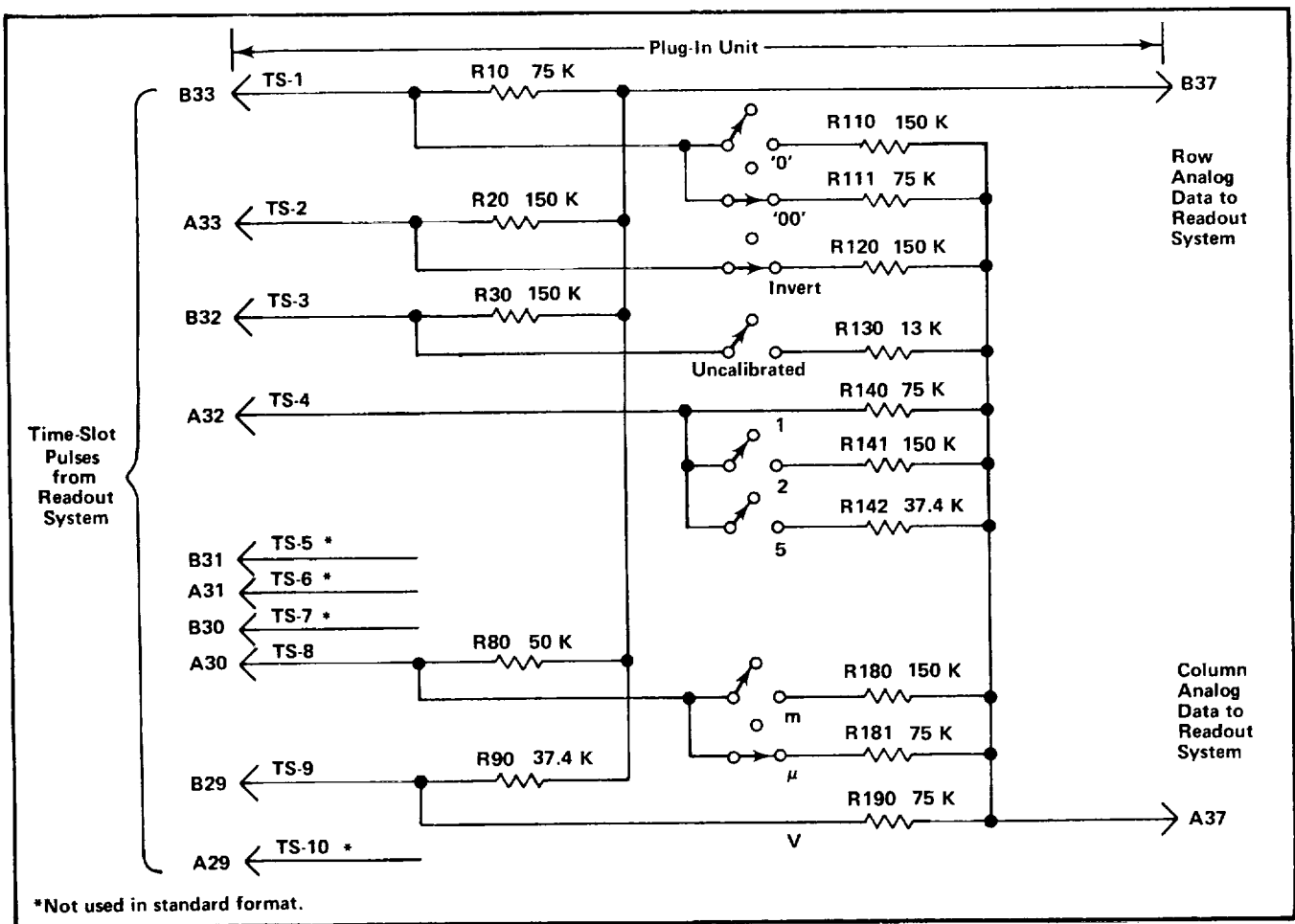


Fig. 3-45. Typical encoding scheme for voltage-sensing plug-in unit. Coding shown for deflection factor of 100 microvolts.

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.

For example, in Fig. 3-45 resistors R10 through R90 control the row analog data which is connected back to the Readout System. These resistors are of fixed value and define the format in which the information will be presented by the Readout System. Fig. 3-46A shows an idealized output current waveform of row analog data which results from the 10 time-slot pulses. Each of the steps 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 shown in Fig. 3-38. 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

indicates a 100 microvolt sensitivity with the CRT display inverted and calibrated vertical deflection factors. This results in the idealized output current waveforms shown in Fig. 3-46B at the column analog data output, terminal A37 of the plug-in interface. Resistor R 111, 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 R100 (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 vertical deflection factors are calibrated. Therefore, there is no column current output during this time-slot and there is 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 and 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 p 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 three units of column current and four units of row current to cause a V (volts) to 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 lines. This encodes 10 units of column current (see shaded area in time-slot 3 of the waveform shown in Fig. 3-46B). 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 the plug-in unit can be modified by attenuator probes connected to the input connectors of vertical 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

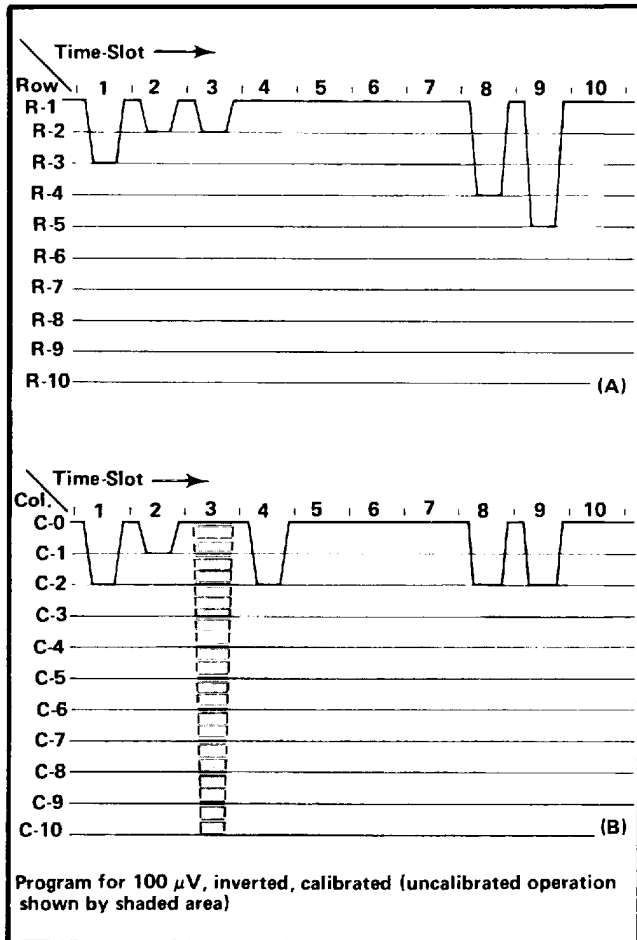


Fig. 3-46. Idealized current waveforms of: (A) Row analog data, (B) Column analog data.

time-slot lines by switch closures to encode the desired data. The data as encoded by the circuit shown in Fig. 3-45 (A)

only). The probe contains a resistor which results in additional column current. For example, if a 10X attenuator probe is connected to a plug-in with the coding for 100 microvolts as shown in Fig. 3-45, an additional unit of current is added to the column analog data during time-slot 1. Since two units of current were encoded by R 111 (see Fig. 3-45), 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 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 reduced. Since this instruction occurs in the same time-slot which 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).

Likewise, if a 100X readout-coded probe is connected to the input of the plug-in unit, the column current during time-slot 1 will be increased two units for a total of four units of column current. This addresses an instruction in the Character Selection Matrix which reduces the prefix and adds one zero to the display. The resultant CRT readout with the previous program is 10 mV.

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; 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 readout data from the plug-in units is connected to the Column and Row Data Switch stages (Diagram 14). 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 U1130 and the Row Data Switch U1170 receive the Channel Address No. 1 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 readout data. Table 3-3

®

**TABLE 3-3
Channel Address No. 1 Code**

Pin 1 U1190 "Identify" Command	Pin 5 U1232	Pin 5 U1231	Pin 5 U1230	Channel Selected
HI	HI	HI	HI	Channel 1 Left Vertical
HI	HI	HI	LO	Channel 2 Left Vertical
HI	HI	LO	HI	Channel 1 Right Vertical
HI	HI	LO	LO	Channel 2 Right Vertical
HI	LO	HI	HI	Channel 1 A Horizontal
HI	LO	HI	LO	Channel 2 A Horizontal
HI	LO	LO	HI	Channel 1 B Horizontal
HI	LO	LO	LO	Channel 2 B Horizontal
LO	Φ	Φ	Φ	IDENTIFY

(Φ= Has no effect in this case.)

gives the eight combinations of the Channel Address No. 1 code and the resultant channel which is selected with each combination. These stages have nine inputs and provide a single 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 R1131 through R1138 and R1171 through R1178 (see Zeros Logic and Memory description for further information on ninth channel).

In addition to the data inputs from the plug-in units, channel-inhibit inputs are provided from each of the plug-in units. The channel inhibit lines are LO only when the associated plug-in unit has been selected for display. When a plug-in unit is not selected, the respective line is HI which forward basis the associated diode CR1112, CR1113, CR1117, CR1118, CR1122, CR1123, CR1127, or CR1128 to bypass the encoded data from this plug-in unit. 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 forcing over-ride 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 switches.

Display-Skip Generator

The Display-Skip Generator, Q1143-Q1150-Q1152Q1155, 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 which should result in a CRT display. The voltage at the base of Q1143B is set by divider CR1141-R1146-R1147R1148. Quiescently, there is about 100 microamperes of current flowing through R1141 from Q1163 and the Zeros Logic and Memory stage (purpose of this quiescent current will be discussed in connection with the Zeros Logic and Memory stage). This current biases Q1143A so its base is about 0.2 volt more positive than the base of Q1143B in the absence of column data. Therefore, since Q1143A and Q1143B are connected as a comparator, Q1143A will remain on unless its base is pulled more negative than the base of Q1143B. The analog data output from the Column Data Switch produces a 0.5-volt change at the base of Q1143A for each unit of column current that has been encoded by the plug-in unit. Therefore, whenever any information appears at the output of the Column Data Switch, the base of Q1143A is pulled more negative than the base of Q1143B, resulting in a negative (LO) Display Skip output to the Timer stage through Q1155. 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.

Q1150-Q1152 also provide display-skip action. The Endof-Word level connected to their emitters through R1152 is LO only during time-slot 1. This means that Q1150-Q1152 are enabled only during time-slot 1. These transistors allow the Zeros Logic and Memory stage to generate a displayskip signal during time-slot 1 when information has been stored in memory which is not to be displayed on the CRT (further information given under Zeros Logic and Memory discussion).

Column and Row Decoder

The Column Decoder U1166 and Row Decoder U1186 sense the magnitude of the analog voltages at their inputs and produce a binary output on one of ten lines corresponding to the column or row data which was 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. The size of the character which will be displayed on the CRT is determined by the value of R 1156. When a display skip signal is present (collector of Q1155 HI), pin 9 is pulled HI through CR1155. 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 Q1185 and its associated components, is a Row 13 detector which 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 13 (thirteen units of row current; 1.3 milliamperes) is encoded, the base of Q1185 is pulled negative enough so that this transistor is reverse biased to produce a Hi Jump Command output at its collector. This Jump Command is connected to the Word Trigger stage (diagram 13) 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 U1190 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 it can store the encoded data. A block representation of the memory sequence is shown in Fig. 3-47. Typical output waveforms for the five possible input conditions that can occur are shown in Fig. 3-48. When time-slot 1 occurs, a store command is given to all of the memories. If the plug-in unit 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 U1190. If data was encoded during time-slot 1, a negative-going output is produced at pin 7 as the memories are being set. This negative-going pulse is connected to the base of Q1152 in the Display-Skip Generator to produce a Display-Skip output. Since the information that was encoded during time-slot 1 was only provided to set the memories and was 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 Q1163 to add one unit of current at the input of the Column Decoder. This produces a zero after the character displayed on the CRT 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.

Finally, memory C is interrogated during time-slot 8 to obtain information on whether the prefix should be reduced or left at the value which was encoded. If data has been encoded which calls for a reduction 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

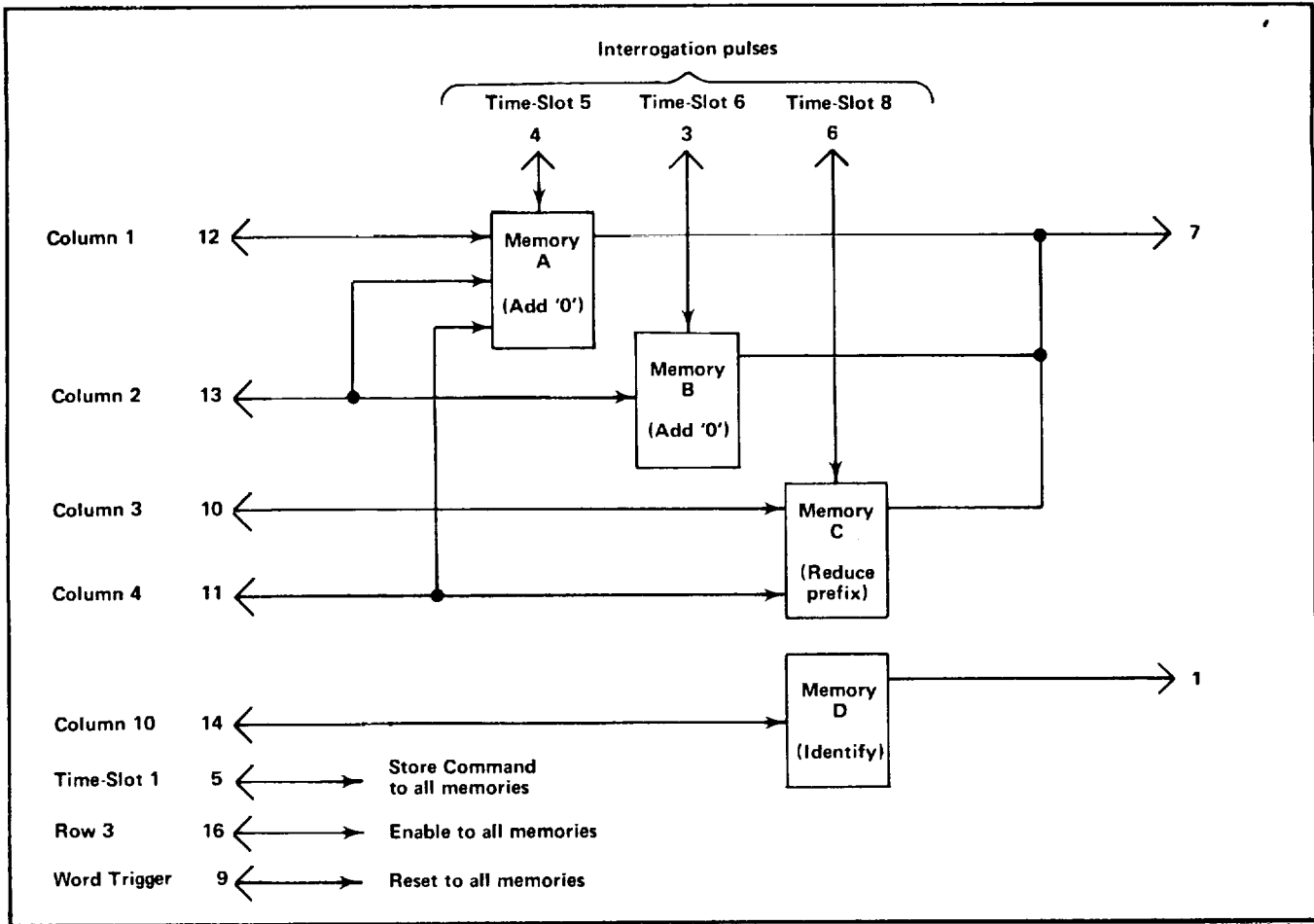


Fig. 3-47. Block representation of memory sequence in U1190.

Character Selection Matrix of Fig. 3-38 that a reduction of one column when row 4 is programmed results in a one unit reduction of the prefix. For example, with the 100 μ V program shown in Fig. 3-45, if the data received from the plug-in called for a reduction 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 R1141 that was provided by Q1163 (see Display-Skip Generator) allows the prefix to be reduced 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 which switches the Column Data 3-68

Switch and Row Data Switch to the ninth channel. Then, time-slot pulses 2 through 9 encode an output current through resistors R1131-R1138 for column data and R1171-R1178 for row data. This provides the currents necessary to display the word IDENTIFY on the CRT in the word position allotted to the channel which 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 U1190 through C1190. 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.

Character Generators

The Character Generator stage (Diagram 15) consists of five similar integrated circuits U1251-U1255 which generate the X (horizontal) and Y (vertical) outputs at pins 16

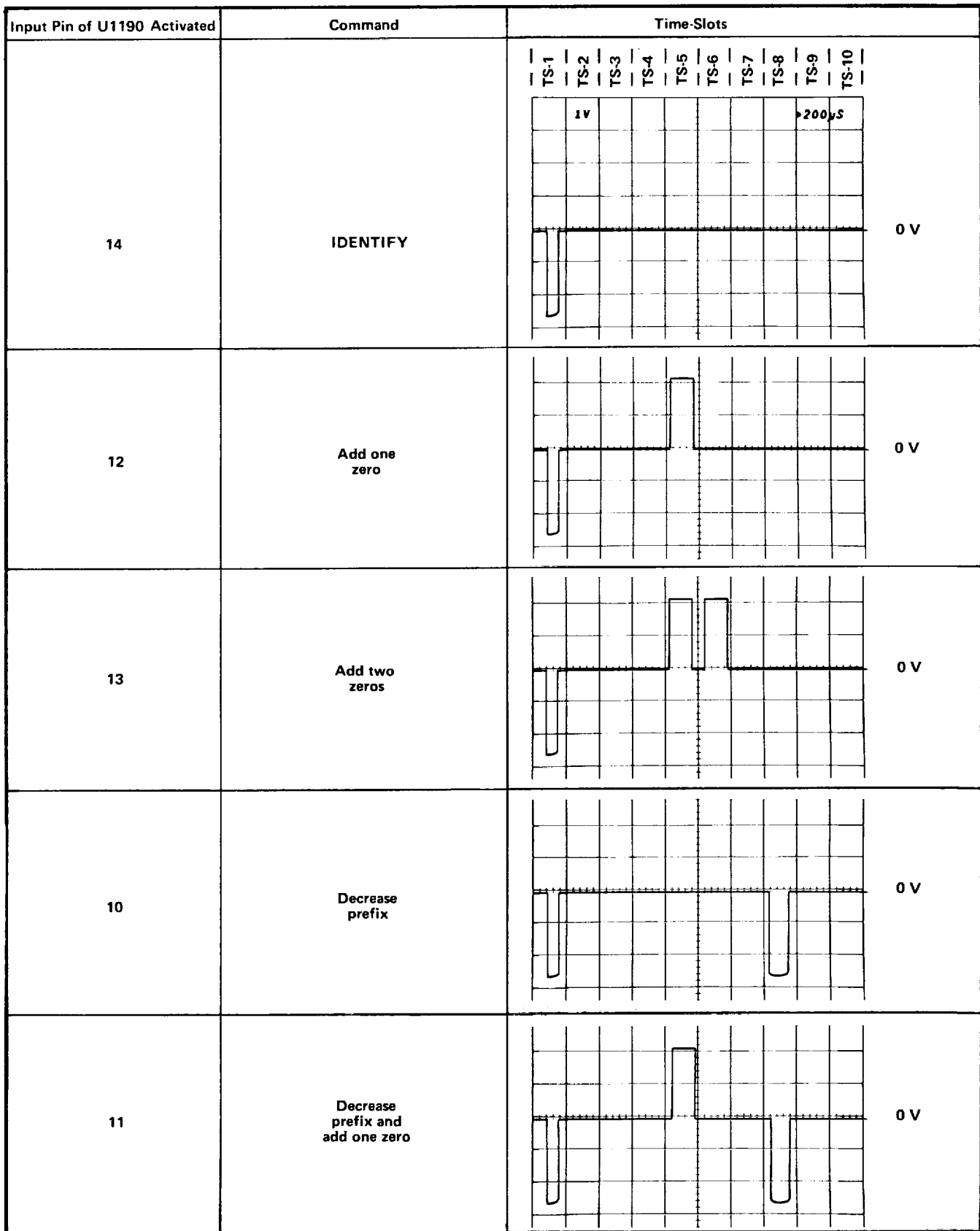


Fig. 3-48. Typical output waveforms for Zeros Logic and Memory stage operation (at pin 7 of U1190).

and 1 respectively to produce the character displayed on the CRT. Each integrated circuit can produce 10 individual characters. U1251 which is designated as the "Numerals" Character Generator can produce the numerals 0 through 9 shown in row 1 of the Character Selection Matrix (Fig. 3-38). U1252 can produce the symbols shown in row 2 of the Character Selection Matrix and U1253 produces the prefixes and some letters of the alphabet which are used as prefixes in row 4. U1254 and U1255 produce the remaining letters of the alphabet shown in rows 5 and 6 of the Character Selection Matrix. All of the Character-Generator stages receive the column digital data from Column Decoder U1166 in parallel. However, only one of the character generators receives row data at a particular time and only the stage which receives both row and column data is activated. For example, if column 2 is encoded by a plug-in unit, the five Character Generators are enabled so that either a 1, <, /, V, or an N can be produced. However, if at the same time row 4 has also been encoded by the plug-in unit, only the Prefix Character Generator U1253 will produce an output to result in a / displayed on the screen. This integrated circuit provides current outputs to the Format Generator which produce the selected character on the CRT. In a similar manner, any of the 50 characters shown in the Character Selection Matrix can be displayed by correct addressing of the row and column.

Decimal Point Logic and Character Position Counter

Decimal Point Logic and Character Position Counter U1260 performs two functions. The first function is to produce a staircase current which is added 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 by the plug-in unit so that a space is left between the displayed characters on the CRT. Row 10 information from the Row Decoder is connected to pin 4 of U1260 through R1265. When row 10 and column 0 are encoded, the output of this stage advances one step to move the next 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 U1260 through VR1260, VR1261, and VR1262 respectively and R1260, R1265. 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 timeslots. With this feature, the information which is displayed during time-slot 4 (1-2-5 data) always starts in the fourth character position whether data has been displayed in the previous time-slots or not. Therefore, the resultant CRT **3-70**

display does not shift position as normal/invert or cal/uncal information is encoded by the plug-in. The Word Trigger pulse connected to pin 8 of U1260 through C1267 resets the Character Position Counter to the first character position at the end of each word.

The Decimal Point Logic portion of this stage allows decimal points to be added to the CRT display as encoded by the plug-in units. When row 7 is encoded in coincidence with columns 3 through 7 (usually encoded during time-slot 1), a decimal point is placed at one of the five locations on the CRT identified in row 7 of the Character Selection Matrix (Fig. 3-38). This instruction refers to the decimal point location in relation to the total number of characters that can be displayed on the CRT (see Fig. 3-49). For example, if column 3 and row 7 are encoded during timeslot 1, the system is instructed to place a decimal point in location No. 3. As shown in Fig. 3-49, this displays a decimal point before the third character that can be displayed on the CRT (first three time-slots produce a space whether data is encoded or not; see previous paragraph). The simultaneous application of row 7 data to the Y-input of the Format Generator through R1269 raises the decimal point so it appears between the displayed characters.

When decimal-point data is encoded, the CRT is unblanked so a readout display is presented. However, since row 7 does not activate any of the five Character Generators, the CRT beam is not deflected but instead remains in a fixed position to display a decimal point between the characters along the bottom line of the readout word. After

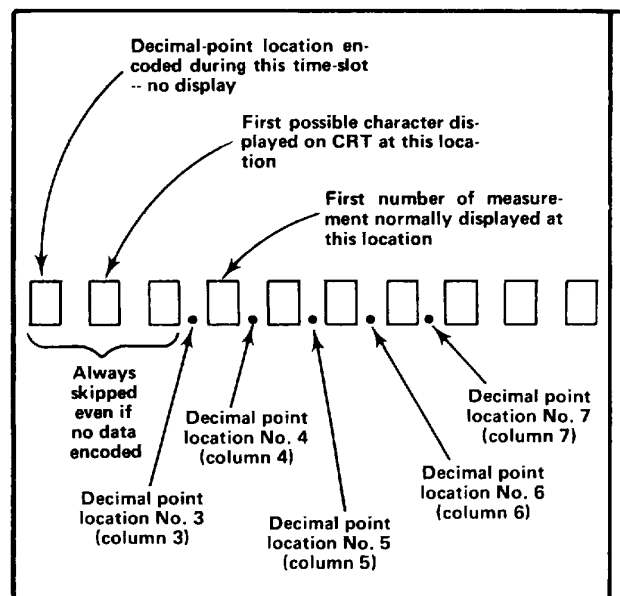


Fig. 3-49. Readout word relating 10 possible character locations to the decimal point instructions that can be encoded, and the resultant CRT display.

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 U1270. The Channel Address No. 2 code from the Channel Counter is also connected to pins 1, 8, and 15 of this stage. The Channel Address No. 2 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 which is associated with the plug-in channel that originated the information (see Fig. 3-37). The Channel Address No. 2 code and the resultant word positions are shown in Table 3-4. In addition, the character position current from the Decimal Point Logic and Character Position stage is added to the X (horizontal) input signal to space the characters horizontally on the CRT (see previous discussion). The Ready signal at pin 13 (coincident with Vertical/Horizontal Channel Switch OFF Command) activates this stage when a character is to be displayed on the CRT.

Y-Output Amplifier

The Y-output signal at pin 6 of U1270 is connected to the Y-Output Amplifier Q1284-Q1288. This stage provides a low impedance load for the Format Generator while providing isolation between the Readout System and the Vertical Amplifier. Vertical Separation adjustment R1285 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.

TABLE 3-4
Channel Address No. 2 Code

Pin 7 U1232	Pin 7 U1231	Pin 5 U1230	Channel Displayed
LO	LO	HI	Channel 1 Left Vertical
LO	LO	LO	Channel 2 Left Vertical
LO	HI	HI	Channel 1 Right Vertical
LO	HI	LO	Channel2 Right Vertical
HI	LO	HI	Channel 1 A Horizontal
HI	LO	LO	Channel 2 A Horizontal
HI	HI	HI	Channel 1 B Horizontal
HI	HI	LO	Channel2 B Horizontal

X-Output Amplifier

The X-Output Amplifier Q1274-Q1278 operates similarly to the Y-Output Amplifier to provide the horizontal deflection from the readout signal available at pin 4 of U1270. The gain of this stage is fixed by the values of the resistors in the circuit.

Display Sequence

Fig. 3-50 shows a flow chart for the Readout System. This chart illustrates the sequence of events which occurs in the Readout System each time a character is generated and displayed on the CRT.

NOTES

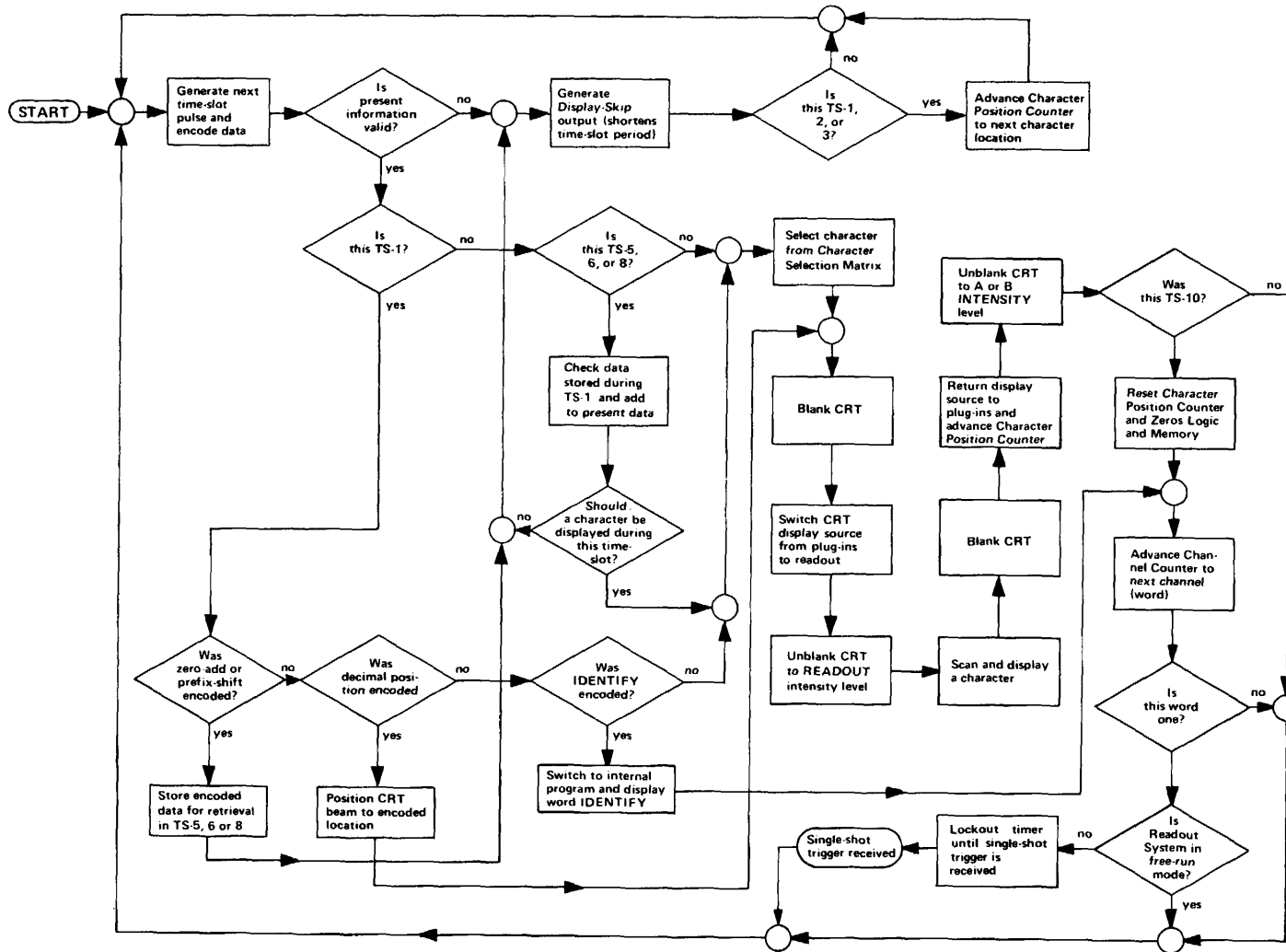


Fig. 3-50. Flow chart for character generation by the Readout System.

SECTION 4 MAINTENANCE

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance, or troubleshooting of the R7704.

Cover 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 top and bottom covers of the R7704 can be removed to gain access to the interior of the instrument. Remove the 12 screws in each cover to remove the covers. The top and bottom covers protect this instrument from dust in the interior, and also provide protection to personnel from the operating potentials present. In addition, they reduce the EMI radiation from the instrument or EMI interference to the display due to other equipment.

Power Unit Removal

The power unit can be slid out of the rear of the R7704 to gain better access to the Logic, Vertical Switching, X-Y Delay Compensation or Horizontal Interconnect, and the Low-Voltage Regulator circuit boards, high-voltage oscillator transistors, and for power-unit maintenance. To remove the power unit, first remove the top cover. Then, remove the four screws (see Fig. 4-1) which hold the power unit to the rear of the instrument. Slide the power unit out of the rear of the instrument until it can be set down on the work surface (guide the power cable so it does not catch on other parts of the instrument). The power unit remains connected to the instrument so it can be operated in this position for maintenance purposes. Reverse this procedure when replacing the power unit; be careful not to pinch the power cable as the power unit is replaced. Be sure that all the securing screws are tight to hold the power unit in place properly.

(A)

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 discussion entitled Troubleshooting the Power Supply for troubleshooting information, and Access to Components in Power Unit for information on how to remove the protective cover/shield on the power unit

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis may prevent instrument break down and will improve the reliability of this instrument. The severity of the environment to which the R7704

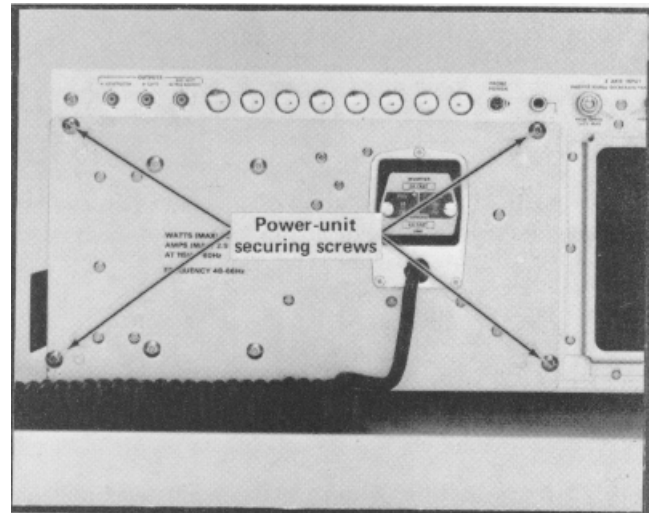


Fig. 4-1. Securing screws for power unit (rear of instrument).

subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding re-calibration of the instrument.

Cleaning

General. The R7704 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 top and bottom covers provide protection against dust in the interior of the instrument. Operation without the covers in place necessitates more frequent cleaning.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. In particular, avoid chemicals which contain benzene, toluene, xylene, acetone, or similar solvents.

Air Filter. The air filter should be visually checked every few weeks and cleaned or replaced if dirty. More frequent inspections are required under severe operating conditions. If the filter is to be replaced, order new air filters from your local Tektronix Field Office or representative; order by Tektronix Part No. 378-0040-01. The following procedure is suggested for cleaning the filter.

1. Remove the filter by pulling it out of the retaining frame on the rear panel. Be careful not to drop any of the accumulated dirt into the instrument.
2. Flush the loose dirt from the filter with a stream of hot water.
3. Place the filter in a solution of mild detergent and hot water and let it soak for several minutes.
4. Squeeze the filter to wash out any dirt which remains.
5. Rinse the filter in clean water and allow it to dry.
6. Coat the dry filter with an air-filter adhesive (available from air conditioner suppliers or order Tektronix Part No. 006-0580-00).
7. Let the adhesive dry thoroughly.

8. Re-install the filter in the retaining frame.

Exterior. Loose dust accumulated on the outside of the R7704 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, faceplate protector, and the CRT face with a soft, lint-free cloth dampened with denatured alcohol.

The CRT mesh filter (furnished with Option 3 only) can be cleaned in the following manner:

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

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.

Lubrication

General. The reliability of potentiometers, switches and other moving parts can be maintained if they are kept properly lubricated. However, over lubrication is as detrimental as too little lubrication. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc. Order Tektronix Part No. 003-0342-01.

Fan. The fan-motor bearings are sealed and do not require lubrication.

Visual Inspection

The R7704 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 in the R7704 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.

Re-calibration

To assure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or every six months if used infrequently. In addition, replacement of components may necessitate re-calibration of the affected circuits. The calibration procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed and/or corrected by re-calibration.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the R7704. Information contained in

other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles, particularly where integrated circuits are used. See the Circuit Description section for complete information.

Troubleshooting Aids

Diagrams. Complete circuit diagrams are given on fold-out pages in the Diagrams section. The component number and electrical value of each component in this instrument are shown on the diagrams (see first page of the Diagrams section for definition of the reference designators used to identify components in this instrument). Each main circuit is assigned a series of component numbers. Table 4-1 lists the main circuits in the R7704 and the series of component numbers assigned to each. Important voltages and waveforms are also shown on the diagrams. The portions of the circuit mounted on circuit boards are enclosed with blue lines.

TABLE 4-1.
Component Numbers

Component Numbers On Diagrams	Diagram Number	Circuit
1-49	1	Main Interface
100-199	2	Logic Circuit
300-349	3	Trigger Selector
200-299	4	Vertical Interface
400-499	5	Vertical Amplifier
50-99	6	Horizontal Interface
350-399		
500-599	7	Horizontal Amplifier
600-699	8	Output Signals and Calibrator
700-799	9	CRT Circuit
800-899	10	Line to DC Converter/ Regulator
900-999	11	Low-Voltage Regulator
1000-1099	12	Controls and Cabling
1200-1249	13	Sequencing Logic
1100-1199	14	Data Collection
1250-1299	15	Character Generators and Output

Circuit Boards. Fig. 4-7 shows the location of the circuit boards within this instrument along with the assembly numbers. The assembly numbers are also used on the diagrams and in the parts list to aid in locating the boards. Pictures of the circuit boards are shown in Figs. 8-1 through 8-27. These pictures are located in the Diagrams section, on the back of the page opposite the circuit diagram, to aid the cross-referencing between the diagrams and the circuit-

board pictures. Each electrical component on the boards is identified by its circuit number. The color and location of the interconnecting wires and/or connectors are also shown. The circuit boards are also outlined on the diagrams with a blue line to show which portions of the circuit are located on a circuit board.

Wiring Color-Code. All insulated wire and cable used in the R7704 is color-coded to facilitate circuit tracing. Table 4-2 gives the wiring color-code used in this instrument.

WARNING

This color code applies to leads within the R7704 only. Color code of the AC power cord is:

- Black Line
- White Neutral
- Green Safety earth (ground)

**TABLE 4-2
Wiring Color Code**

Supply or Function	Background Color	Stripe ¹
-50 volt	Violet	Brown
-15 volt	Violet	Black
+5 volt	Red	Black
+15 volt	Red	Brown
+50 volt	Red	Orange
+75 volt	Red	Yellow
+150 volt	Red	Green
Chassis ground	Black ²	Footnote 3
Safety ground	Green	Yellow
AC (internal)	Gray ²	Footnote 4
Bulb filaments	Brown	Footnote 4
Signal leads	White ²	Footnote 4

¹If more than one stripe appears on lead, extra stripes are for lead identification only (for circuit tracing).

²See WARNING note concerning power-cord color code.

³White stripe indicates floating (signal) ground.

⁴All stripes for lead identification only (for circuit tracing).

Resistor Color-Code. In addition to the brown composition resistors, some metal-film resistors and some wire-wound resistors are used in the R7704. The resistance values of wire-wound resistors are printed on the body of the component. The resistance values of composition resistors and metal-film resistors are color-coded on the components with 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. 4-2). Metal-film resistors have five stripes consisting of three significant figures, a multiplier, and a tolerance value.

Capacitor Marking. The capacitance values of common disc capacitors and small electrolytic are marked in microfarads on the side of the component body. The white ceramic capacitors used in the R7704 are color-coded in picofarads using a modified EIA code (see Fig. 4-2).

Diode Color-Code. The cathode end of each glassencased diode is indicated by a stripe, a series of stripes, or a dot. For most silicon or germanium diodes with a series of stripes, the color-code identifies the three significant digits of the Tektronix Part Number using the resistor color-code system (e.g., a diode color-coded pink-, or blue-, brown gray-green indicates Tektronix Part Number 152-0185-00).

The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

Semiconductor Lead Configuration. Fig. 4-3 shows the lead configuration for the semiconductors used in this instrument. This view is as seen from the bottom of the semiconductors.

Troubleshooting Equipment

The following equipment is useful for troubleshooting the R7704.

1. Transistor Tester

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

Purpose: To test the semiconductors used in this instrument.

Recommended type: Tektronix Type 576 Transistor Curve Tracer.

2. Multimeter

Description: VTVM, 10 megohm input impedance and 0 to 500 volts range, AC and DC; ohmmeter, 0 to 50 megohms. Accuracy, within 3%. Test probes must be insulated to prevent accidental shorting.

Purpose: To check voltages and for general troubleshooting in this instrument.

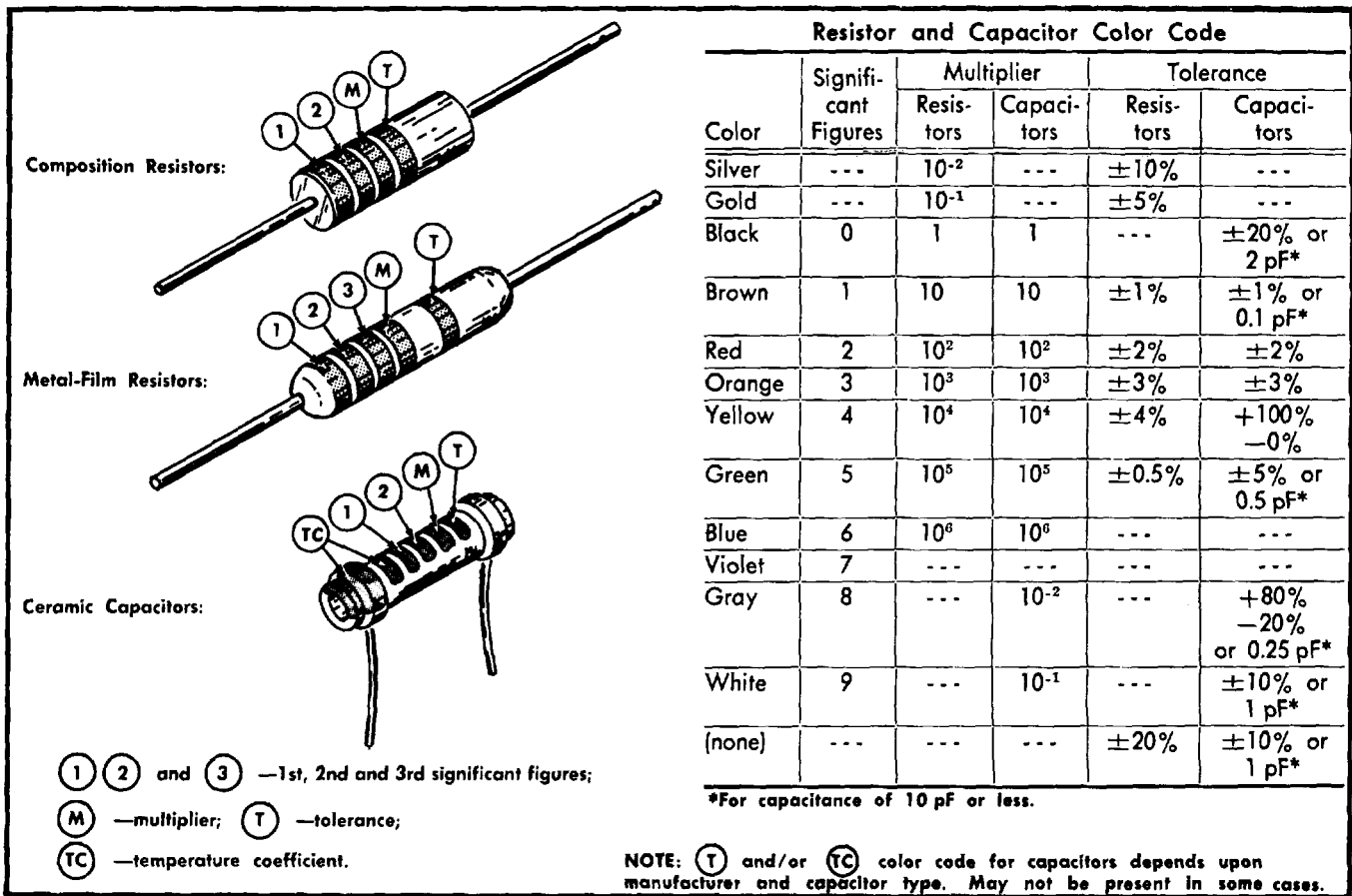


Fig. 4-2. Color-code for resistors and ceramic capacitors.

NOTE

A 20,000 ohms/volt VOM can be used to check the voltages in this instrument if allowances are made for the circuit loading of the VOM at high-impedance points.

3. Test Oscilloscope

Description: Frequency response, DC to 50 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.

Purpose: To check operating waveforms in this instrument.

Recommended type: Tektronix 7503 or 7504 Oscilloscope with 7A16 Amplifier, 7A14 Current Probe Amplifier, and 7B50 Time Base plug-in units. Use a P6053 10X probe " and a P6021 Current Probe.

®

(A)

4. 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 the R7704 from the line potential when troubleshooting in the power supply.

Recommended type: Stancor #P6298 (for 115-volt line only) modified to include three-wire power cord, plug, and receptacle.

5. Variable Autotransformer

Description: Output variable from 0 to 140 volts, 10 amperes minimum rating. Must have three-wire power cord, plug, and receptacle.

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

Recommended type: General Radio W10OMT3W Metered Variac Autotransformer.

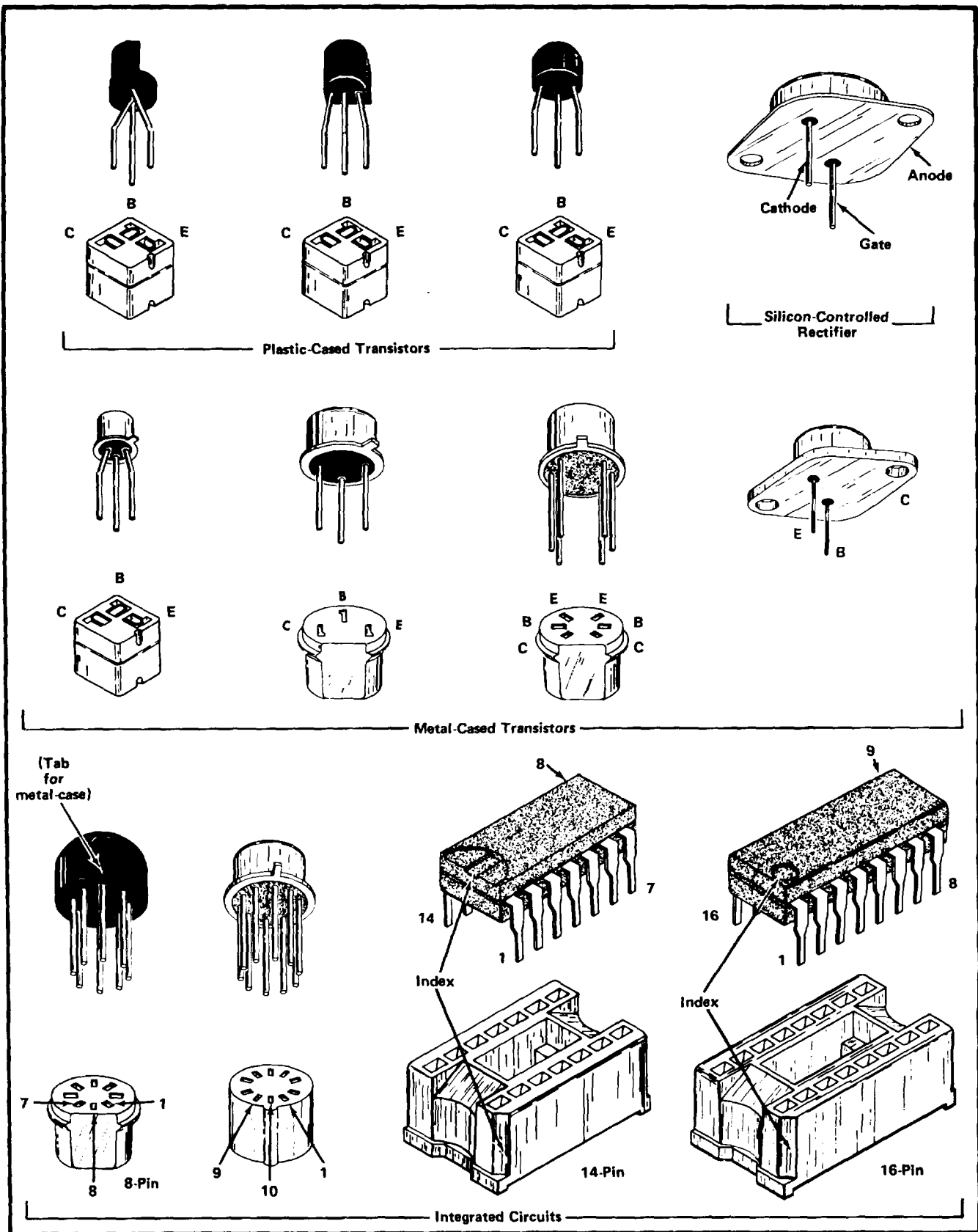


Fig. 4-3. Electrode configuration for semiconductors in this instrument.

Troubleshooting Techniques

IMPORTANT

Special techniques are required to safely troubleshoot certain areas of this instrument. Read Troubleshooting Techniques and Special Troubleshooting Information completely before beginning actual troubleshooting.

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks assure proper connection, operation, and calibration. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced 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, see the Operating Instructions section.

2. Check Associated Equipment. Before proceeding with troubleshooting of the R7704, check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the interconnecting cables are not defective. Also, check the power source. The associated plug-in units can be checked for proper operation by substituting other units which are known to be operating properly (preferably of the same types). If the trouble persists after substitution, the R7704 is probably at fault.

3. Visual Check. Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visual indications such as unsoldered connections, broken wires, damaged circuit boards, damaged components, etc.

4. Check Instrument Calibration. Check the calibration of this instrument, or the affected circuit if the trouble appears in one circuit. The apparent trouble may only be a result of misadjustment or may be corrected by calibration. Complete calibration instructions are given in the Calibration section.

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. For example, poor focus indicates that the CRT circuit (includes high voltage supplies) is probably at fault. When

trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings. Also check for the correct output signals at the front-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 out portion of the Output Signals circuit are operating correctly.

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 4-3 lists the tolerances of the power supplies in this instrument. These voltages are measured between the power-supply and ground test points (on Low-Voltage Regulator board). See Fig. 4-4 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 Calibration section to adjust the power supplies.

TABLE 4-3.
Power Supply Tolerance and Ripple
(Reference to TP GND)

Power Supply	Test Point (See Fig. 4-4)	Tolerance	Maximum ripple (peak-to -peak)
-50 volts	TP-50	±0.10 volt	5 millivolts
-15 volts	TP-15	±0.75 volt	2 millivolts
+5 volts	TP+5	±0.15 volt	2 millivolts
+15 volt	TP+15	±0.30 volt	2 millivolts
+50 volt	TP+50	±0.60 volt	5 millivolts
+75 volt	TP+75	±0.40 volt	200 millivolts
+150 volt	TP+150	±6.0 volts	300 millivolts

NOTE

See the specific information in this section on Troubleshooting the Power Supply for further information.

Fig. 4-5 provides a guide for locating a defective circuit. Start from the top of the chart and perform the given checks on the left side of the page until a step is found which does not produce the indicated results. Further checks and/or the circuit in which the trouble is probably located are listed to the right of this step. This chart does not include checks for all possible defects; use steps 6 and 7 or the Special Troubleshooting Information in such cases.

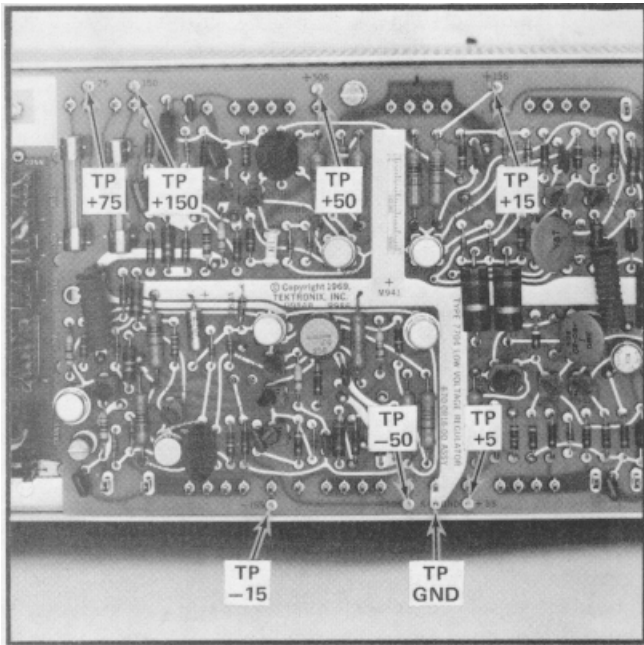


Fig. 4-4. Location of power-supply test points on Low-Voltage Regulator board.

After the defective circuit has been located, proceed with steps 6 and 7 to locate the defective component(s).

6. Check Voltages and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given on the diagrams.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the first diagram page.

7. Check Individual Components. The following procedures describe methods of checking individual components in the R7704. Components which are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

A. SEMICONDUCTORS.

CAUTION

Power switch must be turned off before removing or replacing semiconductors.

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 checked previously). However, be r 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 can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description 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 the Circuit Description section. 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 14 and 16-pin integrated circuits is with an integrated-circuit test clip. This device also doubles as an integrated-circuit extraction tool.

B. DIODES.

A diode can be checked for an open or for a short circuit by measuring the resistance between terminals with an ohmmeter set to the R X 1k scale. The diode resistance should be very high in one direction and very low when the meter leads are reversed. Do not check tunnel diodes or back diodes with an ohmmeter.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode.

C. RESISTORS.

Check the resistors with an ohmmeter. See the Electrical Parts List for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

D. INDUCTORS.

Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (roll-off).

E. 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 re REV. B, FEB. 1976

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 Readjust the Circuit. If any defective parts are located, follow the replacement procedures given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

Special Troubleshooting Information

General. The following information provides a step-by-step procedure to aid in the troubleshooting of some of the more complex circuits and/or systems in the R7704. A thorough understanding of the circuit operation is essential before troubleshooting in these areas. Read the applicable portions of the Circuit Description in Section 3 before proceeding with troubleshooting. This troubleshooting procedure refers to the diagrams, operating voltages, and waveforms given in Section 7. Specifications for the troubleshooting equipment referred to in these procedures are given earlier in this section under Troubleshooting Equipment.

Troubleshooting the Power Supply. The following procedure gives a guide to troubleshooting the Power Supply of the R7704.

WARNING

Line AC and stored DC potentials are present inside the power unit. The stored DC remains long after the instrument is disconnected from the power source. Read the following instructions completely before attempting maintenance with the power-unit cover removed.

1. Isolating the Trouble
 - 1.1 Check the Line Selector assembly on the rear panel of the instrument to verify that the switch is in the correct position for the applied line voltage.
 - 1.2 Verify that the applied line voltage and frequency are within the specified limits.
 - 1.3 Set the POWER switch to the off position and remove the cover from the Line Selector assembly on the rear panel.
 - 1.4 Inspect the fuses in the Line Selector assembly cover. If either fuse is open, install a new fuse of the correct value (see Table 4-4). Replace the Line Selector cover.

(A)

1.4.1 If the LINE fuse is open, do steps 3.1 - 3.9 inclusive; then go directly to step 4. 1.

1.4.2 If the INVERTER fuse is open, do steps 3.1 - 3.9 inclusive; then go directly to step 5.1.

1.5 If neither fuse is open, remove all plug-in units from the instrument and set the following front-panel controls:

CONTROL ILLUM LOW
GRAT ILLUM Fully clockwise

1.6 Set POWER switch to ON.

1.6.1 If instrument comes on and stays on (front-panel lights stay on), proceed to step 2.1.

1.6.2 If instrument does not come on or does not stay on, do steps 3.3 - 3.9 inclusive; then go directly to step 5.1.

2. Low-Voltage Regulator Check

2.1 Set the POWER switch to the off position and remove the power unit from the instrument.

2.2 Inspect the Low-Voltage Regulator board for any visible signs of failure. Check the fuses on this board and the +5-Volt Lamps fuse F1040 to be sure they are good.

2.3 Set the POWER switch to ON. Then, measure the output of each supply between the designated test point (see Fig. 4-4) and the ground test point with the voltmeter. Tolerance for each supply is given in Table 4-3.

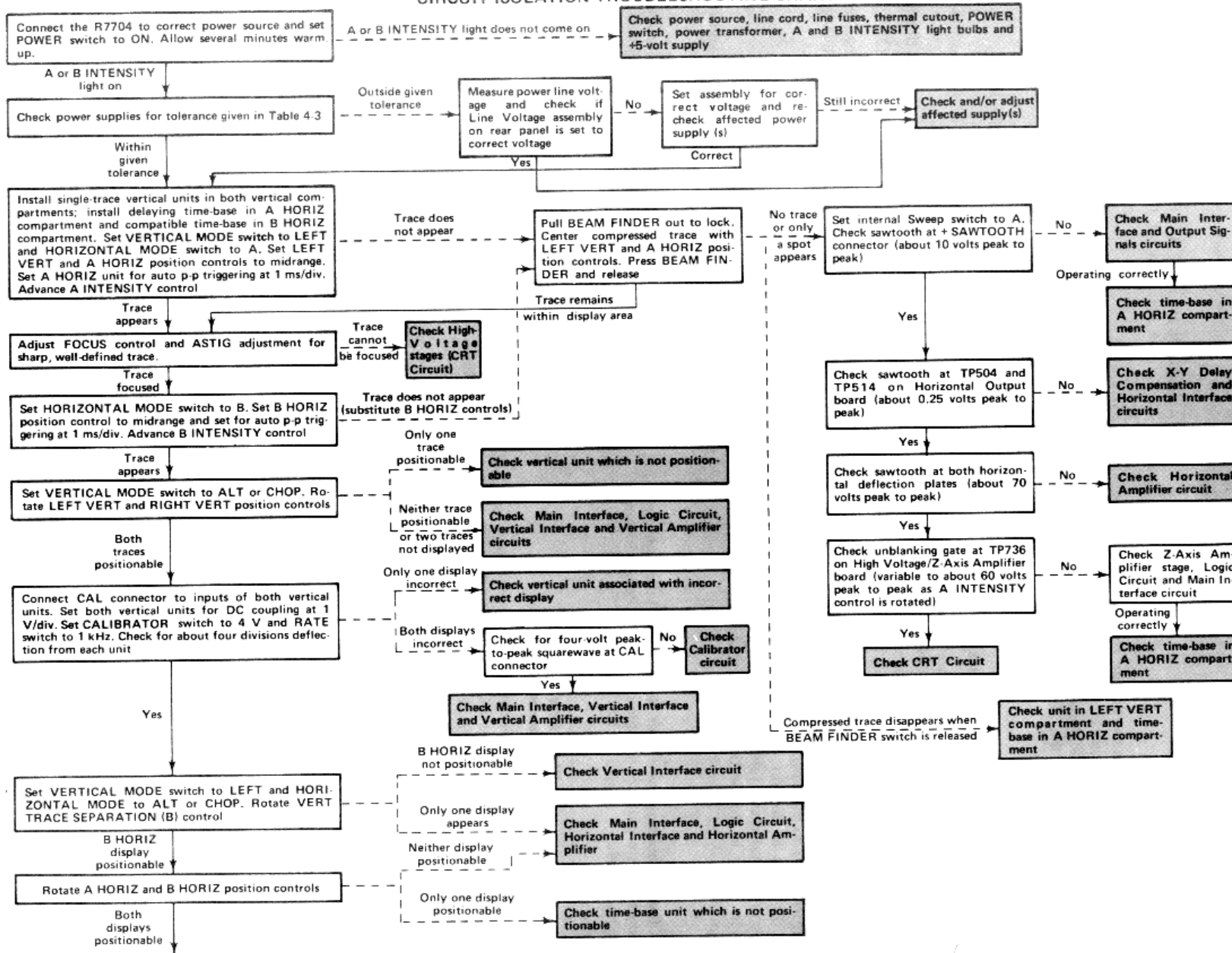
NOTE

The +75- and + 150-volt outputs are derived directly from the Line to DC Converter/Regulator circuit and are not regulated on the Low-Voltage Regulator board. If either of these supplies is out of tolerance, the trouble is probably in the Inverter stage. Do steps 3. 1 - 3.9 inclusive, then go directly to step 5. 1.

2.4 If all supplies are proportionately low, do steps 3.1 - 3.9 inclusive; then go directly to step 4. 1.

2.5 If one supply is noticeably lower than the rest, check for an overload condition on this supply. An overload may cause a supply to operate in a current limiting mode which will reduce its output voltage. If no overload is apparent, check the semi-regulated voltage applied to the applicable regulator stage from the Line to DC Converter/Regulator circuit.

CIRCUIT ISOLATION TROUBLESHOOTING CHART



(A)

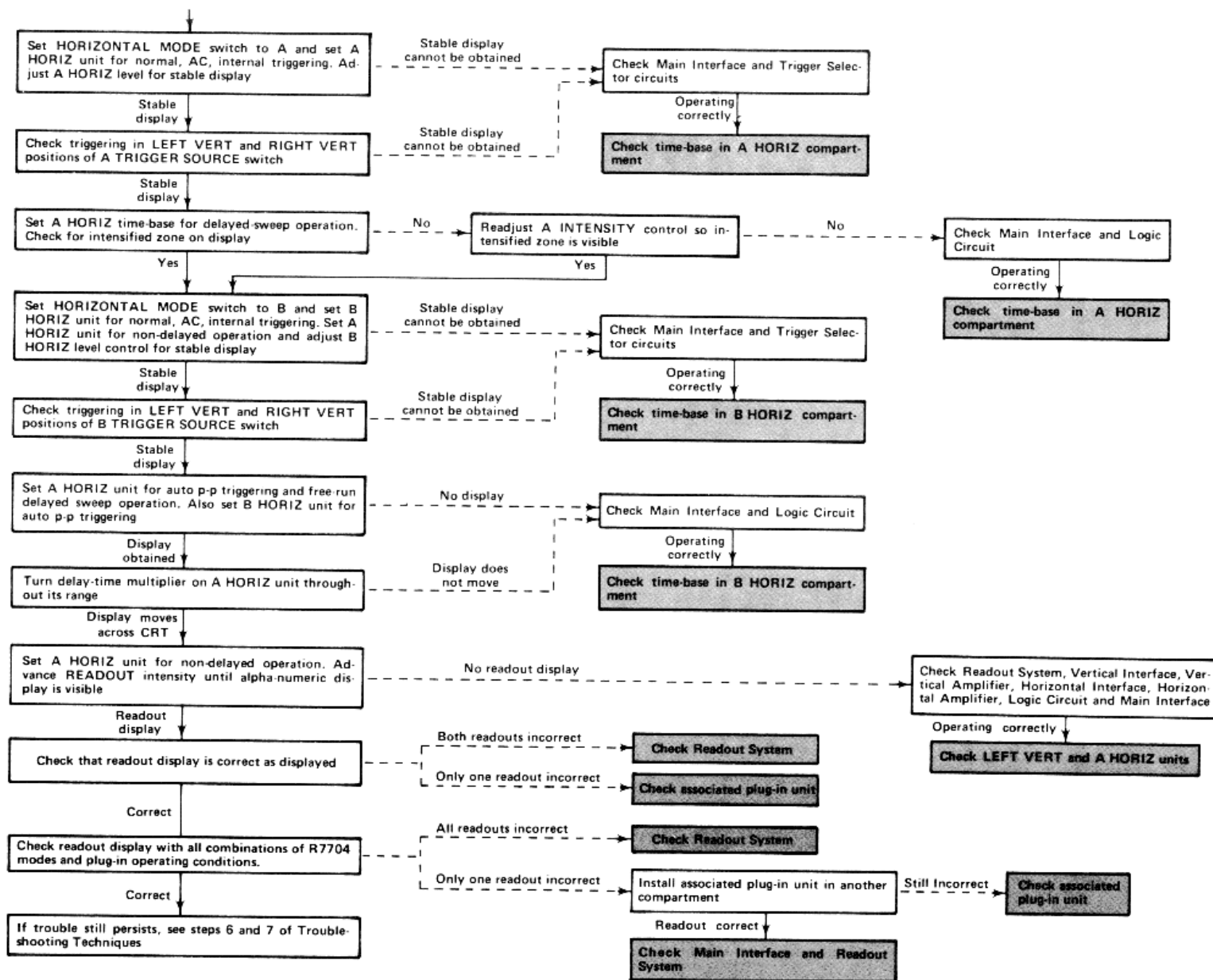


Fig. 4-5. Troubleshooting chart for R7704.

(A)

This can best be done by lowering the swing-down chassis and measuring the input voltage between the interconnecting pin which connects the power unit to the Low-Voltage Regulator board (see diagram for correct pin) and the power-supply test point. For example, the semi-regulated voltage for the +5-Volt Supply is measured between pin SW and TP+5S. Typical values for the semi-regulated voltage are given on the diagrams.

- 2.5.1. If the semi-regulated voltage measures low, do steps 3.1 - 3.9 inclusive; then go directly to step 5.5.
- 2.5.2. If the semi-regulated voltage is correct but the output of the supply remains high or low, make the following checks:
 - 2.5.2.1. Measure the voltage between the semi-regulated input voltage interconnecting pin and TP GND (e.g., note voltage at pin SW). Compare the results to the voltages given on the diagrams.
 - 2.5.2.2. If above check does not locate the fault, check the applicable regulator circuit using the voltages given on the diagrams.

3. Test Set-Up for Troubleshooting the Line to DC Converter/Regulator Circuit

- 3.1. Remove all plug-in units from the instrument.
- 3.2. Set the following front-panel controls:

CONTROL ILLUM	LOW
GRAT ILLUM	Fully counterclockwise
POWER	Off
- 3.3. Connect the isolation transformer to a grounded power outlet. If the isolation transformer has a power switch, set it to the off position. Isolation transformer must have a three-wire power cord, plug, and receptacle.
- 3.4. Connect the auto-transformer to the power receptacle of the isolation transformer. Set the power switch of the auto-transformer to off and set the output-voltage control so it will provide an output of about 115 volts.
- 3.5. Connect the R7704 line cord to the auto-transformer power receptacle. Be sure that the R7704 POWER switch is off.
- 3.6. Remove the four securing screws and slide the power unit out of the instrument.

- 3.7. Verify that a ground connection exists from the chassis of the power unit to the third-wire ground at the input to the isolation transformer.

WARNING

The primary storage capacitors, C813 and C814, remain charged with high voltage DC for several minutes after the line power is disconnected. When this stored voltage exceeds about 80 volts, a neon bulb located on the Line Input board flashes.

- 3.8. Locate the neon warning bulb on the Line Input board (right side of power unit when facing rear panel). Wait at least two minutes after the bulb has stopped flashing before proceeding.
- 3.9. Remove the four screws which hold the cover on the power unit and remove the cover.

CAUTION

Do not short circuit the primary storage capacitors C813 and C814 as they will be damaged by this action. If manual discharge is necessary at any time, use a 1.5 k Ω , two-watt insulated resistor. USE EXTREME CAUTION. Allow at least one minute for the current-limiting thermistors to cool before turning on the POWER switch if the capacitors have been manually discharged. Do not leave the external bleeder resistor connected across the capacitors when the POWER switch is ON.

4. Check Line Input Stage and Primary Storage Capacitors
 - 4.1. Be sure that steps 3.1 - 3.9 have been performed.
 - 4.2. Locate the Line Input board and inspect the components for any visible signs of failure.
 - 4.3. Remove the cover from the Line Selector assembly on the rear panel and remove the INVERTER fuse. Leave the LINE fuse in place and re-install the Line Selector cover. (Notice on the diagrams that this allows the Line Input stage to operate without supplying power to the Inverter stage.)
 - 4.4. Remove the plastic cover shielding the primary storage capacitors C813 and C814.
 - 4.5. Set the power switch of the isolation transformer to on. Then, set the power switch of the auto-transformer to on. Finally, set the R7704 POWER switch to ON.

- 4.6. Set the voltmeter to a scale that will measure at least 400 volts DC. Connect the voltmeter between the positive side of C813 and the negative side of C814 (notice that these capacitors are connected in series by the strap between the negative side of C813 and the positive side of C814). This voltage should be between 220 and 370 volts DC; the exact voltage depends upon the line input voltage.
- 4.7. Set the R7704 POWER switch to the off position and unplug the power cord from the auto-transformer. Observe the neon warning bulb on the Line Input board. Wait at least two minutes after the bulb has stopped flashing before proceeding.

CAUTION

With the voltmeter still connected across C813 and C814, check that these capacitors have fully discharged (voltmeter reading zero volts) before making ohmmeter measurements in the Line Input stage.

- 4.8. If the voltage measured in step 4.6 was lower than 220 volts, check the Line Input stage for defective components.
- 4.9. When the defective component is located, replace it using the replacement procedures given in this section. Then, repeat steps 4.1 - 4.8.
- 4.10. If the voltage measurement in step 4.6 is within the given limits, disconnect the voltmeter and replace the plastic cover over C813 and C814. Then, remove the cover from the Line Selector assembly and replace the INVERTER fuse. Re-install the Line Selector cover. This completes the checks in the Line Input stage.
5. Check Remaining Circuits in the Line to DC Converter/Regulator Circuit
- 5.1. Be sure that steps 3.1 - 3.9 have been performed.

NOTE

If a defective component is located in the following checks, replace it and then proceed to steps 5. 13 -5. 14 before re-assembling the power unit. The checks given in these steps will insure that the Inverter stage is working correctly.

- 5.2. Remove the cover from the Line Selector assembly. This opens the DC path between the Line Input stage and the Inverter stage to allow ohmmeter measurements to be made within the Inverter stage.

- 5.3. Use the following procedure to check the power-handling components in the Inverter stage.

- 5.3.1. Connect the positive lead of the ohmmeter to TP826 and the negative lead to TP836 (both test points on Inverter board). Set the ohm-meter to a scale of R X 10 k or higher. Typical resistance readings between these test points should be between 10 and 50 megohms. If the reading falls below about two megohms, check the following components for reverse breakdown characteristics with a curve tracer: CR825, CR826, CR828, and Q825. Minimum reverse breakdown characteristics for these components should be 400 volts.

- 5.3.2. Connect the positive lead of the ohmmeter to TP836 and the negative lead to TP820. Repeat the check as given in the previous step. Components to check if the reading falls below two megohms are: CR835, CR836, CR828, and Q835. Disconnect the ohmmeter.

- 5.4. Check the LINE and INVERTER fuses to be sure they are good. If not, replace the fuses and re-install the Line Selector assembly cover.

NOTE

The next seven steps will get the Inverter stage operating at low line voltage and low output voltage with the pre-regulator circuitry disabled. This will allow waveform checks and output voltage measurements even though an overload condition may exist.

- 5.5. Remove 0860 from its socket. This disables the pre-regulator circuit.
- 5.6. Connect the voltmeter between TP+75 and TP GND on the Rectifier board. Use the 75 volt, or higher, scale.

CAUTION

TP820 is normally elevated about 100 volts above chassis ground. However, when the isolation transformer is used as given in this procedure, TP820 can be grounded without danger or damage to the power supply.

- 5.7. Connect the 10X probe to the test oscilloscope. Then, connect the probe ground clip to TP820.
- 5.8. Connect the probe tip to TP836 on the Inverter board. Be sure that the test oscilloscope is properly

grounded by the three-wire power cord before proceeding, Set the test oscilloscope for a vertical deflection of 5 volts/division (50 volts/division at probe tip) at a sweep rate of 10 microseconds/division with AC internal triggering in the automatic trigger mode.

- 5.9. Set the output voltage of the auto-transformer to zero volts.
- 5.10. Set the power switch of the isolation transformer to on. Then set the power switch of the auto-transformer to on. Finally, set the R7704 POWER switch to ON.
- 5.11. Read this step completely before proceeding. Slowly increase the output of the auto-transformer until a waveform appears on the test oscilloscope. Then, quickly reduce the auto-transformer setting to keep the voltage, as measured by the voltmeter, below 75 volts. **Do not allow the voltage at TP+75 to exceed 75 volts.** Notice that the Inverter stage will continue to operate with an input voltage as low as one-half the level required to start it. Decreasing the input voltage as described after the Inverter stage has started reduces the possibility of opening the INVERTER fuse if an overload condition exists.

NOTE

The next three steps determine if the Inverter stage and power transformer primary circuit are malfunctioning, or if an overload condition exists in the transformer secondary.

- 5.12. Examine the waveform on the test oscilloscope and compare to the waveform shown in Fig. 4-6A and 4-6B. The waveform should be a square wave with a peak-to-peak amplitude equal to the DC voltage stored in the primary storage capacitors.
- 5.13. Install the current-probe amplifier in the test oscilloscope and connect the current probe to its input. Set the current-probe amplifier for a vertical deflection of one ampere/division at a sweep rate of 10 microseconds/division. Connect the current-probe tip around the wire (gray with red stripe) which connects interconnecting pin NE on the Line Input board to point PC on the Inverter board (connect probe around lead at upper left corner of Inverter board). This wire carries the Inverter supply current.
- 5.14. Compare the test oscilloscope waveforms to the waveforms shown in Fig. 4-6C, 4-6D, and 4-6E. Distorted waveshapes indicate Inverter trouble. High current indicates an overload on the transformer secondary.
- 5.14.1. If the waveforms obtained in steps 5.12 and 5.14 appear normal or near normal, proceed to step 5.15.
- 5.14.2. If the waveforms in step 5.12 or 5.14 are incorrect, turn off the POWER switch and check the components in the Inverter circuit with an ohmmeter (allow sufficient time for the primary storage capacitors in the Line Input stage to discharge before proceeding).

NOTE

The next two steps check the Rectifier circuits for correct operation.

- 5.15. With the Inverter stage operating as given in step 5.11 check the voltmeter reading (voltmeter connected between TP+75 and TP GND). The measured value should be low since the pre-regulator circuitry is disabled, but it should not be zero. If the voltage is zero, reduce the auto-transformer setting to zero. Set the POWER switch to off and remove the Rectifier board. Check all components associated with the +75-volt rectifier circuit. If all components appear to be good, replace the Rectifier board and set the POWER switch to ON. Repeat step 5.11. Then, check the AC voltage between terminals 5 and 7 of the power transformer with the voltmeter (set voltmeter to measure at least 150 volts RMS or 210 volts peak).

CAUTION

The Inverter stage will not function properly if the instrument is operated without the load provided by the Rectifier board.

- 5.15.1. If AC voltage is not present at the transformer terminals, the transformer may be defective.
- 5.15.2. If AC voltage is present at the transformer terminals but voltage is not present at TP+75, further checks of the +75-volt rectifier circuit are necessary to locate the defective component.
- 5.16. Repeat step 5.15 for each output voltage. Measure the output voltage at the applicable board terminals as shown on the diagram. This completes the Rectifier checks.

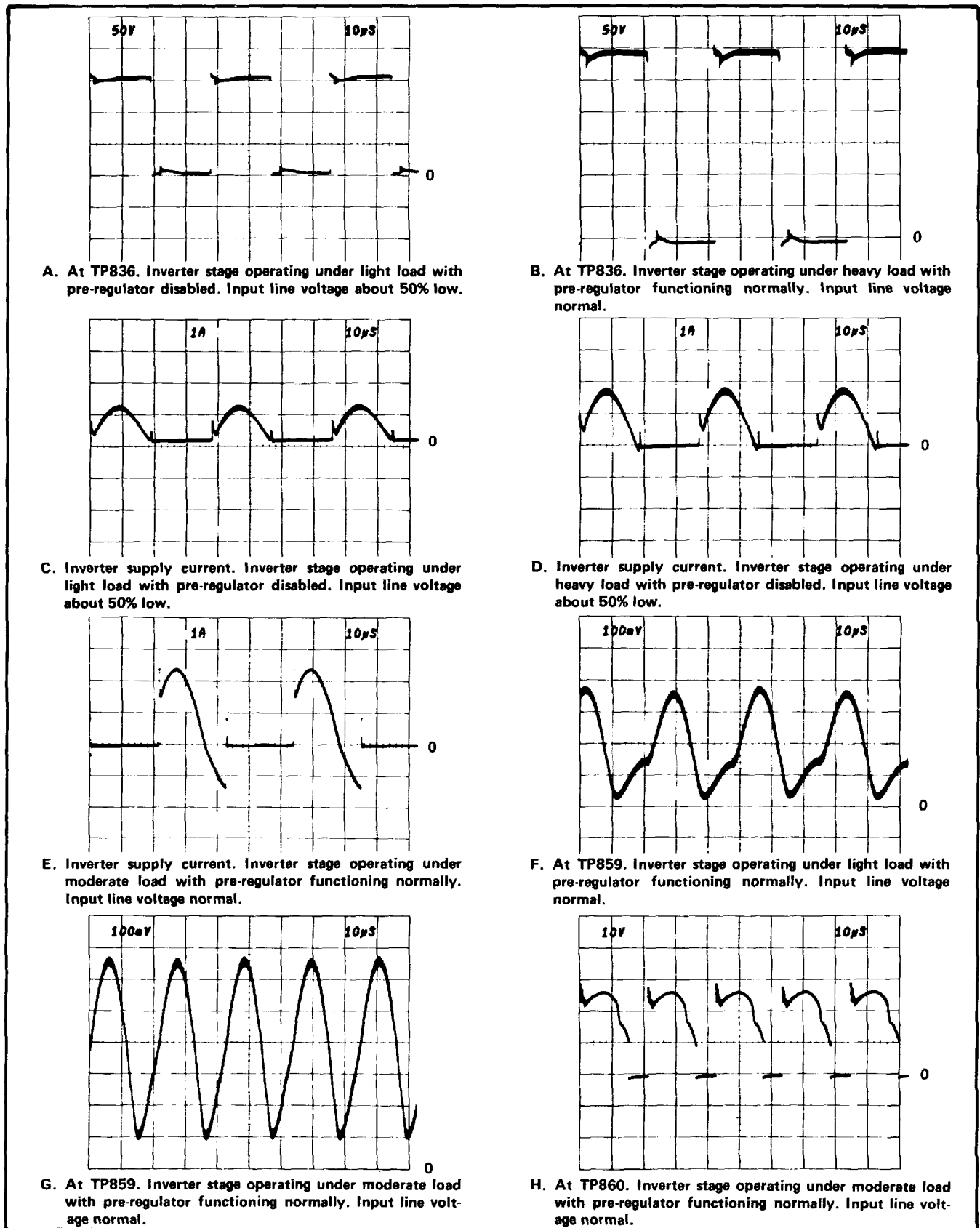


Fig. 4-6. Operating waveforms from power supply.

NOTE

The next nine steps check the pre-regulator circuitry for correct operation.

- 5.17. Set the R7704 POWER switch to the off position.
- 5.18. Re-install Q860 in its socket.
- 5.19. Connect the voltmeter between TP+75 and TP GND on the Rectifier board.
- 5.20. Reconnect the 10X probe to the test oscilloscope. Then, connect the probe tip to TP836 on the Inverter board. Be sure that the test oscilloscope is properly grounded by the three-wire power cord before proceeding. Set the test oscilloscope for a vertical deflection of 10 volts/division at a sweep rate of 10 microseconds/division with AC, internal triggering in the automatic mode.
- 5.21. Connect the probe ground clip to TP820 (see CAUTION in step 5.8).
- 5.22. Set the auto-transformer output voltage to zero. Then, set the R7704 POWER switch to ON.
- 5.23. Slowly increase the auto-transformer output voltage until the Inverter stage runs continuously as shown by the waveform on the test oscilloscope. Do not allow the voltage on the voltmeter to exceed 75 volts.
- 5.24. While observing the test oscilloscope waveform, observe the change in the waveform produced by slightly raising and lowering the output voltage of the auto-transformer. As the line voltage is increased, the Inverter frequency should decrease; i.e., the period should become longer. When the line voltage is at the nominal level (117 V) and the instrument has a two plug-in load, the voltage at TP+75 should be +75 volts +0.40 volt. Refer to the Calibration Procedure if adjustment is necessary.
- 5.25. If a malfunction in the pre-regulator circuitry is suspected, monitor the waveforms at TP859 and TP860 with respect to TP GND. Compare with the waveforms shown in Fig. 4-6F, 4-6G, and 4-6H. Use the ohmmeter to locate defective components (with POWER switch off). Check the transistors with the transistor tester. This completes the pre-regulator circuitry check.

Troubleshooting the Readout System. The following procedure provides a guide to troubleshooting the Readout System of the R7704.

NOTE

In the following procedure, the integrated circuits can be checked by interchanging with similar types on the Readout System board or with other instruments of the same type. Also, the voltages and waveforms as described in the Circuit Description and given on the diagrams can be used to check the operation of the integrated circuits where replacement devices are not available.

1. Isolating the Trouble
 - 1.1 Remove the Readout System board from the instrument and check for damaged components, damaged circuit board, or improperly installed transistors or integrated circuits. Check that the index of all integrated circuits on the Readout System board matches the index of the socket. If no defects are found, re-install the board on the instrument.
 - 1.2 Set the R7704 POWER switch to ON and note which of the following problems exist. Then refer to the step listed.
 - 1.2.1 No readout in any word location. Go to step 2.1.
 - 1.2.2 All readout words incorrect. Go to step 3.1.
 - 1.2.3 Some readout words correct, some incorrect. Go to step 4.1.
 2. No Readout
 - 2.1 Remove all plug-in units from the instrument.
 - 2.2 Remove transistor Q1155 from the Readout System board.
 - 2.3 Set the R7704 POWER switch to ON and allow a warm-up period.
- NOTE**
- Observe the readout display and refer to one of the following steps.**
- 2.4 80 zeros in display (40 within top division of graticule, 40 within bottom division).
 - 2.4.1 If correct display of 80 zeros is obtained, interchange U 1130 and U 1170. Then return to step 1.2 (replace Q1155). If the present readout display is in any way different than the original problem, the trouble is located in the U1130 or U1170 circuits.

- 2.4.2 If step 2.4.1 does not correct the readout display, interchange U1166 and U1186 and return to step 1.2 (replace Q1155). If the present readout display is in any way different from the original problem, the trouble is located in the U1166 or U1186 circuits.
- 2.4.3 If less than 80 zeros are displayed, check output of U1226 (see Fig. 3-44). If incorrect, the trouble is located in the U1226 or U1210 circuits. If correct, check U1130, U1170, U1166, and U1186 circuits as given in steps 2.4.1 and 2.4.2.
- 2.5 80 dots in display.
- 2.5.1 Exchange character generator U 1251 with one of the other character generators U1252 - U1255. If display is still only dots, check U1166 by interchanging it with U1168.
- 2.5.2 If 80 characters are displayed (exact character will depend on which character generator was substituted), re-install the character generators in the correct sockets and replace U1251 with a new integrated circuit.
- 2.6 Pattern other than 80 zeros or dots.
- 2.6.1 Check Channel Address Code (see Table 3-4). If incorrect, check U1230-U1231-U1232.
- 2.6.2 Check 01274, Q1278, Q1284, and Q1288 with the transistor tester (see recommended troubleshooting equipment). If correct, check U1260 and U1270 circuits.
- 2.7 No display.
- 2.7.1 Turn front-panel READOUT control fully clock-wise and check voltage at interconnecting pin XM.
- 2.7.1.1 If less than about -13 volts, check R1040 and S1040. Also check interconnecting leads.
- 2.7.1.2 If greater than -13 volts, check voltage at TP1255: If zero volts or more negative, check the U1210 circuit; if +1 volt or greater, check Q1150-Q1152-Q1155-Q1163. Finally, check U1190.
- 2.7.2 Check waveforms at TP1215, TP1217, and pin 5 of U1210. If correct, check the level at pin 16 of U1226.
- 2.8 Re-install Q1155 in its socket. Check readout display.
3. All Readout Words Incorrect
- 3.1 If only one character is wrong in all displayed readouts, check the character generator which produces this character.
- 3.2 Install a time-base unit in any compartment and turn the time/division switch throughout its range. Note which portions of the readout display are missing or incorrect in each decade of the time/division switch.
- 3.3 Install the time-base unit in another compartment and repeat step 3.2. If the results are the same, continue with this step. If the readout is now correct, go to step 4.1.
- 3.4 Remove the time-base unit. Substitute a different unit and repeat step 3.2. If the results are the same, continue with this step. If the readout is now correct, check the original plug-in unit.
- 3.5 Interchange U 1130 and U 1170 and repeat step 3.2. If the readout is still incorrect but different portions of the readout display are wrong, the trouble is in either the U1130 or U1170 circuit. If the readout is correct, the error may have been corrected; check readout in all plug-in compartments for original error. If no change is noted, proceed to next step.
- 3.6 Repeat step 3.5, only this time interchange U1166 and U1186.
- 3.7 If the zero adding or prefix shifting portion of the readout display is incorrect, check following steps:
- 3.7.1 Check waveform at TP1130 to see if information is being encoded during time-slot 1. If not, check U1130 by substitution with U1170. Also check the encoding network in the plug-in unit.
- 3.7.2 Check for a Word Trigger pulse at pin 9 of U 1190 (one pulse for each 10 time-slot pulses). If not present, check U1227 and U 1226 circuits.
- 3.7.3 Check for presence of row 3 information at pin 16 and column 1, 2, 3, 4 information at pins 12, 13, 10, and 11 respectively of U1190 (current signals). If no signal is present, check U1166 and U1186.
- 3.7.4 Check waveform at TP1190 (see Fig. 3-48). If not present, check U1190 circuit.
4. Some Readout Words Correct, Some Incorrect
- 4.1 Install different plug-in units in the compartment(s) producing the incorrect readout. Check resulting display.

- 4.1.1 Readout correct. Check original plug-in unit.
- 4.1.2 Readout still incorrect.
- 4.1.2.1 Interchange U1130 and U1170 and check the resulting display. If the readout is still incorrect but different portions of the readout display are wrong, the trouble is in either U1130 or U1170. If the readout is correct, the error may have been corrected; check readout in all plug-in compartments. If no change is noted, proceed to the next step.
- 4.1.2.2 Repeat step 4.1.2.1, only this time interchange U1166 and U1186.
- 4.1.2.3 Check all time-slot pulses connected to the plug-in unit at the plug-in interface connector. Pulses must be exactly -15 volts in amplitude. If not, check U1210 and U1226 circuits, and the interconnecting wires.
- 4.2 This completes the troubleshooting procedure for the Readout System.

CORRECTIVE MAINTENANCE

General

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

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the R7704 can be obtained through your local Tektronix Field Office or representative. However, any 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 lists for value, tolerance, rating, and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special components are used in the R7704. These components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special components are indicated in the Electrical Parts List by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix, Inc., 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

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. When soldering on circuit boards, use a 35- to 40-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Also, apply only enough solder to make a firm solder joint; do not apply too much solder.

For metal terminals (e.g., switch terminals, potentiometers, etc.) a higher wattage-rating soldering iron may be required. Match the soldering iron to the work being done. For example, if the component is connected to the chassis or other large heat-radiating surface, it will require a 75-watt or larger soldering iron. The pencil-type soldering iron used on the circuit board can be used for soldering to switch terminals, potentiometers, or metal terminals mounted in plastic holders.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

General. The exploded-view drawings associated with the Mechanical Parts List (located at rear of manual) may be helpful in the removal or disassembly of individual components or sub-assemblies.

Access to Components in Power Unit. To reach the components located inside the power unit for maintenance or repair, use the following procedure:

WARNING

Line AC and stored DC potentials are present inside the power unit. This instrument should be operated with an isolation transformer whenever troubleshooting the circuitry in the power unit. Follow the recommended troubleshooting procedure given under Special Troubleshooting Information.

1. Slide out the power unit as described previously.
2. Remove the small plate (five screws) which secures the housing to the power unit (located on left side of power unit).
3. Remove the remaining five screws which attach the housing to the front of the power unit.

WARNING

Disconnect the instrument from the power source before removing the power-unit cover. A warning light is provided on the Line Input circuit board (on left side of power unit). Do not remove the power-unit cover until this light has extinguished.

4. Spread the housing slightly and slide it off the power unit to the front.
5. The power unit is now open for maintenance or repair. See the instructions under Troubleshooting the Power Supply for information on locating a trouble in the power supply. For information on replacing the transformer, see Power Transformer Replacement.

6. Reverse the order of removal to replace the power-unit cover.

Access to Vertical Components. To reach the Vertical Output circuit board and related components, remove the access plate from the left side of this instrument.

Circuit Board Replacement. If a circuit board is damaged beyond repair, the entire assembly including all soldered on components, can be replaced. Part numbers are given in the Mechanical Parts List for the completely wired (670 _ _ _ _ - _ _) board.

NOTE

Even though unwired boards are available without components, use of the completely wired replacement board is recommended due to the large number of components mounted on most of the boards.

Most of the main circuit boards in this instrument plug onto the chassis or onto other circuit boards. Use the following procedure to remove the plug-on circuit boards (removal instructions for the exceptions will be given later).

A. PLUG-ON BOARDS.

1. Disconnect any pin connectors located on the front of the board.
2. Loosen all of the securing screws on the board.
3. Pull out on the edges of the board until the board clears the chassis terminals. Attempt to lift the board away from the chassis in such a way that it remains parallel to the chassis at all times so as not to bend the interconnecting terminals.
4. To replace a plug-on circuit board, position it so the securing-screw holders mate with the guide posts on the chassis.
5. Gently press the circuit board against the chassis. Be sure that all of the interconnecting pins and sockets mate properly.
6. Uniformly tighten the securing screws. Recommended torque, four to six inch-pounds.

B. MAIN INTERFACE CIRCUIT BOARD REPLACEMENT.

Use the following procedure to replace the Main Interface circuit board:

1. Slide out the power unit as described previously.
2. Remove the top and bottom covers from the instrument.
3. Remove all of the plug-on circuit boards from the Main Interface circuit board (remove plug-in units to gain access to plug-on boards on front of Main Interface board).
4. Disconnect the six multi-pin connectors located at the top of the Main Interface board. Note the order of these connectors so they can be correctly replaced.
5. Remove the three screws from inside each plug-in compartment which hold the plug-in interface connectors to the chassis of this instrument (total of 12 screws). Also remove the two screws which hold the ground straps to the chassis.
6. Slide the Main Interface board assembly to the rear and disconnect all of the pin connectors. Now, the Main Interface board assembly can be removed from the instrument.
7. To replace the Main Interface board, reverse the order of removal. Match the arrows on the multi-pin connectors to the arrows on the board. Correct location of the pin connectors is shown in Figs. 8-1 and 8-2.

C. RECTIFIER BOARD REMOVAL.

The Rectifier circuit board is mounted inside the power unit. To remove this board, proceed as follows:

1. Remove the housing from the power unit as described previously.
2. Remove the four screws which mount the Low-Voltage Regulator chassis to the power unit. Then swing this chassis aside.
3. The Rectifier board can be removed from the power unit in the manner described for the plug-on circuit boards.
4. To replace the board, reverse the procedure.

D. LINE INPUT BOARD REMOVAL.

The Line Input circuit board is also mounted inside the power unit. To remove this board, proceed as follows:

1. Remove the power-unit housing as described previously.
2. Loosen the two securing screws on the board.
3. Remove the nut which holds the heat-sink bracket on the bridge rectifier. Then, loosen the two nuts which mount this bracket to the rear panel and slide the bracket off the rectifier.
4. Pull out on the edges of the board until the board clears the chassis terminals.
5. Unsolder the seven leads connected to this board.
6. To replace the board, reverse the above procedure. Correct location of the soldered wires is shown in Fig. 8-14.

E. INVERTER BOARD REMOVAL.

To replace the Inverter circuit board, use the following procedure:

1. Remove the power-unit housing as described previously.
2. Remove the four screws (with large heads) which secure the power transformer to the rear panel.
3. Remove the two screws located next to the Line Selector assembly which secure the power chassis to the rear sub-panel.
4. Remove the five screws which hold the ceramic heat sink (on Inverter Board) to the rear sub-panel.
5. Remove the Line Input board as described above. Then, swing this board aside for the next step. (The Line Input board can be plugged back into place for troubleshooting with the supply separated.)
6. Now, slide the power chassis/transformer assembly away from the rear sub-panel.

7. Disconnect the four leads between the pin connectors on the power chassis and the Inverter board. Then unsolder the three leads at points PA, PB, and PC, and the shielded coax at PD and PE.

8. Remove the two screws which mount the Inverter board to the power chassis.

9. To replace the Inverter board, reverse the order of removal. Correct connection of the wires is shown in Fig. 8-15.

Plug-In Interface Connectors. The individual contacts of the plug-in interface connectors can be replaced. However, it is recommended that the entire Main Interface board be replaced 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 or representative. Use the following procedure to replace an individual contact of the plug-in interface connector.

1. Remove the Main Interface circuit board from the instrument as described previously.

2. Snap the connector cover (white plastic) off the side of the plug-in interface connector which needs repair.

3. Unsolder and remove the damaged contact.

4. Install the replacement contact. Carefully form it to the required shape to fit against the connector body.

5. Snap the connector cover back onto the plug-in interface connector. Check that the contact which was replaced is aligned with the other contacts.

6. Replace the Main Interface board.

Semiconductor Replacement. 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 calibration of this instrument. When semiconductors are replaced, check the operation of the part of the instrument which may be affected.

CAUTION

POWER switch must be turned off before removing or replacing semiconductors.

Replacement semiconductors should be of the original type or a direct replacement. Fig. 4-3 shows the lead configuration of the semiconductors used in this instrument. Some plastic case transistors have lead configurations which do not agree with those shown here. 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 the standard basing as used for metal-cased transistors. Transistors which have heat radiators or are mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease when replacing these transistors.

WARNING

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

An extracting tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix Part No. 003-0619-00. If an extracting tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. Try to avoid having one end of the integrated circuit disengage from the socket before the other, as this may damage the pins.

To replace one of the power transistors mounted on the front of the power unit, first remove the Low-Voltage Regulator board. Then, take out the mounting screws and remove the defective transistor. When replacing the transistor, tighten the mounting screws just tight enough to hold the transistor in place (use silicone grease as described previously). Then, temporarily re-install the Low-Voltage Regulator board to align the transistor with the sockets in the board. Remove the board and firmly tighten the mounting screws.

Interconnecting Pin Replacement. Two types of interconnecting pins are used in this instrument to interconnect the circuit boards with other components of this instrument. When the connection is made at the chassis of the instrument, a chassis feed-thru pin is used which is mounted in an insulated bushing. When the interconnection is made at a circuit board, the pin is soldered into the board. In addition, 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 replacement procedure for the various types of interconnecting methods.

A. CHASSIS FEED-THRU PINS.

To replace a chassis feed-thru pin, first remove the applicable circuit board(s) and disconnect any end-lead pin connectors from the pin. Then pull the damaged pin out of the chassis from the rear. If the plastic bushing does not come out with the pin, remove it from the chassis hole. Press the new plastic bushing into the chassis hole. Now, insert the long end of the new feed-thru pin into the plastic bushing from the rear of the chassis. Gently press the feed-thru pin until it is seated firmly into the plastic bushing. Be careful not to bend the pin as it is inserted into the bushing. Check to see that the new feed-thru pin is perpendicular to the chassis and in line with other associated pins.

NOTE

The feed-thru pins which must conduct large amounts of current are of a special heavy-duty design. These pins can be replaced by pressing the complete feed-thru pin/bushing out of the chassis to the rear and pressing the replacement part back into the chassis.

B. CIRCUIT-BOARD PINS.**NOTE**

A circuit-board pin replacement kit including necessary tools, instructions and replacement pins is available from Tektronix, Inc. Order Tektronix Part No. 040-0542-00.

To replace a pin which is mounted on a circuit board, first disconnect any pin connectors. Then, unsolder the damaged pin and pull it out of the circuit board with a pair of pliers. Be careful not to damage the wiring on the board with too much heat. Ream out the hole in the circuit board with a 0.031-inch drill. Remove the ferrule from the new interconnecting pin and press the new pin into the hole in the circuit board. Position the pin in the same manner as the old pin. Then, solder the pin on both sides of the circuit board. If the old pin was bent at an angle to mate with a connector, bend the new pin to match the associated pins.

C. CIRCUIT BOARD PIN SOCKETS.

The pin sockets on the circuit boards are soldered to the rear of the board. To 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 it from the hole in the circuit 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 into the socket.

NOTE

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.

D. 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 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.

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. To provide correct orientation of this multi-pin connector when it is replaced, an arrow is stamped on the circuit board or chassis and a matching arrow is molded into the plastic housing of the multi-pin connector. Be sure these arrows are aligned as the multi-pin connector is replaced. If the individual end-lead pin connectors are removed from the plastic holder, note the color of the individual wires for replacement.

Cathode-Ray Tube Replacement. To replace the cathode-ray tube, proceed as follows:

WARNING

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

A. REMOVAL:

1. Slide out the power unit as described previously.
2. Remove the top cover from the instrument.
3. Remove the nine screws holding the filter/fan assembly to the rear panel. Move the assembly aside so the CRT socket can be reached.
4. Remove the plastic CRT mask, light filter and metal light shield.

5. 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.

6. Press inward on the white tabs of the graticule-light assembly and pull the assembly out of the CRT bezel (leave wires connected).

7. Remove the Horizontal Amplifier circuit board. Then, disconnect the CRT anode plug located beneath the Horizontal Amplifier chassis (use a screwdriver) through the cutout in the chassis to disconnect the anode plug. Ground this plug to the chassis to dissipate any stored charge.

8. Disconnect the six deflection-plate connectors. Be careful not to bend these pins.

9. Remove the CRT base socket from the rear of the CRT.

10. Loosen the two 3/32-inch hex-socket 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.

11. 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 around the structural members of the instrument and through the cutout in the CRT shield as the CRT is removed.

B. REPLACEMENT:

1. Insert the CRT into the shield. Guide the anode lead through the hole in the CRT shield and into place beneath the Horizontal Amplifier chassis. Seat the CRT firmly against the cushions mounted on each corner of the CRT support.

2. Place the black-plastic CRT mask over the CRT face-plate.

3. 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 re-install the CRT bezel. Firmly tighten the four screws.

4. Push forward on the CRT base to be certain that the CRT is as far forward as possible. Then tighten the two

hex-socket screws beside the CRT base socket until the springs on the screws are fully compressed.

5. Replace the CRT base socket.

6. Reconnect the CRT anode plug.

7. Carefully reconnect the deflection-plate connectors. Correct location is shown on the CRT shield. After each connector is installed, lightly pull on its lead to be sure that it will remain in its socket.

8. Replace the graticule-light assembly and the Horizontal Amplifier circuit board.

9. Clean the CRT faceplate, plastic faceplate protector, and the light filter with denatured alcohol.

10. Replace the metal light shield and the tinted filter. Then snap the plastic CRT mask into the CRT bezel.

11. Re-install the power unit and the fan assembly.

12. Check the calibration of the complete instrument. Calibration procedure is given in Section 5.

WARNING

Incorrect adjustment of the high-voltage, -50-volt, and +75-volt supplies may result in excessive X-Ray emission from the CRT faceplate. See the Calibration Procedure for correct adjustment.

Switch Replacement. Several different types of switches are used in this instrument. The toggle, micro, slide, and rotary switches should be replaced as a unit if damaged. Observe the soldering precautions given earlier in this section when replacing these switches. The following special maintenance information is provided for the push-button switches.

PUSHBUTTON SWITCHES.

The push-button switches are not repairable and should be replaced as a unit if defective. Components which are mounted on the circuit board associated with the push-button switches can be replaced using the normal replacement procedures. See the information under Light-Bulb Replacement for instructions on replacing the light bulbs.

REV. MAY 1974

Mode Switches. Use the following procedure to replace the VERTICAL MODE or HORIZONTAL MODE push-button switches:

1. Disconnect the multi-pin connectors from the rear of the switch.
2. Remove the two 5/32-inch socket head securing nuts from the inside of the front-panel and remove the switch.
3. 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 switch assembly.

Trigger Source Switches. To replace the A TRIGGER SOURCE or B TRIGGER SOURCE push-button switches, proceed as follows:

1. Disconnect the multi-pin connector from the switch.
2. Remove the front panel from the instrument using the following procedure:
 - a. Remove all knobs from the front-panel controls.
 - b. Remove the handles, ground binding post, and CRT bezel.
3. Remove the two screws holding the switch to the front sub-panel.
4. To replace the switch, reverse the above procedure. Match the arrow on the multi-pin connector to the arrow on the switch assembly.

Light-Bulb Replacement. The following procedures describe replacement of the light bulbs in this instrument.

A. MODE SWITCHES.

To replace light bulbs in the VERTICAL MODE or HORIZONTAL MODE switches, proceed as follows:

1. Remove the applicable mode switch as given previously.
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 screw which holds the metal cover on the back of the switch to expose the light bulb.
3. Note the position of the bulb on the switch. Then 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 metal cover on the switch.
7. Re-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 this 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 onto the holder.

D. GRATICULE BULB REPLACEMENT.

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 strip to the side, off the bulb base. Pull the bulb out of the circuit board. Reverse the order of removal for replacement.

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. Follow the procedure given under Inverter Board Removal.
2. Remove the Rectifier board from the power chassis.
3. Unsolder the four leads which come out of the side of the power transformer. Note the color and location of these wires for replacement.
4. Reverse the order of removal to replace the power transformer.

High-Voltage Compartment. The components located in the high-voltage compartment can be reached for maintenance or replacement by using the following procedure:

NOTE

All solder joints in the high-voltage compartment should have smooth surfaces. Any protrusions may cause high-voltage arcing at high altitudes.

1. Remove the bottom cover from the instrument.
2. Loosen the three screws and slide the cover off the high-voltage compartment.
3. Remove the three screws which hold the plastic over onto the high-voltage box.
4. Using an insulated shorting strap, discharge all exposed connections to chassis ground.
5. Unsolder the lead between the encapsulated voltage-multiplier assembly and the high-voltage transformer. Now, all of the circuitry in the high-voltage box can be reached for maintenance or replacement except those in the encapsulated assembly.
6. To replace the encapsulated assembly, remove the three screws located beneath the rear of the CRT (remove Vertical Output board to reach screws). Also unsolder the ground lug located under the Vertical Output board.

7. To replace the high-voltage compartment, reverse the above procedure. Be careful not to pinch any of the interconnecting wires when replacing the cover to the high-voltage box.

Fuse Replacement. Table 4-4 gives the rating, location and function of the fuses used in this instrument.

TABLE 4-4
Fuse Ratings

Circuit Number	Rating	Function	Location
F801	4A Fast	Line Input	Line Selector
F810	2A Fast	Inverter	Assembly
F901	0.25A Fast	+75 volts	Low
F902	0.25A Fast	+150 volts	Voltage
F921	2A Fast	High Voltage	Regulator
F957	1A Fast	Graticule Lights	Board
F1040	6A Fast	Control Illumination	Front of power unit

Re-calibration After Repair

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits. Since the low-voltage supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the low-voltage supply or if the power transformer has been replaced. The Performance Check procedure provides a quick and convenient means of checking instrument operation.

Instrument Repackaging

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, 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:

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. The shipping carton test strength for this instrument is 375 lbs.
2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.
3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.
4. Seal carton with shipping tape or industrial stapler.

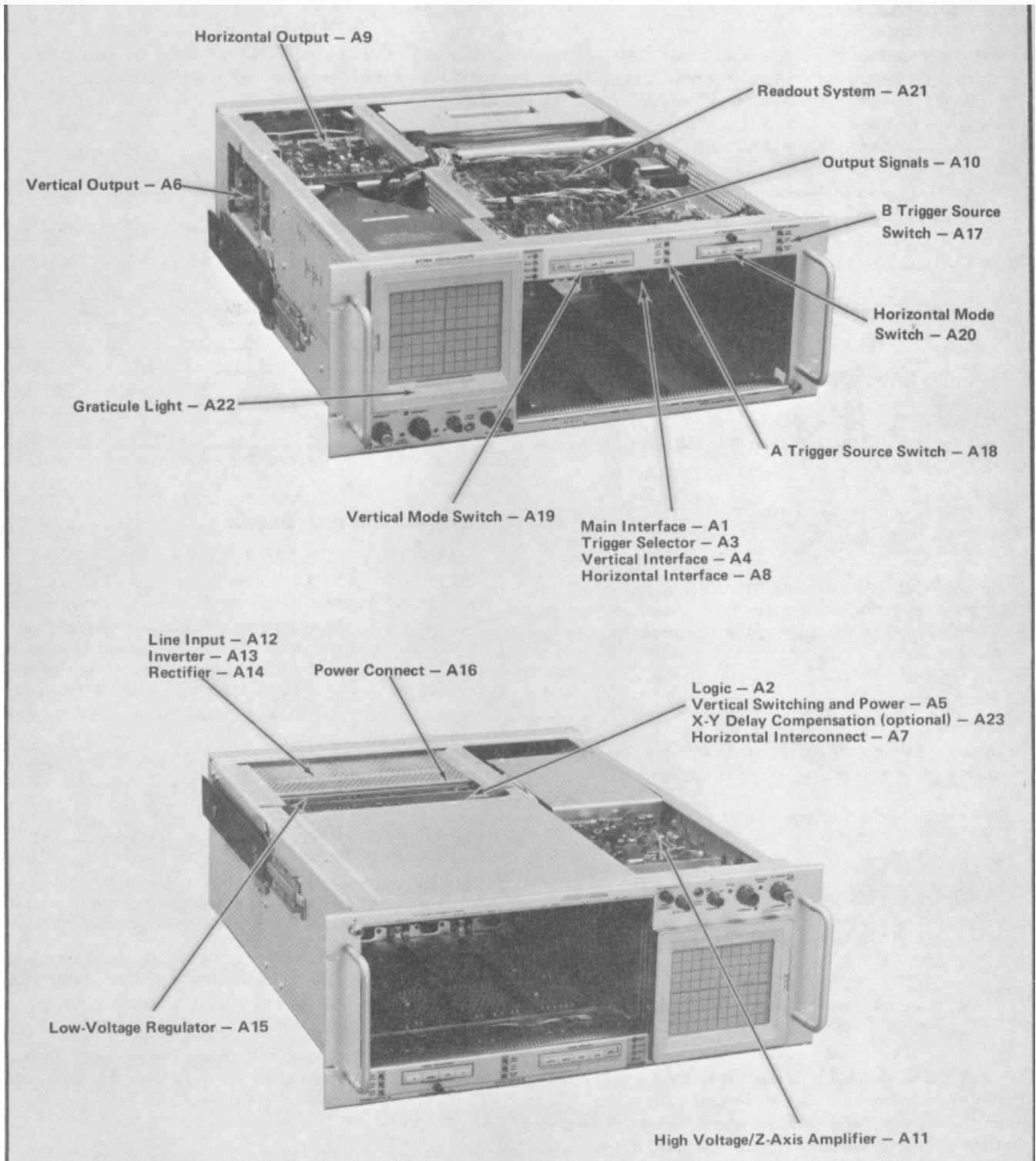


Fig. 4-7. Location of circuit boards in R7704.

SECTION 5 PERFORMANCE CHECK/CALIBRATION

Change information, if any, affecting this section will be found at the rear of this manual

Introduction

To assure instrument accuracy, check the calibration of the R7704 every 1000 hours of operation, or every six months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section.

Short-Form Procedure. As an aid to the calibration of this instrument, a Short-Form Procedure is given prior to the complete procedure. To facilitate instrument calibration for the experienced calibrator, the Short-Form Procedure lists the calibration adjustments necessary for each step and the applicable tolerances. This procedure also includes the step number and title as listed in the complete. Performance Check/Calibration Procedure and the page number on which each step begins. Therefore, the Short-Form Procedure can be used as an index to locate a step in the complete procedure. Another feature of the Short-Form Procedure is the spaces provided to record performance data or to check off steps as they are completed. This procedure can be reproduced and used as a permanent record of instrument calibration.

Performance Check. The complete Performance Check/ Calibration Procedure can be used to check instrument performance without removing the covers or making internal adjustments by performing all portions except the ADJUST- part of a step. Screwdriver adjustments which are accessible without removing the covers are adjusted as part of the performance check procedure. A note titled PERFORMANCE CHECK ONLY gives instructions which are applicable only to the performance check procedure and lists the next applicable step for the performance check procedure.

Complete Procedure. Completion of each step in the complete Performance Check/Calibration Procedure insures that this instrument meets the electrical specifications given in Section 1. Where possible, instrument performance is checked before an adjustment is made. For best overall instrument performance when performing a complete calibration procedure, make each adjustment to the exact setting even if the CHECK-is within the allowable tolerance.

NOTE

Limits, tolerances and waveforms in this procedure are given as calibration guides and should not be interpreted as instrument specifications except as specified in Section 1.

Partial Procedure. A partial calibration is often desirable after replacing components, or to touch up the adjustment of a portion of the instrument between major re-calibrations. To check or adjust only part of the instrument, set the controls as given under Preliminary Control Settings and start with the nearest test-equipment list preceding the desired portion. To prevent unnecessary re-calibration of other parts of the instrument, readjust only if the tolerance given in the CHECK-part of the step is not met. If readjustment is necessary, also check the calibration of any steps listed in the INTERACTION-part of the step.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or its equivalent, is required for complete calibration of the R7704. Specifications given are the minimum necessary for accurate calibration. Therefore, some of the recommended equipment may have specifications which exceed those given. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

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

Test Equipment

1. Variable auto-transformer.¹ Must be capable of supplying at least 250 volt-amperes over a range of 95 to 136 volts (190 to 272 volts for 230-volt nominal line). (If auto-transformer does not have an AC voltmeter to indicate

¹Not required for performance check only.

output voltage, monitor the output with an AC voltmeter with a range of at least 136 or 272 volts, RMS.) For example, General Radio W100MT3A Metered Variac Auto-transformer. (Use General Radio W20HMT3A for 230-volt nominal operation.)

2. Precision DC voltmeter.¹ Accuracy, within 0.02%; resolution, 50 microvolts; range, zero to 500 volts. For example, Fluke Model 825A Differential DC Voltmeter.

3. DC voltmeter (VOM). Range, zero to 4000 volts; accuracy, checked to within 1% at -2960 volts. For example, Triplett Model 630-NA.²

4. Time-Mark generator. Marker outputs, 5 nanoseconds to 0.5 second; marker accuracy, within 0.1%. Tektronix TM 501 Time-Mark Generator recommended.⁴

5. Medium-frequency signal generator. Frequency, 350 kilohertz to 100 megahertz; reference frequency, 50 kilo-hertz; output amplitude, from five millivolts to five volts peak to peak into 50 ohms; amplitude accuracy, output amplitude constant within 3% of reference as output frequency changes. Tektronix SG 503 Signal Generator recommended.⁴

6. High-Frequency signal generator. The Tektronix SG 503 is used for this application.

7. Low-frequency signal generator. Frequency, 100 hertz to 35 kilohertz; output amplitude, variable from 50 millivolts to five volts peak to peak. For example, General Radio Model 1310-A Oscillator.

8. Test-oscilloscope system. Bandwidth, DC to 75 megahertz; minimum deflection factor, 10 millivolts/division; accuracy, within 3%. Tektronix 7503 Oscilloscope with 7A16 Amplifier, 7B50 or 7B52 Time-Base, and P6053 Probe.

9. Vertical plug-in unit (two required). Calibrated Tektronix 7A16 Amplifier.

²If a precision voltage divider is available for use with the precision DC voltmeter (such as Fluke 80E-2) it can be used in place of this meter.

⁴Requires TM 500-Series Power Module.

10. Time base plug-in unit. Tektronix 7B-series. Calibrated Tektronix 7B70 Time Base.

11. Delaying time base plug-in unit. Calibrated Tektronix 7B71 Delaying Time Base.

12. Signal standardize calibration fixture. Tektronix Calibration Fixture 067-0587-01.

Accessories

13. 10X probe. Tektronix P6053 recommended.

14. 1X Probe. Tektronix P6011 recommended.

15. Cable. Impedance, 50 ohms; connectors, BNC male one end and pin-jacks on other. Tektronix Part No. 175-1178-00 (supplied accessory).

16. BNC T connector. Tektronix Part No. 103-0030-00.

17. Termination. Impedance, 50 ohms; accuracy, $\pm 2\%$; connectors, BNC. Tektronix Part No. 011-0049-01.

18. Cable. Impedance, 50 ohms; type RG-58/U; length, 18 inches; connectors, BNC. Tektronix Part No. 012-0076-00.

19. Cable. Impedance, 50 ohms; type RG-58/U; length 42 inches; connectors, BNC. Tektronix Part No. 012-0057-01 (supplied accessory).

20. Cable. Impedance, 50 ohms; type RG-213/U; electrical length, five nanoseconds; connectors, GR874. Tektronix Part No. 017-0502-00.

21. In-line termination. Impedance, 50 ohms; wattage rating, two watts; accuracy, $\pm 2\%$; connectors, GR874 input with BNC male output. Tektronix Part No. 017-0083-00.

22. Adapter. Adapts GR874 connector to BNC female connector. Tektronix Part No. 017-0064-00.

Adjustment Tools

23. Screwdriver. Three-inch shaft, 3/32-inch bit. For example, Xcelite R-3323.

24. Low-capacitance screwdriver.¹ 1-1/2-inch shaft. Tektronix Part No. 003-0000-00.

25. Tuning tool.¹ Handle and insert for 5/64-inch (ID) hex cores. Tektronix Part Nos. 003-0307-00 and 003-0310-00.

SHORT-FORM PROCEDURE AND INDEX

R7704, Serial No. _____

Calibration Date _____

Elapsed-Time Reading _____

Calibrated by _____

Power Supply and Display Calibration

1. Adjust +75-Volt Power Supply (R843) Page 5-7

REQUIREMENT: +75 volts \pm 0.38 volt.

PERFORMANCE: + _____ volts.

2. Adjust -50-Volt Power Supply (R986) Page 5-7

REQUIREMENT: -50 volts \pm 0.1 volt.

PERFORMANCE: _____ volts.

3. Check Power-Supply Voltages and Regulation Page 5-7

REQUIREMENT: See complete procedure.

PERFORMANCE: All correct _____ Incorrect (list exceptions)

4. Adjust High-Voltage Power Supply (R743) Page 5-9

WARNING

High- Voltage Supply must be correctly adjusted to minimize X-ray emission from CRT faceplate; see complete procedure.

REQUIREMENT: -2960volts \pm 29.6volts.

PERFORMANCE: - __-__ volts.

(A)

5. Check/Adjust Z-Axis DC Levels (R739, R 140) Page 5-9

REQUIREMENT: See complete procedure.

PERFORMANCE: Correct _____; Incorrect _____

6. Check/Adjust Focus and Astigmatism (FOCUS, ASTIG) Page 5-10

REQUIREMENT: Optimum display definition.

PERFORMANCE: Correct ____; Incorrect _____

7. Check/Adjust Trace Alignment (TRACE ROTATION, R795) Page 5-10

REQUIREMENT: Trace aligns with graticule vertically and horizontally within 0.1 division.

PERFORMANCE: Correct _____ ; Incorrect _____

8. Check/Adjust Geometry (R792) Page 5-11

REQUIREMENT: Vertical bowing and tilt of markers within 0.1 division.

PERFORMANCE: Within - _____ division.

Vertical Deflection System Calibration

9. Check/Adjust Vertical Centering (For Instruments With Readout Only) (R443, R257, R277) Page 5-12

REQUIREMENT: Readout centered; undeflected traces within 0.8 division of center vertical line.

PERFORMANCE: Correct _____ ; Incorrect _____

9A. Check/Adjust Vertical Centering (For Instruments Without Readout) (R443, R257, R277) Page 5-12

REQUIREMENT: Undeflected traces within 0.6 division of center vertical line.

PERFORMANCE: Within _____ division.

10. Check/Adjust Vertical Output Amplifier Gain (R468) Page 5-13

REQUIREMENT: Standardized to test fixture.

PERFORMANCE: Correct _____ ; Incorrect _____

11. Check/Adjust Right Vertical Amplifier Gain (R242) Page 5-14

REQUIREMENT: Channels matched within 1%.
PERFORMANCE: Correct _____; Incorrect _____.

12. Check Low-Frequency Linearity Page 5-14

REQUIREMENT: Compression or expansion of two-division signal, 0.1 division or less.
PERFORMANCE: _____- division (worst case).

13. Check/Adjust Vertical High-Frequency Compensation (R423, R421, R422, C430, R430, C483, C484, L483, L484, C458, R458, C274, R274, C244, R254) Page 5-14

REQUIREMENT: Optimum square leading corner and flat top on displayed pulse with aberrations not to exceed +0.15 or -0.15 division; total peak-to-peak aberrations not to exceed 0.24 division.
PERFORMANCE: Correct _____; Incorrect _____.

14. Check Vertical Amplifier Bandwidth Page 5-15

REQUIREMENT: At least 190 megahertz.
PERFORMANCE: _____ megahertz.

15. Check Vertical Amplifier Channel Isolation Page 5-15

REQUIREMENT: 100:1 at 150 megahertz.
PERFORMANCE: Correct _____; Incorrect _____.

16. Check Vertical Chopped Mode Operation Page 5-16

REQUIREMENT: See complete procedure.
PERFORMANCE: Correct _____; Incorrect _____.

Horizontal Deflection System Calibration

17. Check/Adjust Horizontal Amplifier Thermal Balance (R571) Page 5-17

REQUIREMENT: See complete procedure.
PERFORMANCE: Correct _____; Incorrect _____.

18. Check/Adjust Horizontal Amplifier Centering (R529) Page 5-18

REQUIREMENT: See complete procedure.
PERFORMANCE: Correct _____; Incorrect _____.

19. Check/Adjust Horizontal Amplifier Gain and Low-Frequency Linearity (R522) Page 5-18

REQUIREMENT: Gain-Standardized to test fixture; channels matched within 1%.
Linearity-Less than 0.05 division error at each graticule line.
PERFORMANCE: Gain-Correct _____; Incorrect _____.
Linearity-Correct _____; Incorrect _____.

20. Check/Adjust High-Frequency Timing (R568, C568) Page 5-19

REQUIREMENT: See complete procedure.
PERFORMANCE: Correct _____; Incorrect _____.

21. Check/Adjust X-Y Delay Compensation (C55, C75) Page 5-19

REQUIREMENT: Without correction -20 or less at 35 kilohertz.
With correction --20 or less at two megahertz.
PERFORMANCE: Correct-_____; Incorrect _____.

22. Check Horizontal Bandwidth Page 5-20

REQUIREMENT: With correction-At least two megahertz.
Without correction-At least six megahertz.

PERFORMANCE: Correct _____; Incorrect _____.

23. Check Vertical Trace Separation Control Range Page 5-21

REQUIREMENT: B trace can be positioned from +4 to +6 and -4 to -6 divisions from the A trace.
PERFORMANCE: Correct _____; Incorrect _____.

Output Signals Calibration

24. Check/Adjust Calibrator Output Voltage (R649) Page 5-22

REQUIREMENT: 0.4 volt ± 0.004 volt output at 0.4 V Calibrator pin jack.

PERFORMANCE: ____ volt.

25. Check/Adjust Calibrator Repetition Rate (R625) Page 5-22

REQUIREMENT: One kilohertz ± 0.25%.

PERFORMANCE: Correct ____; Incorrect ____.

26. Check Calibrator Risetime, Falltime, and Duty Cycle Page 5-23

REQUIREMENT: Risetime and falltime-0.25 microsecond or less.

Duty cycle-50% ± 1%

PERFORMANCE: Risetime and falltime-microsecond.

Duty cycle-Correct ____; Incorrect ____.

27. Check Sawtooth Output Signal Page 5-23

REQUIREMENT: 10 volts or greater amplitude.

PERFORMANCE: ____ volts.

28. Check Gate Output Signal Page 5-24

REQUIREMENT: 10volts ±0.1 volt amplitude.

PERFORMANCE: ____ volts.

29. Check Vertical Signal Output Page 5-24

REQUIREMENT: See complete procedure.

PERFORMANCE: Correct ____; Incorrect ____.

Z-Axis Calibration

30. Check External Z-Axis Operation Page 5-25

REQUIREMENT: See complete procedure.

PERFORMANCE: Correct ____; Incorrect ____

(A)

31. Adjust Z-Axis Transient Response (R719, C732) Page 5-25

REQUIREMENT: Optimum square-wave response.

PERFORMANCE: Correct ____; Incorrect ____.

32. Adjust Auto Focus Operation (R769, C767, R761) Page 5-26

REQUIREMENT: See complete procedure.

PERFORMANCE: Correct ____; Incorrect ____.

Readout System Calibration

33. Check/Adjust Readout System Operation (R1285, R1219) Page 5-28

REQUIREMENT: See complete procedure.

PERFORMANCE: Correct ____; Incorrect ____.

**PERFORMANCE CHECK/
CALIBRATION PROCEDURE**

General

NOTE

All waveforms shown in this procedure were taken with a Tektronix Oscilloscope Camera System and Projected Graticule.

The following procedure is arranged so the R7704 Oscilloscope can be calibrated with the least interaction of adjustments and reconnection of equipment. The control settings and test equipment setup throughout this procedure continue from the preceding step(s) unless noted otherwise.

NOTE

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

The following procedure uses the equipment listed under Test Equipment Required. If other equipment is substituted, control settings or calibration setup may need to be altered to meet the requirements of the equipment used. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

NOTE

This instrument should be calibrated and checked at an ambient temperature of +25°C +5°C for best overall accuracy. The performance of this instrument can be checked at any temperature within the 0°C to +500C range unless stated otherwise.

Preliminary Procedure for Performance Check Only

1. Connect the R7704 to a power source which meets the voltage and frequency requirements of this instrument.
2. Set the controls as given under Preliminary Control Settings. Allow at least 20 minutes warm-up before proceeding.
3. Begin performance check with step 6.

Preliminary Procedure for Complete Calibration

1. Remove the top and bottom covers from the R7704.

NOTE

If the R7704 is on a bench, all adjustments and test points can be reached by setting the instrument on its right side. If mounted in a rack, pull the instrument out to the fully extended position and use the tilt-lock feature of the slide-out tracks to reach all points.

2. Connect the auto-transformer to a suitable power source.

3. Connect the R7704 to the auto-transformer output.
4. Set the auto-transformer output voltage to the center of the voltage range selected by the Line Selector switch.
5. Set the controls as given under Preliminary Control Settings. Allow at least 20 minutes warm-up before proceeding.

Preliminary Control Settings

Set the R7704 controls as follows:

Display Controls

A INTENSITY	Midrange
BEAM FINDER	Released
B INTENSITY	Midrange
READOUT	OFF
GRAT ILLUM	As desired
POWER	On (pulled out)
CONTROLILLUM (side panel)	LOW

Mode Selectors

VERTICAL MODE	LEFT
A TRIGGER SOURCE	VERT MODE
HORIZONTAL MODE	A
B TRIGGER SOURCE	VERT MODE
VERT TRACE SEPARATION (B)	Midrange

NOTES

POWER SUPPLY AND DISPLAY CALIBRATION

Equipment Required

- | | |
|------------------------------------|------------------------------|
| 1. Auto-transformer | 8. Time-mark generator |
| 2. Precision DC voltmeter | 9. 1X probe |
| 3. 7A16 plug-in unit | 10. BNC to pin-jack cable |
| 4. 7B71 plug-in unit | 11. 18-inch 50-ohm BNC cable |
| 5. DC voltmeter (VOM) | 12. 42-inch 50-ohm BNC cable |
| 6. 067-0587-01 calibration fixture | 13. Three-inch screwdriver |
| 7. 7B70 plug-in unit | |

Control Settings

Set the controls as given under Preliminary Control Settings.

1. Adjust +75-Volt Power Supply *PERFORMANCE CHECK ONLY*

Steps 1 through 5 are not applicable to a performance check. Set controls as given under Preliminary Control Settings and begin with step 6.

- a. Change the following control settings:

A INTENSITY Counterclockwise
 B INTENSITY Counterclockwise
 CONTROL ILLUM OFF
 (side panel)

b. Shut off the POWER switch and remove the power unit from the instrument. Return the POWER switch to on.

c. Connect the precision DC voltmeter between TP +75 and TP GND (see Fig. 5-1A).

NOTE

Power supply and ripple tolerances given in steps 1 through 4 are typical values provided as guides to correct instrument operation, and are not instrument specifications. Actual values may exceed those listed without loss of measurement accuracy if the instrument meets the specifications given in Section 1 (as tested in this procedure).

d. CHECK-Meter reading; +75 volts ± 0.38 volt.

e. ADJUST-+75 Volts adjustment R843 (see Fig. 5-1B) for a meter reading of exactly +75 volts.

f. INTERACTION-Check step 4. Change in setting of R843 may also affect operation of all circuits within the R7704.

2. Adjust -50-Volt Power Supply 

a. Connect the precision DC voltmeter between TP -50 and TP GND (see Fig. 5-1A).

b. CHECK-Meter reading; -50 volts ± 0.1 volt.

c. ADJUST-50 Volts adjustment R986 (see Fig. 5-1A) for a meter reading of exactly -50 volts.

d. INTERACTION-Check step 4. Change in setting of R986 may also affect operation of all circuits in the R7704.

3. Check Power-Supply Voltages and Regulation

a. CHECK-Table 5-1 lists the low-voltage power supplies in this instrument. Check each supply with the precision DC voltmeter for output voltage within the given tolerance (connect meter ground lead to TP GND). Power supply test points are shown in Figs. 5-1A and 5-2.

b. Disconnect the precision DC voltmeter.

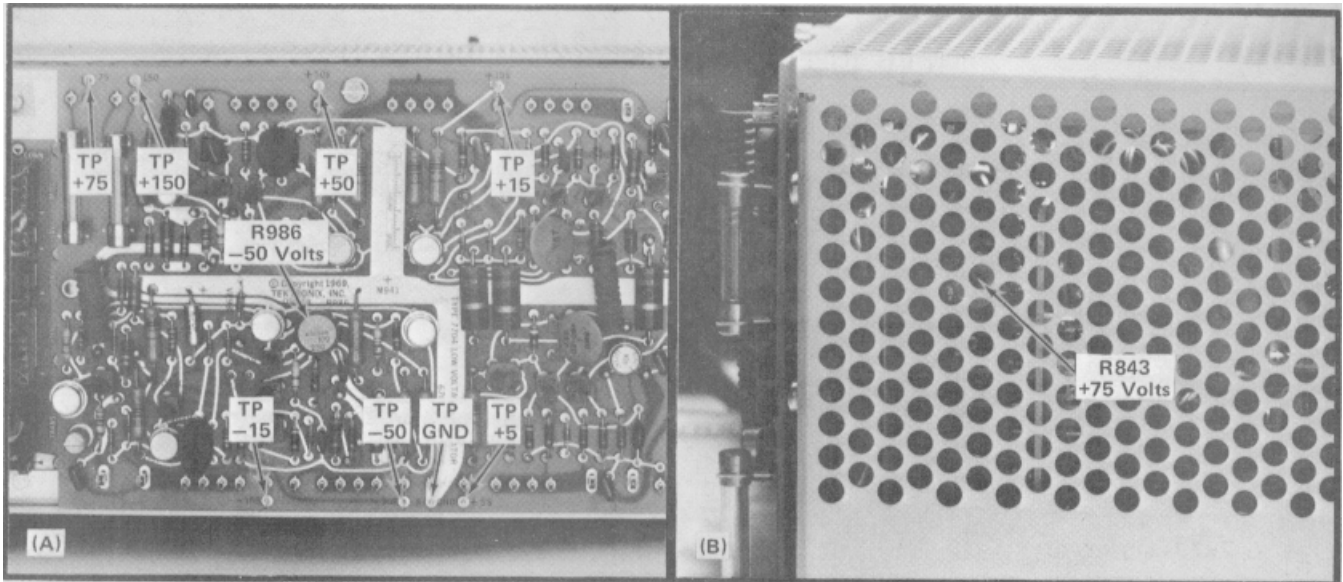


Fig. 5-1. (A) Location of low-voltage power supply test points and adjustment (Low-Voltage Regulator board), (B) Location of +75 Volts adjustment (right side of power unit).

TABLE 5-1
Power Supply Tolerance and Ripple

Power supply	Output voltage tolerance	Maximum ripple
-50 Volt	± 0.1 volt	5 millivolts
-15 Volt	± 0.3 volt	2 millivolts
+5 Volt	± 0.15 volt	2 millivolts
+15 Volt	± 0.3 volt	2 millivolts
+50 Volt	± 0.6 volt	5 millivolts
+75 Volt	± 0.38 volt	200 millivolts
+150 Volt	± 6.0 volts	300 millivolts
Control Illum (5 V)	± 0.2 to -0.5 volt	10 millivolts

- c. Install the 7A16 in the LEFT VERT compartment and the 7B71 in the A HORIZ compartment.
- d. Connect the 40 mV Calibrator pin-jack to the input of the 7A16 with the BNC to pin-jack cable.
- e. Set the A INTENSITY control to midrange.
- f. Set the 7A16 for a deflection factor of 10 millivolts/ division with DC input coupling.
- g. Set the 7B71 for P-P auto, internal triggering at a sweep rate of one millisecond/division.

- h. Set the 7A16 gain adjustment for exactly four divisions of vertical deflection.
 - i. Disconnect the cable.
 - j. Connect the 1X probe to the input of the 7A16.
 - k. CHECK-Ripple of each supply (except Control Illum) while varying the auto-transformer throughout the regulating range selected by the Line Selector switch (90-136 volts for 115 V nominal; 180-272 volts for 230 V nominal). Table 5-1 gives the maximum ripple limits.
 - l. Connect the probe tip to the Control Illum (+5 V) test point (see Fig. 5-2).
 - m. CHECK-10 millivolts or less ripple with the CONTROL ILLUM switch set to OFF, LOW, and HIGH.
 - n. Set the CONTROL ILLUM switch to LOW,
 - o. Disconnect the probe and return the auto-transformer to the center of the voltage range selected by the Line Selector switch (if line voltage is near the center of the range, the R7704 can be connected directly to the line for the remainder of this procedure).



Fig. 5-2. Location of Control Illum. (+5 V) test point (bottom of instrument).

4. Adjust High-Voltage Power Supply

WARNING

Care should be taken to accurately adjust the High-Voltage Supply, the -50-Volt Supply, and the +75-Volt Supply to minimize the X-ray emission from the CR T faceplate.

- a. Set the POWER switch to off.
- b. Connect the DC voltmeter (VOM)³ (set to measure at least 3000 volts) between TP -2960 and chassis ground. TP -2960 is accessible through a hole in the center bulkhead of the instrument with the power unit removed. (If instrument is on its side, voltmeter lead must be held on test point; be sure test leads are well insulated.)
- c. Set the POWER switch to on.
- d. CHECK-Meter reading; -2960 volts \pm 29.6 volts.
- e. ADJUST-High Voltage adjustment R743 (see Fig. 5-3) for a meter reading of -2960 volts.

³If the precision high-voltage divider is available for use with the precision DC voltmeter, it should be used for this step.

(B)

- f. Set the POWER switch to off and disconnect the voltmeter. Replace the power unit; then return the POWER switch to on.
- g. INTERACTION-Check steps 5 and 32.

5. Check/Adjust Z-Axis DC Levels

- a. Remove the 7A16 and install the 067-0587-00 calibration fixture in the LEFT VERT compartment.
- b. Set the A INTENSITY control fully counterclockwise.
- c. Set the 7B71 for P-P auto triggering at a sweep rate of five seconds/division.
- d. Connect the DC voltmeter (VOM) between TP 736 (see Fig. 5-3) and chassis ground. Note the voltmeter reading.
- e. Adjust the A INTENSITY control for a meter reading four volts more positive than the reading in part d.
- f. ADJUST-CRT Grid Bias adjustment R739 (see Fig. 5-3) so the dot on the CRT screen is just extinguished.
- g. Set the 7B71 for a sweep rate of 50 milliseconds/division.

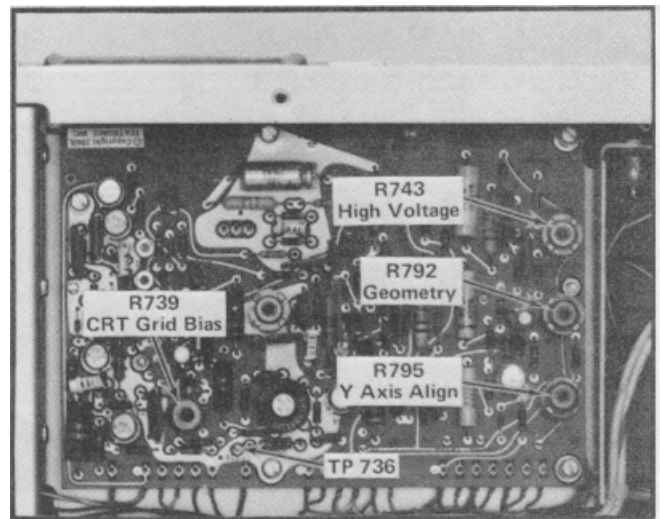


Fig. 5-3. Location of high-voltage test points and adjustments (bottom of instrument).

h. With the trace de-focused and positioned off screen (set calibration fixture to Vert of Horiz Freq Resp for sufficient range to position display off screen), set the A INTENSITY control fully clockwise.

i. CHECK-Meter reading should be 60 volts more positive than the reading noted in part e.

j. ADJUST-Maximum Intensity adjustment R140 (see Fig. 5-4) for a meter reading 60 volts more positive than the reading noted in part e.

k. Set the 7B71 for a sweep rate of 0.1 second/division.

l. CHECK-Meter reading should be between +28 and +35 volts.

m. Disconnect the voltmeter and reduce the A INTENSITY setting to a normal viewing level.

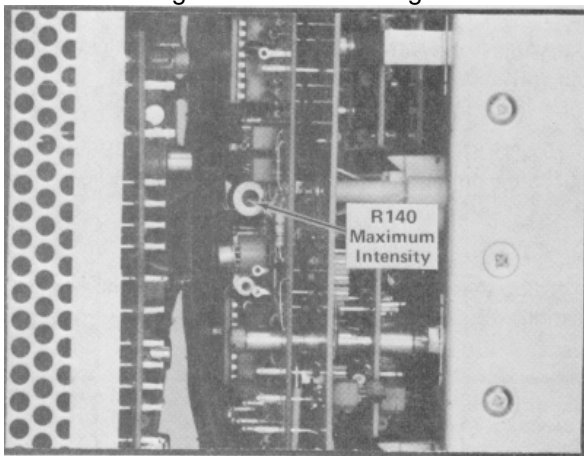


Fig. 5-4. Location of maximum intensity adjustment (bottom of instrument).

6. Check/Adjust Focus and Astigmatism

a. Set the 7B71 for a sweep rate of one millisecond/division.

b. Set the calibration fixture Test switch to Vert or Horiz Aux In.

c. Connect the 4 V Calibrator pin-jack to the Aux In connector of the calibration fixture with the BNC to pin-jack cable.

d. Set the calibration fixture Position control for a centered display, and the Amplitude control for about two divisions of vertical deflection.

e. CHECK-CRT display is well defined.

f. ADJUST-FOCUS adjustment (front panel) and ASTIG adjustment (side panel) to obtain best display definition.

NOTE

The auto-focus circuit is adjusted for correct operation in step 32.

g. Disconnect the cable.

7. Check/Adjust Trace Alignment

a. Change the following control settings:
 B INTENSITY Midrange
 VERTICAL MODE ALT
 HORIZONTAL MODE CHOP

b. Remove the 7B71 from the A HORIZ compartment and install it in the RIGHT VERT compartment; install the 7B70 in the B HORIZ compartment.

c. Install the calibration fixture in the A HORIZ compartment.

d. Set both time-base units for auto triggering operation.

e. Position the traces to the vertical and horizontal center lines of the graticule. Use the VERT TRACE SEPARATION (B) control to position the horizontal trace, and the calibration fixture Position control to position the vertical trace.

f. 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.

g. ADJUST-Front-panel TRACE ROTATION adjustment (horizontal alignment) and Y Axis Align adjustment (vertical alignment) R795 (see Fig. 5-3) so the vertical and horizontal traces align with the vertical and horizontal center lines.

h. INTERACTION-Check step 8.

8. Check/Adjust Geometry



a. Remove the calibration fixture from the A HORIZ compartment and install it in the LEFT VERT compartment.

b. Change the following control settings:

VERTICAL MODE LEFT
HORIZONTAL MODE B

c. Connect the marker output of the time-mark generator to the Aux In connector of the calibration fixture with an 18-inch 50-ohm BNC cable.

d. Connect the trigger output of the time-mark generator to the Ext Trig In connector of the 7B70 with a 42-inch 50-ohm BNC cable.

e. Set the time-mark generator for one-millisecond markers and one-millisecond triggers.

f. Set the calibration fixture Amplitude Step or Aux control fully clockwise.

g. Set the 7B70 for P-P auto triggering from the external source at a sweep rate of 0.5 millisecond/division.

h. Set the 7B70 variable time/division control to obtain exactly one marker for each major graticule division.

i. Set the time-mark generator for both one- and 0.1-millisecond markers.

j. CHECK-Vertical bowing and tilt of the marker display is less than 0.1 division (each 0.1-millisecond marker represents 0.1 division).

k. ADJUST-Geometry adjustment R792 (see Fig. 5-3) for minimum bowing of time markers. Adjustment may have to be compromised to obtain less than 0.1 division bowing and tilt everywhere within the graticule area.

l. Disconnect all test equipment and remove the plug-in units.

NOTES

Multiple horizontal lines for taking notes.

VERTICAL DEFLECTION SYSTEM CALIBRATION

Equipment Required

- | | |
|------------------------------------|--------------------------------|
| 1. 067-0587-01 calibration fixture | 6. BNC to pin-jack cable |
| 2. 7B71 plug-in unit | 7. GR to BNC adapter |
| 3. SG 503 Signal Generator | 8. Three-inch screwdriver |
| 4. 7A16 plug-in unit | 9. Low-capacitance screwdriver |
| 5. 10X probe | 10. Tuning tool |

Control Settings

Set the controls as given under Preliminary Control Settings.

NOTE

If this instrument does not contain a Readout System board (Option 1), omit step 9 and proceed with step 9A.

9. Check/Adjust Vertical Centering (For Instruments With Readout Only)

- a. Set POWER switch to off.
- b. Remove the vertical-access plate on the left side of the instrument.
- c. Remove 01155 (see Fig. 5-13B) from its socket.
- d. Return the POWER switch to on.
- e. Install the 7B71 in the A HORIZ compartment.
- f. Set the 7B71 for P-P auto, internal triggering at a sweep rate of one millisecond/division.
- g. Set the READOUT intensity control for a visible display of readout characters at the top and bottom of the display area.
- h. Set the VERTICAL MODE switch to ALT.



i. CHECK-Displayed readout characters should be equally spaced vertically from the center vertical line with the traces within 0.8 division of the center line.

NOTE

This tolerance is provided as a guide to correct instrument operation, and is not an instrument specification.

j. ADJUST-Vertical Centering adjustment R443 (see Fig. 5-5) for equal spacing of the displayed readout characters from the graticule center line. Adjust Right Vertical Centering adjustment R257 and Left Vertical Centering adjustment R277 (see Fig. 5-6) to position the alternating traces to the graticule center line.

k. Set the READOUT intensity control to OFF and replace Q1155.

NOTE

If step 9 was performed, omit step 9A and proceed with step 10.

9A. Check/Adjust Vertical Centering (For Instruments Without Readout)

- a. Install the 7B71 in the A HORIZ compartment.
- b. Set the 7B71 for P-P auto, internal triggering at a sweep rate of one millisecond/division.
- c. Set the VERTICAL MODE switch to ALT.



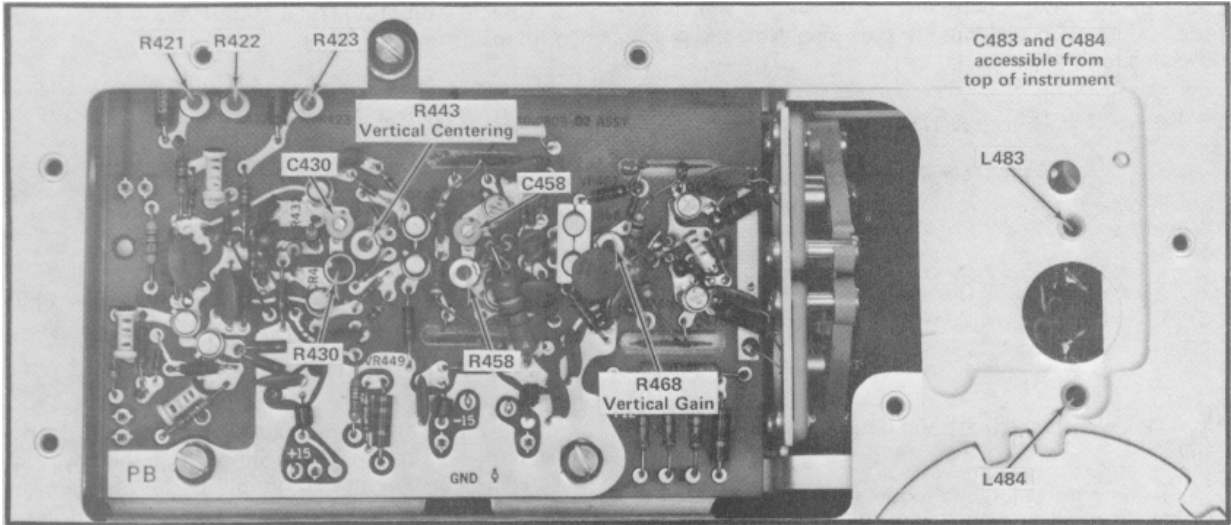


Fig. 5-5. Location of vertical adjustments (Vertical Output board; vertical-access plate removed).

- d. Remove the vertical-access plate on the left side of the instrument.
- e. CHECK-The alternating traces should be within 0.6 division of the graticule center line.

NOTE

Tolerances in parts e and g are provided as guides to correct instrument operation and are not instrument specifications.

- f. ADJUST-Right Vertical Centering adjustment R257 and Left Vertical Centering adjustment R277 (see Fig.5-6) to position the alternating traces to the center horizontal line.
- g. Set the VERTICAL MODE switch to ADD.
- h. CHECK-Trace should be within 0.6 division of the graticule center line.
- i. ADJUST-Note the distance the trace is displaced from the center horizontal line. Then, adjust the Vertical Centering adjustment R443 (see Fig. 5-5) to position the trace away from the center horizontal line by twice the distance noted prior to adjustment (e.g., if the trace was 0.1 division below the center horizontal line, adjust R443 to move the trace so it is 0.2 division below the center horizontal line)
- j. Repeat parts d through i until correct vertical centering is obtained in all vertical modes.

10. Check/Adjust Vertical Output Amplifier Gain

- a. Install the calibration fixture in the LEFT VERT compartment.
- b. Set the VERTICAL MODE switch to LEFT.
- c. Set the calibration fixture Test switch to Vert or Horiz Gain with the Rep Rate switch set to 250 kHz.

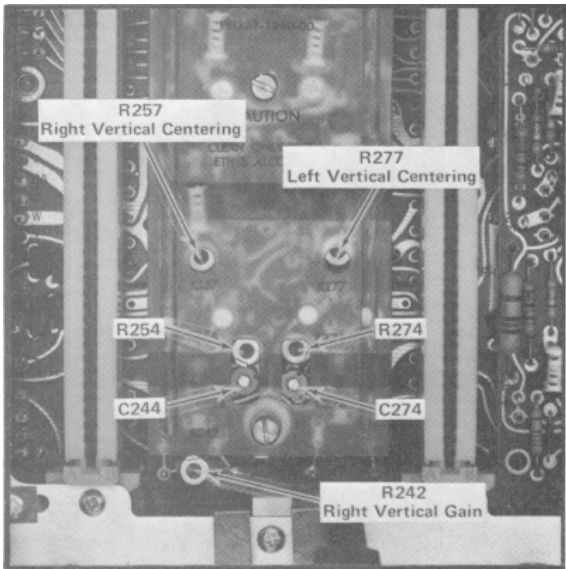


Fig. 5-6. Location of vertical preamplifier adjustments (Vertical Interface board).

d. CHECK-Deflection between the second and sixth traces should be six divisions ± 0.06 division. Note the exact deflection for step 11c.

NOTE

This tolerance is provided as a guide to correct instrument operation and is not an instrument specification.

e. ADJUST-Vertical Gain adjustment R468 (see Fig. 5-5) for exactly six divisions of deflection between the second and sixth traces.

11. Check/Adjust Right Vertical Amplifier Gain



a. Remove the calibration fixture from the LEFT VERT compartment and install it in the RIGHT VERT compartment.

b. Set the VERTICAL MODE switch to RIGHT.

c. CHECK-Deflection between the second and sixth traces should be the same as step 10d $\pm 1\%$ (six divisions ± 0.06 division if R468 was adjusted in step 10).

d. ADJUST-Right Vertical Gain adjustment R242 (see Fig. 5-6) for exactly six divisions of deflection between the second and sixth traces.

12. Check Low-Frequency Linearity

a. Set the calibration fixture Test switch to Aux In.

b. Connect the 4 V Calibrator pin-jack to the calibration fixture Aux In connector with the BNC to pin-jack cable.

c. Set the calibration fixture Amplitude control so the display is exactly two divisions in amplitude; adjust the calibration fixture Position control to keep the display centered on the graticule while setting the amplitude.

d. CHECK-Position the two divisions of deflection vertically and check for not more than 0.1 division of compression or expansion anywhere within the graticule area.

e. Disconnect the cable.

13. Check/Adjust Vertical High-Frequency Compensation



a. Remove the calibration fixture from the RIGHT VERT compartment and install it in the LEFT VERT compartment.

b. Set the VERTICAL MODE switch to LEFT.

c. Set the calibration fixture Test switch to +Step Resp, Rep Rate switch to 250 kHz, and adjust the Amplitude control for a six-division display.

d. Set the 7B71 for a calibrated sweep rate of five nanoseconds/division (use 10X magnifier). Set the triggering level control and position control for a stable display, centered on the graticule.

e. CHECK-Temporarily lay the vertical-access plate back in place. Check for optimum square corner and flat top on displayed pulse with aberrations not to exceed ± 0.15 or -0.15 division with total peak-to-peak aberrations not to exceed 0.24 division.

NOTE

Tolerances in parts e and i are provided as guides to correct instrument operation and are not instrument specifications.

f. ADJUST-High-frequency compensation as given in Table 5-2 for optimum square leading corner and flat top with minimum aberrations within limits given in part e. Location of adjustments is shown in Fig. 5-5. Use the low-capacitance screwdriver to adjust the variable capacitors, and the tuning tool to adjust the variable inductors. Make these adjustments with the vertical-access plate covering as much of the Vertical Output board as possible. Repeat the complete adjustment procedure several times to obtain optimum adjustment; then, replace the vertical-access plate and check the final result.

g. Remove the calibration fixture from the LEFT VERT compartment and install it in the RIGHT VERT compartment.

h. Set the VERTICAL MODE, switch to RIGHT.

i. CHECK-Optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed ± 0.15 or -0.15 division, with total peak-to-peak aberrations not to exceed 0.24 division.

TABLE 5-2.

High-Frequency Compensation

Adjustment	Primary area of pulse affected		Best sweep speed
R423	First microsecond	0.5	1 microsecond/division
R421	First microsecond	0.3	0.2 microsecond/division
R422	First microsecond	0.1	50 nanosecond/division
C430, R430	First nanoseconds	20	50 nanosecond/division
C483, C484, L483, L484,	First nanoseconds	10	20 nanosecond/division
C458, R458	First nanoseconds	5	20 nanosecond/division
C274, R274	Leading edge		20 nanosecond/division

j. ADJUST-C244 and R254 (see Fig. 5-6) for optimum square leading corner and flat top with minimum aberrations within limits given in part i.

14. Check Vertical Amplifier Bandwidth

a. Connect the signal generator to the CW In connector of the calibration fixture with the GR-to BNC adapter.

b. Set the Test switch of the calibration fixture to Vert or Horiz Freq Resp.

c. Set the 7B71 for a sweep rate of 0.2 microsecond/division.

d. Set the signal generator for eight divisions of deflection at its reference frequency (three megahertz).

e. Set the signal generator to the variable frequency position.

f. Without changing the output amplitude, increase the output frequency of the signal generator until the display is reduced to 5.6 divisions (-3 dB point).

g. CHECK-Output frequency must be 190 megahertz or higher (180 megahertz if checked outside the +20°C to +30°C temperature range)

h. Remove the calibration fixture from the RIGHT VERT compartment and install it in the LEFT VERT compartment (leave signal connected)

i. Set the VERTICAL MODE switch to LEFT.

j. Repeat parts d through g.

k. Disconnect all test equipment (leave plug-in units installed).

15. Check Vertical Amplifier Channel Isolation

a. Remove the calibration fixture and install a 7A16 plug-in unit in the LEFT VERT compartment.

b. Set the 7A16 for a deflection factor of 0.1 volt/division.

c. Connect the output of the signal generator to the input of the 7A16 with the GR-to-BNC adapter.

d. Set the signal generator for eight divisions of deflection at 150 megahertz.

e. Set the VERTICAL MODE switch to RIGHT.

f. CHECK-CRT display for not more than 0.1 division of 150 megahertz signal (channel isolation at least 100: 1).

g. Remove the 7A16 from the LEFT VERT compartment and install it in the RIGHT VERT compartment (leave signal connected).

h. Set the signal generator for eight divisions of deflection at 150 megahertz.

i. Set the VERTICAL MODE switch to LEFT.

j. CHECK-CRT display for not more than 0.1 division of 150 megahertz signal.

k. Disconnect all test equipment (leave plug-in unit installed).

16. Check Vertical Chopped Mode Operation

PERFORMANCE CHECK ONLY

This step is not applicable to a performance check. Proceed with step 17.

- a. Connect the 10X probe to the external trigger input of the 7B71.
- b. Connect the probe tip to TP 137 (accessible from bottom; see Fig. 5-7 for location).
- c. Set the VERTICAL MODE switch to CHOP.
- d. Set the 7B71 for P-P auto, external triggering at a sweep rate of 0.2 microsecond/division.
- e. CHECK-CRT display for chopped waveform display with duration of the time segment from each channel, including the blanked portion, between two and three divisions, Also, check that the unblanked (visible) portion

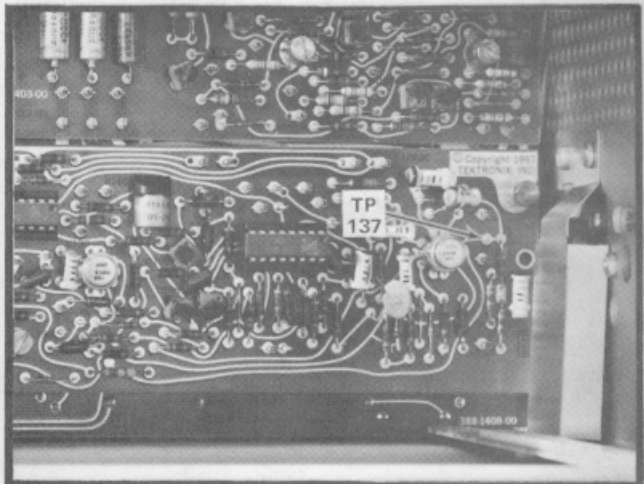


Fig. 5-7. Location of test point for chopped mode operation check (Logic board, viewed from rear of instrument). of the time segment from each channel consists of at least 75% of the duration of the total channel segment.

- f. Disconnect the probe and remove all plug-in units.

NOTES

HORIZONTAL DEFLECTION SYSTEM CALIBRATION

Equipment Required

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. 7B70 plug-in unit 2. 7B71 plug-in unit 3. 7A16 plug-in unit (two) 4. Time-mark generator 5. 067-0587-01 calibration fixture 6. Low-frequency generator 7. Medium-frequency generator 8. 42-inch 50-ohm BNC cable | <ol style="list-style-type: none"> 9. 50-ohm BNC termination 10. BNC T connector 11. 18-inch 50-ohm BNC cable 12. Five-nanosecond GR cable 13. 50-ohm in-line termination 14. Three-inch screwdriver 15. Low-capacitance screwdriver |
|--|---|

Control Settings

Set the controls as given under Preliminary Control Settings.

17. Check/Adjust Horizontal Amplifier Thermal Balance

- a. Install the 7B70 in the B HORIZ compartment and the 7B71 in the A HORIZ compartment.
- b. Install the 7A16 plug-in unit in the LEFT VERT compartment.
- c. Set the HORIZONTAL MODE switch to CHOP.
- d. Set the 7B70 for P-P auto, internal triggering at a sweep rate of five milliseconds/division with the magnifier on.
- e. Set the 7B71 for P-P auto, internal triggering at a sweep rate of five microseconds/division.
- f. Connect the marker output of the time-mark generator to the input of the 7A16 with the 42-inch 50-ohm BNC cable and a 50-ohm BNC termination.
- g. Set the time-mark generator for five microsecond markers. Set the deflection factor of the 7A16 so the markers are at least two divisions in amplitude.
- h. Set the 7B71 for a stable, triggered display; set the 7B70 for free-running operation.

i. Position the start of the sweep produced by the 7B71 to the center vertical line.

j. CHECK-Not more than 0.1 division movement of the displayed markers. If this instrument contains a Readout System, set the READOUT intensity control for visible characters; check that the displayed characters do not move more than 0.1 division.

NOTE

Tolerances in parts j and p are provided as guides to correct instrument operation and are not instrument specifications.

k. ADJUST-Thermal Balance adjustment R571 (see Fig. 5-8) for minimum movement of the displayed markers or readout characters.

l. Set the 7B70 for a sweep rate of five microseconds/division with the magnifier off.

m. Set the 7B71 for a sweep rate of five milliseconds/division with the magnifier on.

n. Set the 7B70 for a stable, triggered display; set the 7B71 for free-running operation.

o. Position the start of the sweep produced by the 7B70 to the center vertical line.

REV. B, FEB. 1976

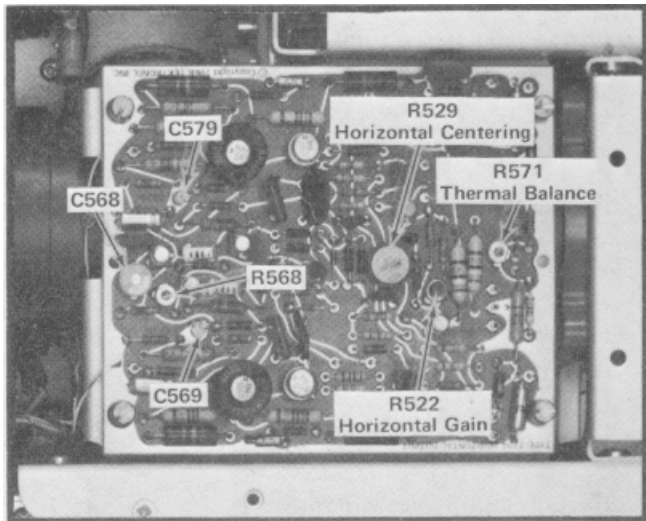


Fig. 5-8. Location of Horizontal Amplifier adjustments (Horizontal Output board).

e. CHECK-Vertical trace should align with the vertical center line of the graticule within 0.8 division (within 0.6 division if R7704 under calibration does not contain a Readout System board). Check in all positions of the HORIZONTAL MODE switch except B.

NOTE

This tolerance is provided as a guide to correct instrument operation and is not an instrument specification.

f. ADJUST-Horizontal Centering adjustment R529 (see Fig. 5-8) to position the trace to the vertical center line. If necessary, adjust for the best compromise in all positions of the HORIZONTAL MODE switch.

g. INTERACTION-If R529 is adjusted, check steps 17 and 19.

19. Check/Adjust Horizontal Amplifier Gain and Low-Frequency Linearity



a. Set the Test switch on the calibration fixture to Vert or Horiz Gain.

b. Set the HORIZONTAL MODE switch to A.

c. CHECK-Deflection between the second and eighth traces is eight divisions ± 0.08 division. Note the exact deflection for step 19h.

NOTE

Tolerances given in parts c and e are provided as guides to correct instrument operation and are not instrument specifications.

d. ADJUST-Horizontal Gain adjustment R522 (see Fig. 5-8) for exactly eight divisions of deflection between the second and eighth traces.

e. CHECK-With gain set exactly, all nine vertical traces align with their respective graticule lines within 0.1 division.

f. Remove the 7B70 from the B HORIZ compartment; move the calibration fixture from the A HORIZ compartment to the B HORIZ compartment.

g. Set the HORIZONTAL MODE switch to B.

p. CHECK-Not more than 0.1 division movement of the displayed markers. If this instrument contains a Readout System, check that the displayed characters do not move more than 0.1 division.

q. ADJUST-If necessary, compromise the setting of R571 for minimum movement of the displayed markers or readout characters in both checks j and p. If re-adjustment is necessary, recheck parts d through p.

r. INTERACTION-If R571 is adjusted, check steps 18 and 19.

s. Set the READOUT intensity control to OFF.

18. Check/Adjust Horizontal Amplifier Centering



a. Remove the 7B71 from the A HORIZ compartment and install it in the RIGHT VERT compartment.

b. Install the calibration fixture in the A HORIZ compartment.

c. Change the following control settings:

VERTICAL MODE	RIGHT
HORIZONTAL MODE	A

d. Set the Test switch on the calibration fixture to Triggering Gain.

h. CHECK-Deflection between the second and eighth traces is the same as in part c +1% (eight divisions +0.08 division if R522 was adjusted in part d).

i. ADJUST-If necessary, compromise the setting of R522 for optimum gain for both horizontal compartments.
If re-adjustment is necessary, re-check parts b through h.

j. INTERACTION-If R522 is adjusted, check steps 17 and 18.

20. Check/Adjust High-Frequency Timing 

a. Remove the calibration fixture and install the 7B70 in the B HORIZ compartment.

b. Set the VERTICAL MODE switch to LEFT.

c. Set the time-mark generator for one-millisecond markers (connected to 7A16).

d. Set the 7B70 for a sweep rate of one millisecond/division.

e. Set the 7B70 Swp Cal adjustment for one marker each major graticule division.

f. Visually check the setting of variable capacitors C569 and C579 (see Fig. 5-8). These capacitors control linearity at faster sweep rates, and should normally be adjusted out about one-third of their length. If further adjustment appears necessary due to non-linearity in the faster sweeps, adjust both capacitors equally and in the same direction. Then re-check all high-frequency timing.

g. Set the time-mark generator for two-nanosecond markers.

h. Set the 7B70 for a sweep rate of 0.02 microsecond/division with the X10 magnifier on; set the deflection factor of the 7A16 so the markers are about two divisions in amplitude.

i. CHECK-CRT display for one marker each division over the center eight divisions.

j. ADJUST-R568 (see Fig. 5-8) for one marker each division over the center eight divisions.


k. Set the 7B70 for a sweep rate of 0.05 microsecond/division with the X 10 magnifier on.

l. Set the time-mark generator for five-nanosecond markers.

m. CHECK-CRT display for one marker each division over the center eight divisions.

n. ADJUST-C568 (see Fig. 5-8) for one marker each division over the center eight divisions.

o. Repeat parts g through n until no interaction is noted.

p. Disconnect all test equipment and remove the plug-in units. 

21. Check/Adjust X-Y Delay Compensation

a. Install 7A16 plug-in units in the LEFT VERT and B HORIZ compartments.

b. Set both 7A16 units for a deflection factor of 10 millivolts/division with DC input coupling.

c. If this instrument contains Option 2 (X-Y Delay Compensation board), set the A and B Delay Disable switches to the Out (down) position.

d. Connect the low-frequency signal generator to the input of either 7A16 plug-in unit with the 42-inch 50ohm BNC cable, 50-ohm BNC termination, and BNC T connector. Connect the output of the BNC T connector to the input of the other 7A16 with an 18-inch 50-ohm BNC cable.

e. Set the low-frequency generator for eight divisions of vertical and horizontal deflection at an output frequency of 35 kilohertz.

f. CHECK-CRT lissajous display for an opening at the center vertical line of 0.28 division or less (indicates 2° or less phase shift; see Fig. 5-9B).

g. Remove the 7A16 from the B HORIZ compartment and install it in the A HORIZ compartment (leave signals connected).

- h. Set the HORIZONTAL MODE switch to A.
- i. Repeat parts e and f.
- j. Disconnect the low-frequency generator from the BNC T connector. Connect the medium-frequency generator to the input of the BNC T connector with a five-nanosecond GR cable and the 50-ohm in-line termination.

NOTE

If this instrument does not contain Option 2, omit the remainder of this step; perform steps 22a, b, c and then proceed with step 22i.

- k. Set both internal Delay Disable switches to the In (up) position.
- l. Set the medium-frequency generator for eight divisions of vertical and horizontal deflection at two megahertz.
- m. CHECK-CRT lissajous display for an opening at the center vertical line of 0.28 division or less (2° or less phase shift).
- n. ADJUST-A Phase Correction adjustment C55 (see Fig. 5-9A) for minimum opening of the display at the center vertical line.
- o. Remove the 7A16 from the A HORIZ compartment and install it in the B HORIZ compartment (leave signals connected).
- p. Set the HORIZONTAL MODE switch to B.
- q. CHECK-CRT lissajous display for an opening at the center vertical line of 0.28 division or less (20 or less phase shift).
- r. ADJUST-B Phase Correction adjustment C75 (see Fig. 5-9A) for minimum opening of the display at the center vertical line.

22. Check Horizontal Bandwidth

- a. Install the 7B70 in the RIGHT VERT compartment.
- b. Set the VERTICAL MODE switch to RIGHT.
- c. Set the 7B70 for P-P auto triggering at a sweep rate of one millisecond/division (display will free run).
- d. Set the medium-frequency generator for 10 divisions of horizontal deflection at its reference frequency (50 kilohertz).
- e. Without changing the output amplitude, increase the output frequency of the generator to three megahertz.
- f. CHECK-CRT display for 7.1 divisions or more horizontal deflection.

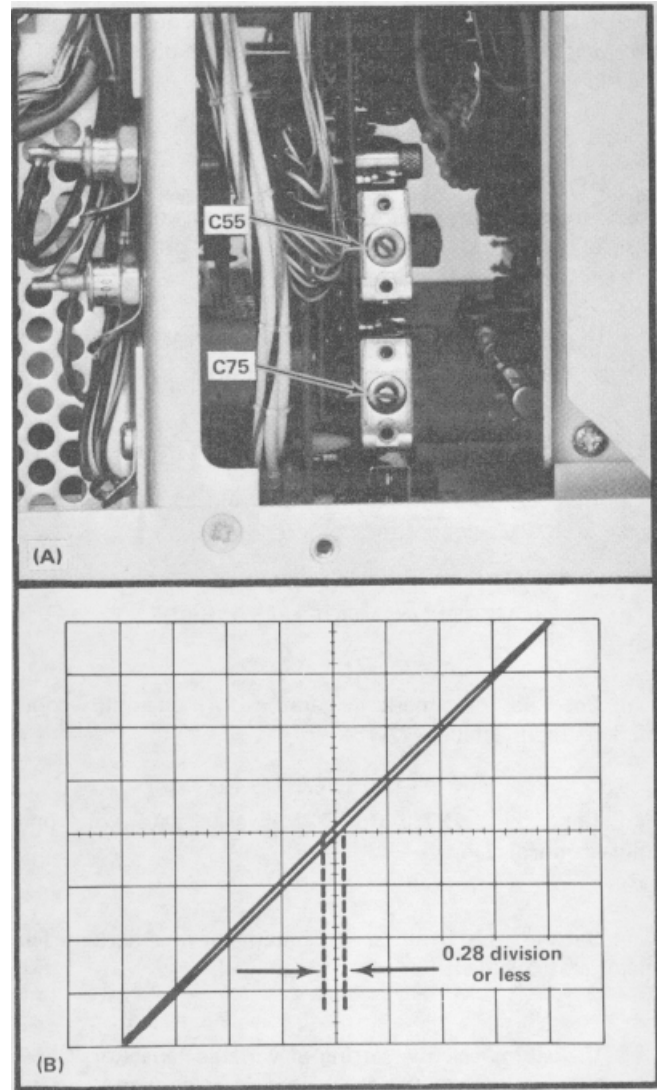


Fig. 5-9. (A) Location of phasing adjustments (X-Y Delay Compensation board), (B) Typical display when checking X-Y delay compensation.

g. Remove the 7A16 from the B HORIZ compartment and install it in the A HORIZ compartment (leave signals connected).

h. Set the HORIZONTAL MODE switch to A and repeat parts d through f of this step.

i. If this instrument contains Option 2 (X-Y Delay Compensation board), set the internal A and B Delay Disable switches to the Out (down) position.

j. Set the medium-frequency generator for five divisions of horizontal deflection at its reference frequency (50 kilohertz).

k. Without changing the output amplitude, increase the output frequency of the generator to six megahertz.

l. CHECK-CRT display for 4.5 divisions or more horizontal deflection.

m. Remove the 7A16 from the A HORIZ compartment and install it in the B HORIZ compartment.

n. Set the HORIZONTAL MODE switch to B and repeat parts j through l o. Disconnect all test equipment and remove the plug-in units.

23. Check Vertical Trace Separation Control Range



a. Install a 7A16 in the LEFT VERT compartment, a 7B71 in the A HORIZ compartment, and a 7B70 in the B HORIZ compartment.

b. Set the HORIZONTAL MODE switch to LEFT.

c. Position the trace to the top line of the graticule with the 7A16 position control.

d. Set the HORIZONTAL MODE switch to CHOP.

e. Turn the VERT TRACE SEPARATION (B) control fully counterclockwise.

f. CHECK-Trace produced by 7B70 must be positioned at least four, but not more than six, divisions below the trace produced by the 7B71.

g. Position the trace produced by the 7B71 to the bottom line of the graticule with the 7A16 position control.

h. Turn the VERT TRACE SEPARATION (B) control fully clockwise.

i. CHECK-Trace produced by 7B70 must be positioned at least four, but not more than six, divisions above the trace produced by the 7B71.

j. Remove all plug-in units.

NOTES

Horizontal lines for taking notes.

OUTPUT SIGNALS CALIBRATION

Equipment Required

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Precision DC voltmeter 2. 7A16 plug-in unit (two) 3. 7B71 plug-in unit 4. Time-mark generator 5. 7B70 plug-in unit | <ol style="list-style-type: none"> 6. BNC to pin-jack cable 7. 42-inch 50-ohm BNC cable 8. 50-ohm BNC termination 9. Three-inch screwdriver |
|---|---|

Control Settings

Set the controls as given under Preliminary Control Settings.

24. Check/Adjust Calibrator Output Voltages

PERFORMANCE CHECK ONLY

For a Performance Check, check the amplitude of the Calibrator with a calibrated oscilloscope system.

- a. Remove Q642 from its socket (see Fig. 5-10).
- b. Connect the precision DC voltmeter between the 0.4 V Calibrator pin-jack and chassis ground.
- c. CHECK-Meter reading; 0.4 volts ± 0.004 volt (within 0.008 volt if this measurement is made outside the +150C to +350C range).

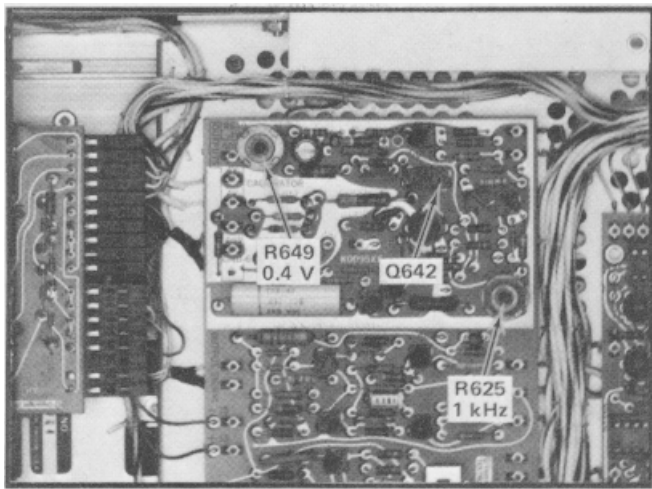


Fig. 5-10. Location of Calibrator adjustments (Output Signal board).

d. ADJUST-0.4 V adjustment R649 (see Fig. 5-10) for a meter reading of exactly 0.4 volt.

e. Disconnect the voltmeter and replace Q642.

25. Check/Adjust Calibrator Repetition Rate

- a. Install 7A16 plug-in units in both vertical compartments and the 7B71 plug-in unit in the A HORIZ compartment.
- b. Set the VERTICAL MODE switch to ALT.
- c. Connect the 0.4 V Calibrator pin-jack to the input of the 7A16 in the RIGHT VERT compartment with the BNC to pin-jack cable.
- d. Set the 7A16 in the RIGHT VERT compartment for a deflection factor of 0.2 volt/division.
- e. Connect the marker output of the time-mark generator to the 7A16 in the LEFT VERT compartment with a 42-inch 50-ohm BNC cable and a 50-ohm BNC termination.
- f. Set the time-mark generator for one-millisecond markers.
- g. Set the deflection factor of the 7A16 in the LEFT VERT compartment so the markers are at least two divisions in amplitude.
- h. Set the 7B71 for a stable display of both waveforms in the normal, internal triggering mode at a sweep rate of one millisecond/division.

i. ADJUST-1 kHz adjustment R625 (see Fig. 5-10) to align the leading edges of the calibrator square wave with the markers over the entire display area (preliminary adjustment).

j. Change the following control settings:

VERTICAL MODE	ADD
A TRIGGER SOURCE	RIGHT VERT

k. Set the 7B71 for a sweep rate of 0.2 millisecond/division. If necessary, adjust the triggering control for a stable display.

l. ADJUST-1 kHz adjustment for minimum drift of the time markers across the calibrator square wave.

m. Set the A TRIGGER SOURCE switch to VERT MODE.

n. Adjust the 7B71 triggering level so a triggered trace is presented only when the time markers occur during the positive portion of the calibrator square wave.

o. Set the 7B70 for AC low-frequency reject coupling at a sweep rate of 0.2 second/division.

p. CHECK-The amount of time required for a time marker to drift across the positive level of the calibrator square wave to the negative level and back to the positive level must be at least 0.4 second (0.2 second if outside the +150C to +350C temperature range). This time can be measured directly from the display by observing the number of divisions that the marker moves across the display area before it returns to the positive level. If the above time is not met, repeat parts h through p.

26. Check Calibrator Risetime, Falltime, and Duty Cycle

a. Set the VERTICAL MODE switch to RIGHT.

b. Set the 7B71 for P-P auto, AC-coupled triggering at a sweep rate of one-millisecond/division.

c. Set the 7A16 in the RIGHT VERT compartment for a deflection factor of 50 millivolts/division; then set the variable control for exactly five divisions of vertical deflection.

d. Position the display so it is centered vertically on the graticule.

e. Set the 7B71 for a stable display, triggered on the rising portion of the waveform at a sweep rate of 0.1 microsecond/division. Adjust the triggering level control to show as much of the rising portion as possible.

f. CHECK-Displayed waveform for not more than 2.5 divisions between the 10% and 90% points (risetime 0.25 microsecond or less).

g. Set the 7B71 for a stable display triggered on the falling portion of the waveform.

h. CHECK-Displayed waveform for not more than 2.5 divisions between the 90% and 10% points (falltime 0.25 microsecond or less).

i. Set the 7A16 for a calibrated deflection factor of 0.1 volt/division with AC input coupling.

j. Set the 7B71 for a sweep rate of 50 microseconds/division. Set the triggering controls so the display starts at the 50% point on the rising edge of the waveform.

k. Position the display horizontally so the falling edge of the waveform aligns with the center vertical line. Then, set the magnifier to on. If necessary, reposition the display so the falling edge is positioned to the center vertical line.

l. Set the 7A16 to invert the display. (NOTE the display is triggered on the opposite slope even though the display appears the same)

m. CHECK-50% point on falling edge of the waveform now displayed is within 0.4 division of the center line (indicated duty cycle of 50% +0.1%).

n. Disconnect the cables.

27. Check Sawtooth Output Signals

a. Connect the + SAWTOOTH connector (on rear panel) to the input of the 7A16 in the RIGHT VERT compartment with the 42-inch 50-ohm BNC cable.

- b. Set the 7A16 for a deflection factor of two volts/division with DC input coupling.
- c. Set the 7B71 for a sweep rate of two milliseconds/division with the magnifier off.
- d. Install the 7B70 plug-in unit in the B HORIZ compartment.
- e. Set the 7B70 for a free-running sweep at a sweep rate of 0.5 millisecond/division.
- f. Set the SWEEP switch (on top panel) to B.
- g. CHECK-CRT display for sawtooth waveform about five divisions in amplitude with a duration of at least 2.5 division.
- h. Set the HORIZONTAL MODE switch to B.
- i. Set the SWEEP switch to A.
- j. Set the 7B70 for P-P auto triggering at a sweep rate of two milliseconds/division and the 7B71 for a free-running sweep at a sweep rate of 0.5 millisecond/division.
- k. CHECK-CRT display for sawtooth waveform about five divisions in amplitude with duration of at least 2.5 divisions.

28. Check Gate Output Signals

- a. Move the cable at the rear panel from the + SAWTOOTH connector to the + GATE connector.
- b. Set the GATE switch (on top panel) to A.
- c. CHECK-CRT display for gate waveform five divisions +0.5 division in amplitude with a duration of at least 2.5 divisions.
- d. Set the HORIZONTAL MODE switch to A.
- e. Set the GATE switch to B.
- f. Set the 7B71 for P-P auto triggering at a sweep rate of two milliseconds/division and the 7B70 for a free-running sweep at a sweep rate of 0.5 millisecond/division.
- g. CHECK-CRT display for gate waveform five divisions -0.5 division in amplitude with a duration of at least 2.5 divisions.

- h. Set the GATE switch to DLY'D.
- i. Set the 7B71 delay mode to B starts after delay.
- j. CHECK-CRT display for delayed gate waveform five divisions in amplitude +0.5 division, with the starting point determined by the setting of the 7B71 delay time multiplier.

29. Check Vertical Signal Output

- a. Move the cable at the rear panel from the + GATE connector to the SIG OUT connector.
- b. Connect the 0.4 V Calibrator pin-jack to the input of the 7A16 in the LEFT VERT compartment with the BNC to pin-jack cable.
- c. Set both 7A16 plug-in units for a deflection factor of 0.2 volt/division.
- d. Set the VERTICAL MODE switch to LEFT.
- e. Position the display to the top of the display area.
- f. Change the following control settings:
VERTICAL MODE ALT B TRIGGER SOURCE
LEFT VERT
- g. CHECK-CRT display produced by 7A16 in RIGHT VERT compartment is about five divisions in amplitude.
- h. Interchange the cables connected to the 7A16 plug-in units so the calibrator signal is connected to the 7A16 in the RIGHT VERT compartment and the SIG OUT connector is connected to the 7A16 in the LEFT VERT compartment.
- i. Set the B TRIGGER SOURCE switch to RIGHT VERT.
- j. CHECK-CRT display produced by 7A16 in the RIGHT VERT compartment is about five divisions in amplitude.
- k. Disconnect all test equipment and remove the plug-in units.

Z-AXIS CALIBRATION

Equipment Required

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. 7A16 plug-in unit 2. 7B71 plug-in unit 3. Medium-frequency generator 4. Test-oscilloscope system 5. Five-nanosecond GR cable | <ol style="list-style-type: none"> 6. 50-ohm in-line termination 7. BNC T connector 8. 42-inch 50-ohm BNC cable 9. Three-inch screwdriver 10. Low-capacitance screwdriver |
|---|--|

Control Settings

Set the controls as given under Preliminary Control Settings.

30. Check External Z-Axis Operation

- a. Install the 7A16 in the LEFT VERT compartment and the 7B71 in the A HORIZ compartment.
- b. Connect the output of the medium-frequency constant amplitude signal generator to the input of the 7A16 through the five-nanosecond GR cable, 50-ohm in-line termination, and the BNC T connector.
- c. Set the 7A16 for a deflection factor of one volt/division.
- d. Set the 7B71 for P-P auto triggering at a sweep rate of 10 microseconds/division.
- e. Set the medium-frequency generator for a two division display at its reference frequency (50 kilohertz).
- f. Remove the cover from the HIGH SENSITIVITY connector on the rear panel.
- g. Connect the output of the BNC T connector to the HIGH SENSITIVITY connector with a 42-inch 50-ohm BNC cable.
- h. CHECK-Top portion of displayed waveform blanked out.
- i. Remove the cover from the HIGH SPEED connector.

j. Disconnect the cable from the HIGH SENSITIVITY connector and connect it to the HIGH SPEED connector.

k. Set the medium-frequency generator for maximum output amplitude.

l. CHECK-Top portion of displayed waveform blanked out (A INTENSITY control setting may need to be reduced to observe blanking).

m. Disconnect all test equipment and replace the covers on the Z-Axis Input connectors (leave plug-in units installed).

**31. Adjust Z-Axis Transient Response**

PERFORMANCE CHECK ONLY
Steps 31 and 32 are not applicable to a performance check. Proceed with step 33.

- a. Set the 7B71 for a sweep rate of one microsecond/division.
- b. Connect a 10X probe to the input of the test oscilloscope. Check the probe compensation.
- c. Connect the probe tip to TP 736 (see Fig. 5-11); connect the probe ground to chassis ground with a short grounding strap.
- d. Set the test oscilloscope for a vertical deflection factor of 0.5 volt/division (five volts/division at probe tip) and a sweep rate of 20 nanoseconds/division (use sweep magnifier if necessary).

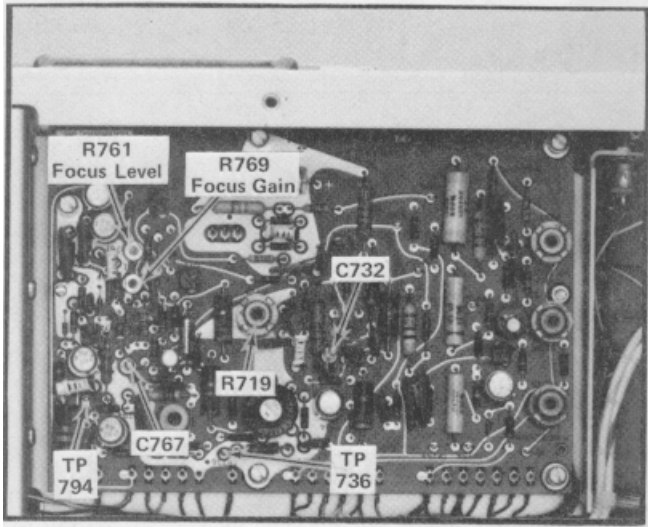


Fig. 5-11. Location of Z-Axis and auto-focus test points and adjustments (High Voltage/Z-Axis Amplifier board).

e. Adjust the A INTENSITY control for six divisions of vertical deflection on the test oscilloscope. Position the display so the leading edge of the waveform is displayed.

f. CHECK-Test oscilloscope display for risetime of 30 nanoseconds or less with a good square leading corner.

g. ADJUST-R719 and C732 (see Fig. 5-11) for optimum square leading corner while maintaining a risetime of 30 nanoseconds or less (use low-capacitance screwdriver to adjust variable capacitor).

32. Adjust Auto-Focus Operation

a. Set the 7B71 for a sweep rate of 0.05 micro-second/division.

b. Connect the test oscilloscope probe to TP 794 (see Fig. 5-11); connect the probe ground to chassis ground with a short grounding strap.

c. Set the test oscilloscope for a vertical deflection factor of five volts/division (50 volts/division at probe tip) at a sweep rate of 0.5 microsecond/division. Set the triggering controls for a stable display triggered on the negative-going slope.

d. Establish the ground reference level on the test oscilloscope. Then, set the test oscilloscope for DC input coupling.

e. Set the A INTENSITY control fully counterclockwise.

f. CHECK-DC level of trace +140 volts \pm 7 volts.

NOTE

This tolerance is provided as a guide to correct instrument operation and is not an instrument specification.

g. Set the A INTENSITY control fully clockwise.

h. ADJUST-Focus Gain adjustment R769 (see Fig. 5-11) until the baseline of the waveform just begins to lift from the zero-volt level (see Fig. 5-12 for a typical waveform).

i. Turn the A INTENSITY control counterclockwise until the baseline of the waveform raises about 0.5 division from the zero-volt level.

j. ADJUST-Focus compensation adjustment C767 (see Fig. 5-11) for best square corner (see Fig. 5-12) on the negative portion of the displayed waveform (use low capacitance screwdriver). Rotate the A INTENSITY control between midrange and maximum; if necessary, compromise the adjustment of C767 for best square corner throughout the rotation of the A INTENSITY control.

NOTE

If a good square corner cannot be obtained with C767, re-position the gimmick-capacitor wire located around R772. Then re-adjust C767 for best square corner.

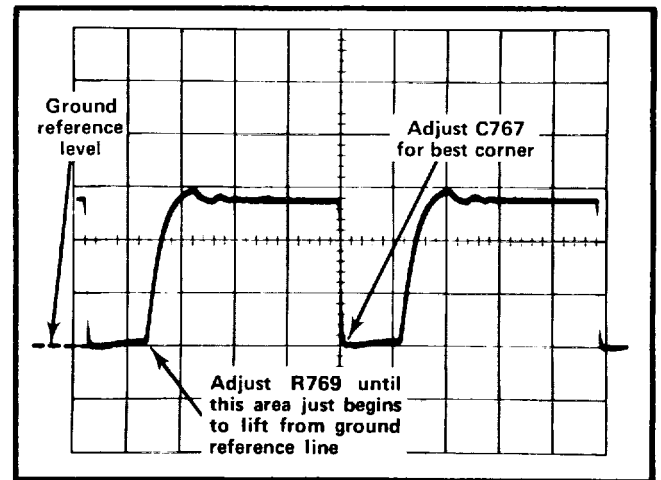


Fig. 5-12. Typical test oscilloscope display when adjusting autofocus operation.

READOUT SYSTEM CALIBRATION

Equipment Required

- 1. 7A16 plug-in unit
- 2. 7B71 plug-in unit

- 3. Three-inch screwdriver

Control Settings

Set the controls as given under Preliminary Control Settings.

33. Check/Adjust Readout System Operation 

- a. Set the POWER switch to off and remove Q1155 (see Fig. 5-13B) from its socket; return the POWER switch to on.
- b. Set the READOUT intensity control for visible characters (all zeros).
- c. CHECK-CRT display for two rows of zeros, 40 zeros to a row with no overlap. Total length of each row of characters should be between 9.5 and 10.5 divisions. Character height should be 0.25 to 0.5 division. There should be one zero or less to the right of the last graticule line, and one zero or less to the left of the first graticule line. The two rows of zeros should be located vertically in the middle of the top and bottom divisions of the graticule (see Fig. 5-13A).

NOTE

These tolerances are provided as guides to correct instrument operation and are not instrument specifications.

- d. ADJUST-Vertical Separation adjustment R1285 (see Fig. 5-13B) to position the two rows of readout characters to the middle of the top and bottom divisions of the graticule.

NOTE

Vertical centering adjustment must be correct before making this adjustment, see step 9.

- e. Set the POWER switch to off and replace Q1155 in its socket; return the power switch to ON.

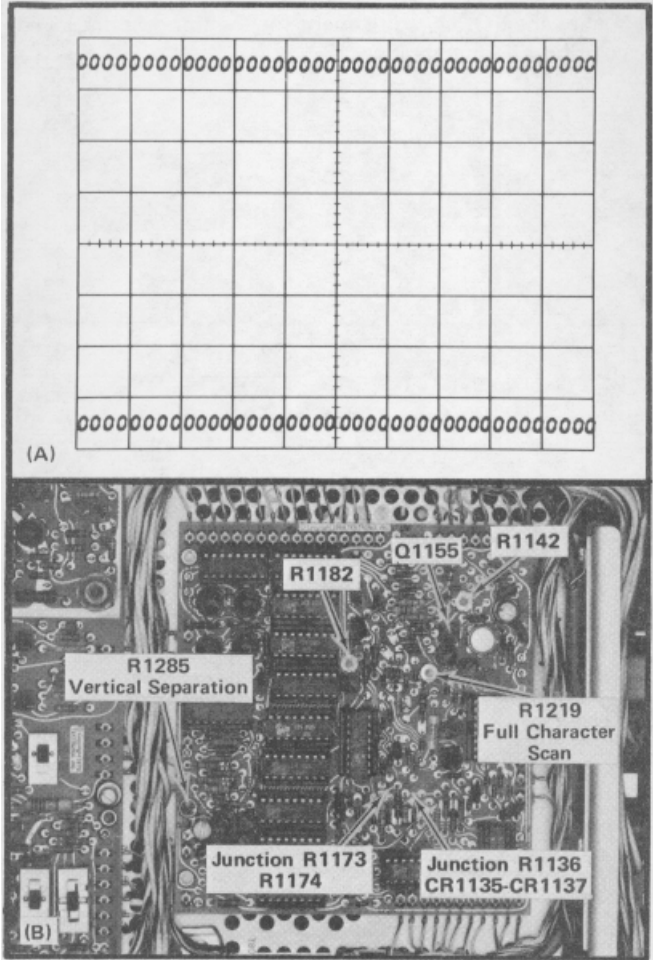


Fig. 5-13. (A) Readout display with Q1155 removed, (B) Location of Q1155 and readout adjustments (Readout System board).

- f. Install the 7A16 in the LEFT VERT compartment.
- g. Set the 7A16 for a deflection factor of 50 millivolts/ division.
- h. CHECK-Displayed characters for completeness.
- i. ADJUST-Full Character Scan adjustment R1219 (see Fig. 5-13B) for fully scanned characters. The m and the 5 will show the most change.

- j. Install the 7B71 in the A HORIZ compartment.
- k. Set the 7B71 for P-P auto triggering.
- l. Set the READOUT MODE switch to FREE RUN-REMOTE and the GATE switch to A (switches located on top panel).
- m. CHECK-Turn the 7B71 time/division switch throughout its complete range. Check that the readout characters are presented on a free-run basis, independent of the sweep rate.
- n. Set the READOUT MODE switch to GATE TRIG'D.
- o. Set the 7B71 for a sweep rate of 0.1 second/division.
- p. CHECK-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.

NOTE

The remainder of this step applies only to instruments above SN B050000.

- q. Return the Readout Mode switch to Free Run-Remote.

NOTE

Two methods of adjustment follow. If digital plug-in units such as the Tektronix 7D13 or 7D14 are to be used in this instrument, parts r through z must be used to insure correct readout operation. However, with other types of plug-in units, the alternative procedure given in parts aa through ac will provide correct operation in most cases.

- r. Set the CALIBRATOR switch to 0.4 V.
- s. Connect the calibrator signal to the junction of R1136CR1135-CR1137 (see Fig. 5-13B) with an 18-inch BNC cable, BNC to alligator clips adapter 013-0076-00

(use red lead), 0.1 pf 25 volt capacitor, and a 10 kΩ 5% resistor, in given order. The resistor can either be temporarily soldered in place or a mini-alligator clip can be added to the resistor to clip it in place.

- t. Press and hold the Identify button on the 7A16.
- u. CHECK-Readout display for correct indication of 'IDENTIFY'. If the readout display either blinks or is incorrect, adjustment is required.
- v. ADJUST-R1142 (see Fig. 5-13B) for correct readout indication. Set R 1 142 to the center of the adjustment range which provides correct readout indication. Release the Identify button.
- w. Disconnect the 10 kΩ resistor and re-connect it to the junction of R 1173-R 1174 (see Fig. 5-13B).
- x. Press and hold the Identify button on the 7A16.
- y. CHECK-Readout display for correct indication of 'IDENTIFY'. If the readout display either blinks or is incorrect, adjustment is required.
- z. ADJUST-R 1182 (see Fig. 5-13B) for correct readout indication. Set R1182 to the center of the range of adjustment which provides correct readout indication. Release the Identify button and disconnect the 10 kΩ resistor.

Alternative Procedure

- aa. Press and hold the Identify button on the 7A16.
- ab. CHECK-Readout display for correct indication of 'IDENTIFY'.
- ac. ADJUST-R1142 and R1182 (see Fig. 5-13B) for correct readout indication. Set these adjustments to the center of the range of adjustment that provides correct readout indication. Release the Identify button.

This completes the calibration/checkout procedure for the R7704. Disconnect all test equipment and replace the top and bottom covers. If the instrument has been completely checked and adjusted to the tolerances given in this procedure, it will meet or exceed the specifications given in Section 1.

SECTION 6 RA CKMOUNTING

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

The R7704 Oscilloscope is designed to be installed in a standard 19-inch wide rack. It can be mounted in racks with Universal, EIA, RETMA, or Western Electric mounting-hole spacing. The following information provides complete rackmounting instructions for this instrument.

Instrument Dimensions

A dimensional drawing showing the major dimensions of the R7704 is shown in Fig. 6-7.

Rack Dimensions

Height. At least seven inches of vertical space is required to mount this instrument in a rack. This allows sufficient clearance for adjacent instruments or panels.

Width. Minimum dimension between the front rails of the rack is 17 5/8 inches. This allows room on each side of the instrument for the slide-out tracks to operate freely, permitting the instrument to move in and out of the rack. An additional inch of clearance is required on the right of the instrument for proper cooling (see dimensional drawing).

Depth. Total depth necessary to mount this instrument in an enclosed cabinet rack is 24 inches. This allows sufficient room for circulation, power cord and signal connections, and for the necessary mounting hardware.

NOTE

If this instrument is mounted in a shallow rack where the rear mounting brackets must extend behind the instrument, a maximum of 27 inches clearance behind the front rails is required.

The rear mounting brackets supplied allow mounting this instrument in racks which have rear rails spaced between 16 3/8 and 26 3/4 inches from the front rail. Do not mount the R7704 in an installation where it is not correctly supported at the rear, as the instrument may be damaged.

Slide-Out Tracks

The slide-out tracks provided with the R7704 permit it to be extended out of the rack for maintenance and calibration without removing it from the rack. In the fully extended position, the R7704 can be tilted and securely locked in any one of six positions above and below horizontal. This allows access to the bottom and rear of the instrument without removing the instrument from the rack. To operate the R7704 in the extended position, be sure the power cord and any signal cables are long enough for this purpose.

The slide-out tracks consist of two assemblies; one for the left side of the instrument and one for the right side. Fig. 6-1 shows the complete slide-out track assemblies. The stationary section of each assembly attaches to the front and rear rails of the track, and the chassis section is attached to the instrument. The intermediate section slides between the stationary and chassis sections to allow the R7704 to be extended out of the rack. When this instrument is shipped, the stationary and intermediate sections of the tracks are packaged as matched sets, and should not be separated. To identify the left or right assembly, note the position of the automatic latch (see Fig. 6-1). When mounted in the rack, the automatic latch should be at the bottom of both assemblies. The chassis sections of both assemblies are installed on the instrument and pre-adjusted for correct alignment at the factory.

The hardware needed to mount the slide-out tracks to the rack is shown in Fig. 6-2. Since the hardware supplied is intended to make the tracks compatible with a variety of cabinet racks and installation methods, not all of it will be needed for this installation. Use only the hardware that is required for the mounting method used.

Mounting Procedure

Use the following procedure to install the R7704 in a rack:

1. Select the proper front-rail mounting holes for the stationary sections using the measurements shown in Fig. 6-3.
2. Mount the front-flanges of the stationary sections to the front rails of the rack with a bar nut and two pan-head

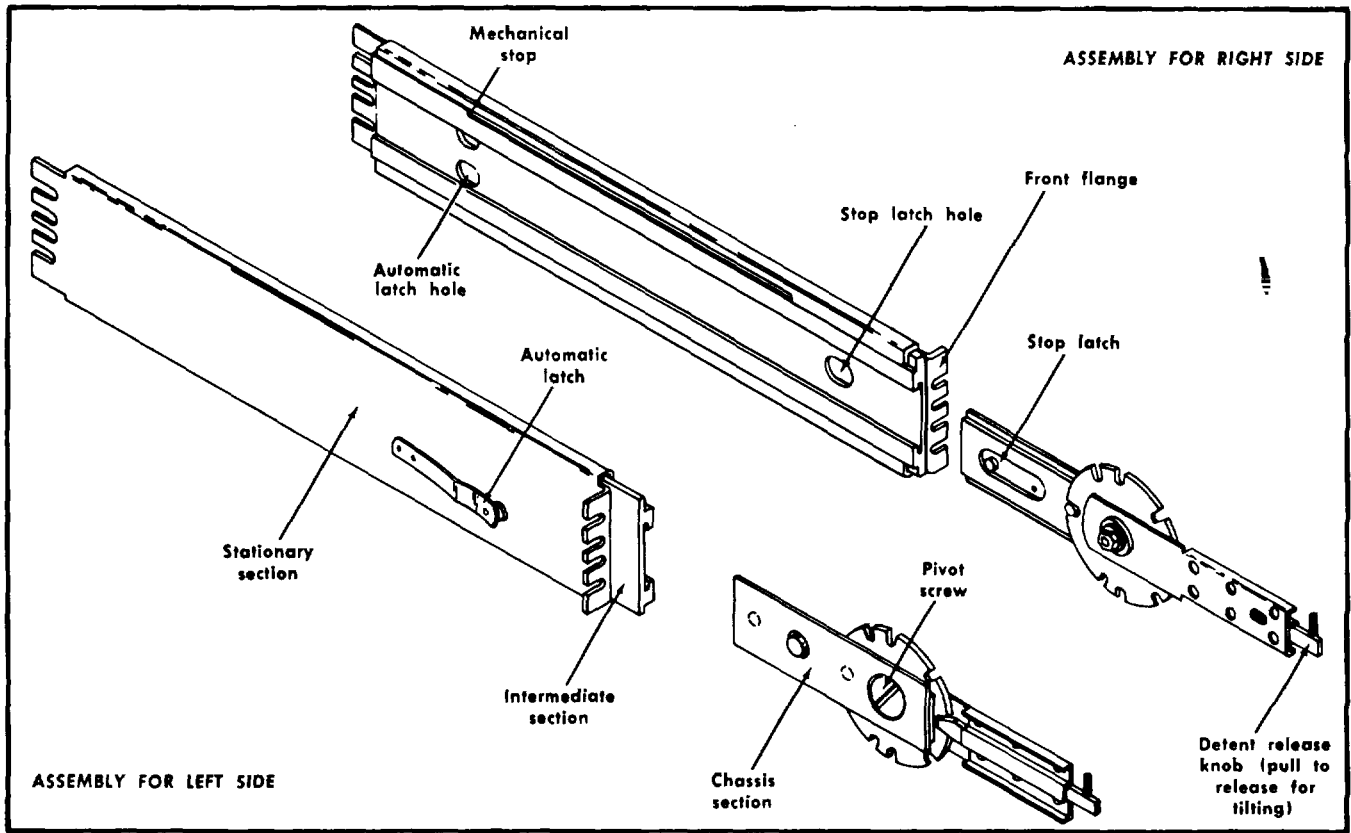


Fig. 6-1. Slide-out track assemblies.

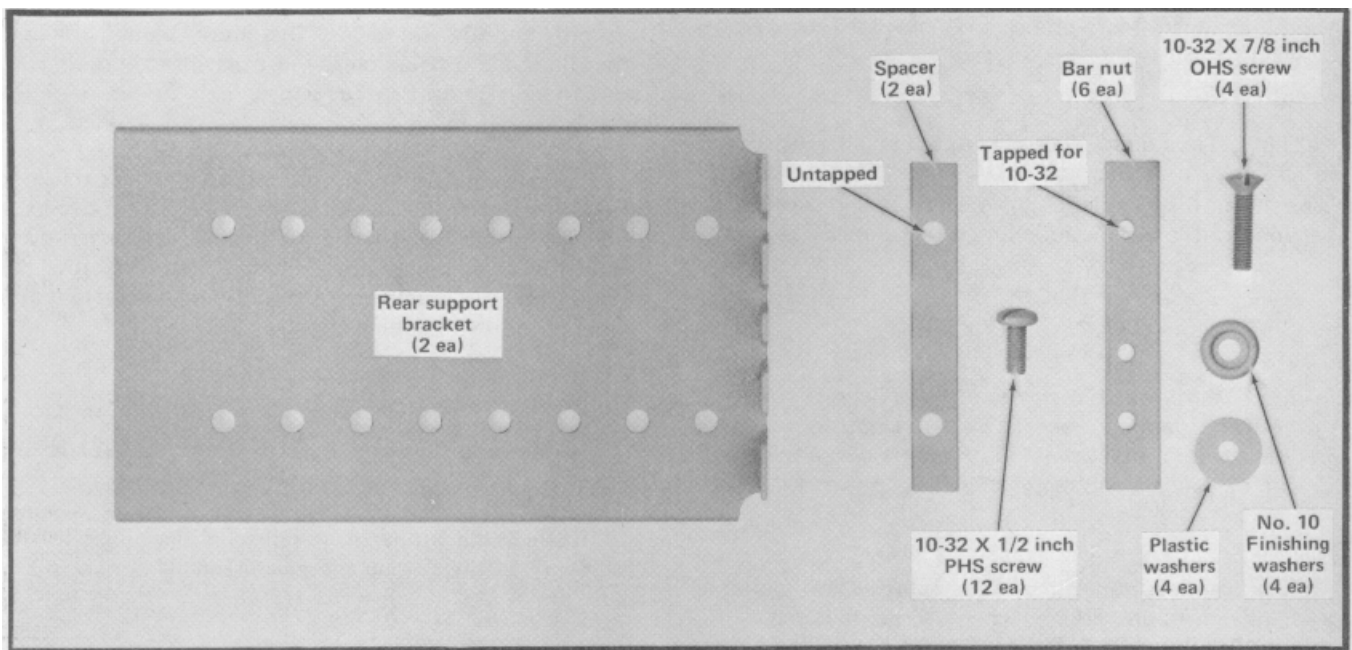


Fig. 6-2. Hardware required to mount the instrument in a cabinet rack.

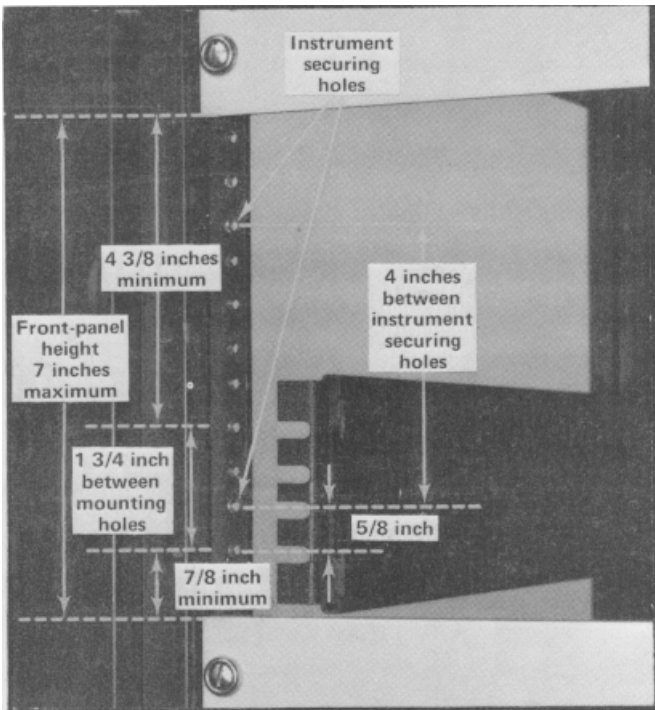


Fig. 6-3. Locating the mounting holes for the left stationary section. Same dimensions apply to right stationary section.

screws (see Fig. 6-4A). Position the bar nut so the offset middle hole is toward the bottom.

NOTE

If the rails of the rack are tapped, drill out these three holes with a $\text{O. } 1/16\text{-inch}$ drill.

3. Mount the rear of the stationary sections to the rear rails using the method shown in either 6-4B or 6-4C. Be sure the tracks are mounted level.

4. Refer to Fig. 6-5 to insert the instrument into the rack. Do not connect the power cord or install the securing screws until all adjustments have been made.

5. Follow the procedure given in Fig. 6-6 to adjust the alignment of the stationary sections.

NOTE

If the slide-out tracks can not be adjusted so the instrument slides in and out of the rack easily using the procedure given in Fig. 6-6, adjust the pivot screw on the chassis section for correct alignment of the chassis section with the bottom of the instrument. This adjustment is made before the instrument is shipped and should not need readjustment in normal use.

6. After the tracks operate smoothly, connect the power cord to the power source and connect any necessary cables to the rear panel connectors.

7. Push the instrument all the way into the rack and secure it to the front-rail of the rack with the securing screws and washers shown in Fig. 6-5. If the top securing hole is not tapped, use a "speed-nut" or similar item to install the top screw.

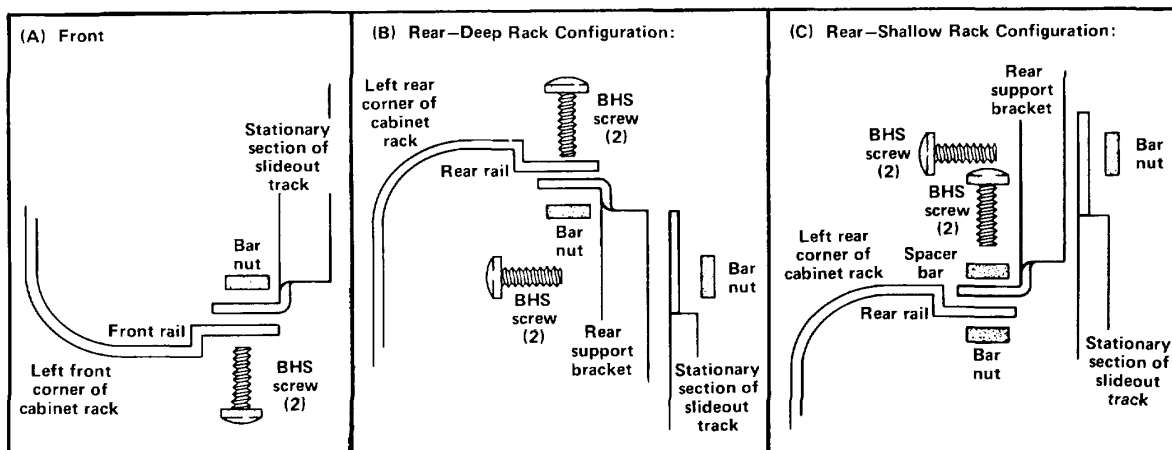
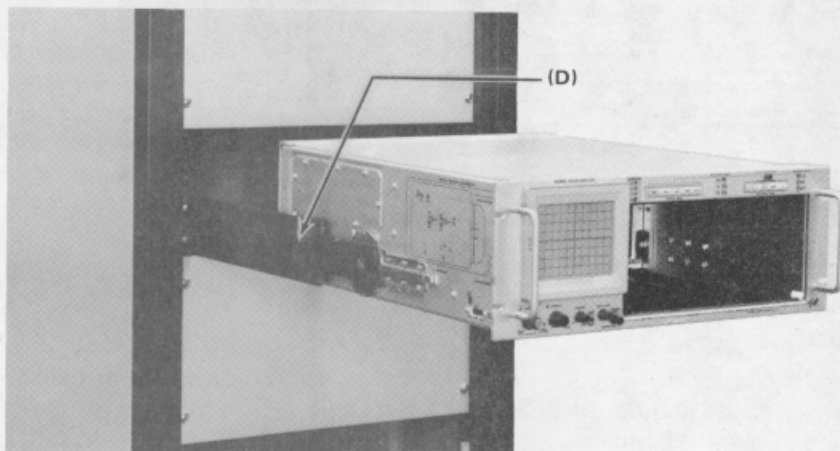
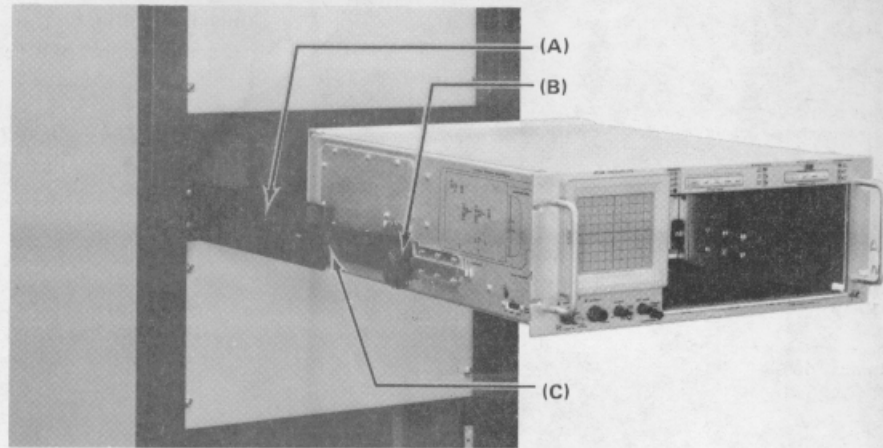


Fig. 6-4. Details for mounting stationary sections.

TO INSERT THE INSTRUMENT:

1. Pull out the intermediate section (A) of each slide-out track to its fully extended position.
2. Insert the chassis sections (B) into the intermediate sections and push the instrument in until the stop latches (C) hit the intermediate sections.
3. Press both stop latches (C) and push the instrument in until the stop latches snap into the stop-latch holes (D).
4. Press both stop latches (D) and push the instrument all the way into the rack. The automatic latches will release as the instrument is pushed in.
5. Insert the 4 securing screws (E), with finishing washers and plastic washers, through the slots in the front panel in the front rails of the rack.

**TO REMOVE THE INSTRUMENT:**

1. Remove the securing screws and washers (E).
2. Pull the instrument outward until the stop latches snap into the stop-latch holes and the automatic latches snap into the automatic latch holes.
3. Disconnect the power cord and remove the interconnecting cables from the rear-panel connectors.
4. Press both stop latches (D) and pull the instrument out of the rack.

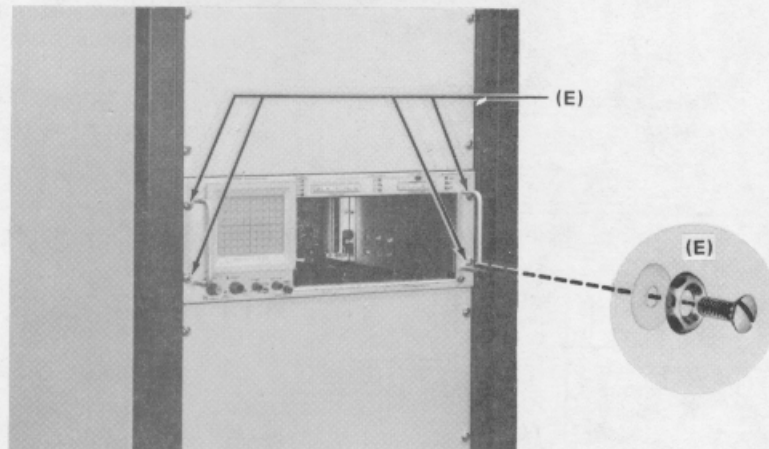


Fig. 6-5. Procedure for inserting or removing the instrument after the slideout tracks have been installed.

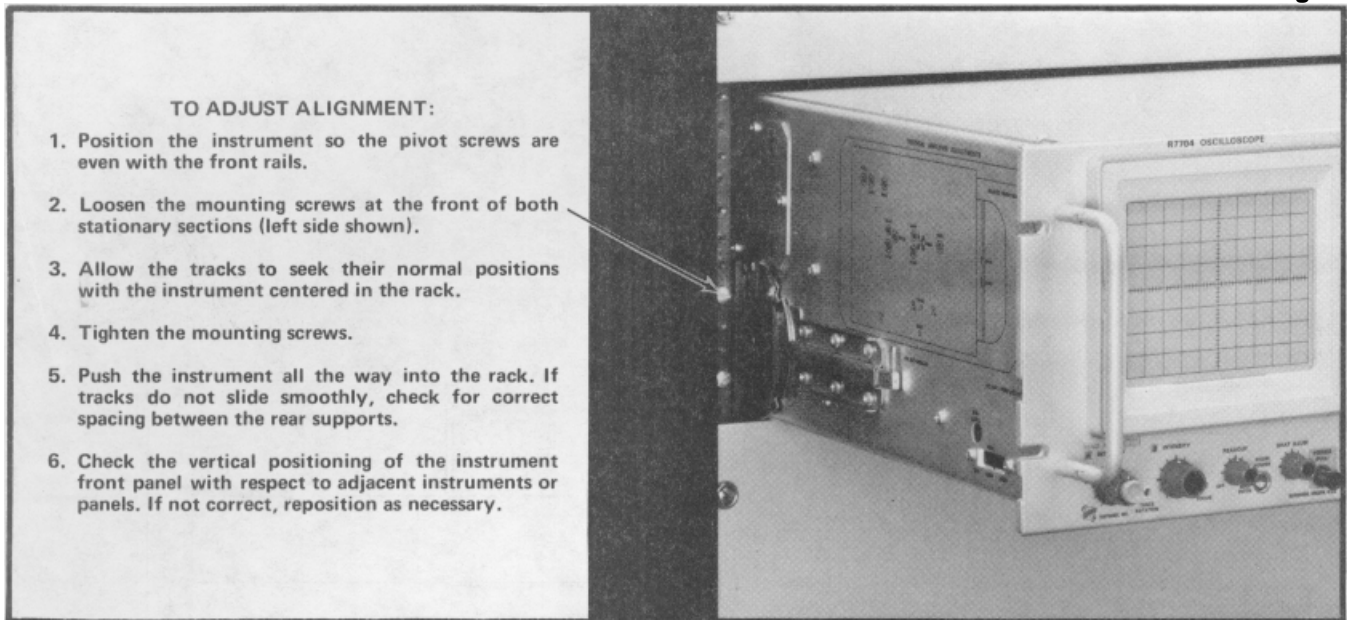


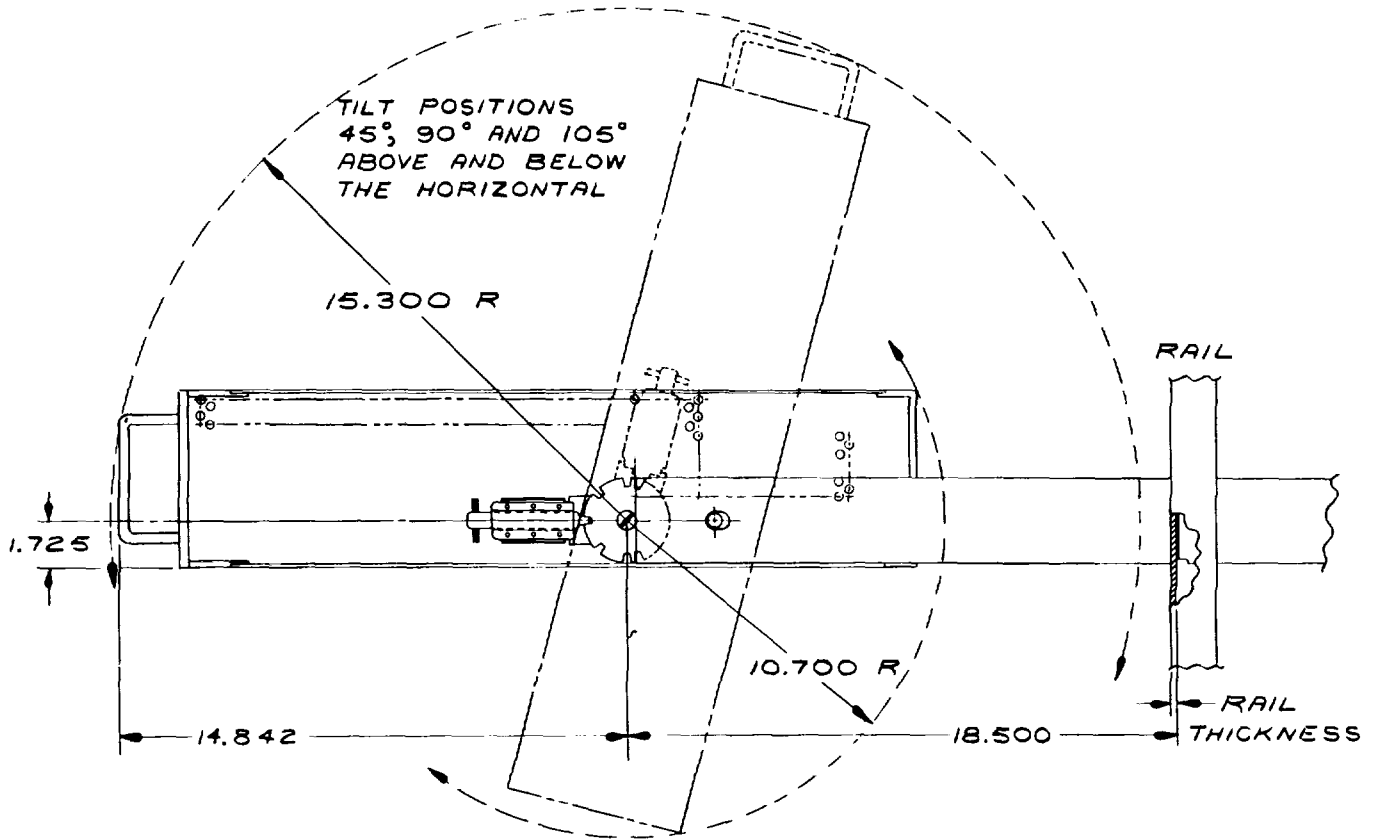
Fig. 6-6. Slide-out track alignment adjustment.

Removing or Installing the Instrument

After initial installation and adjustment of the slide-out tracks, the R7704 can be removed or installed by following the instructions given in Fig. 6-5. No further adjustments are required under normal conditions.

Slide-Out Track Lubrication

The special finish on the sliding surfaces of the slide-out tracks provides permanent lubrication. However, if the tracks do not slide smoothly even after proper adjustment, a thin coating of paraffin can be rubbed onto the sliding surfaces for additional lubrication.



NOTES:

1. ALL DIMENSIONS ARE REFERENCE DIMENSIONS EXCEPT AS NOTED

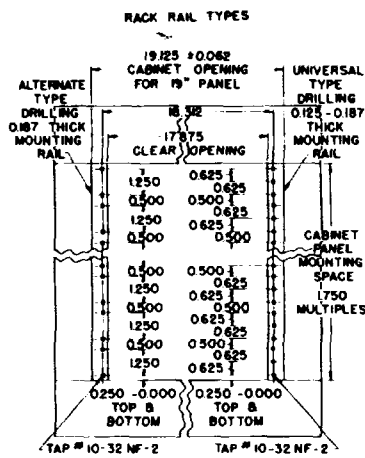


Fig. 6-7. Dimensional drawing of R7704.

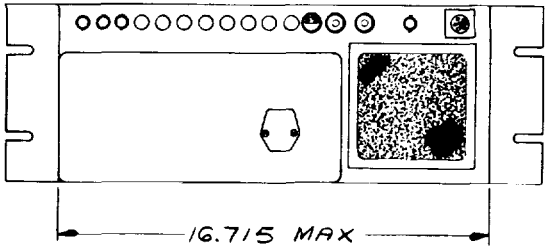
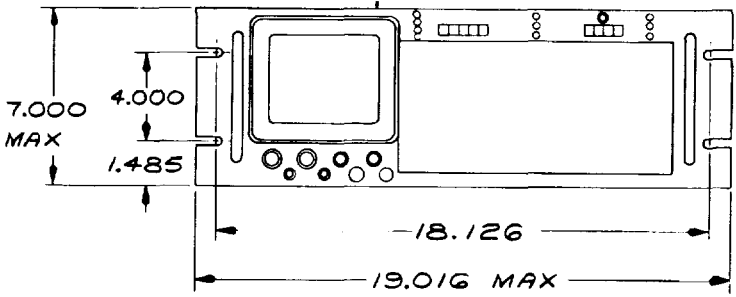
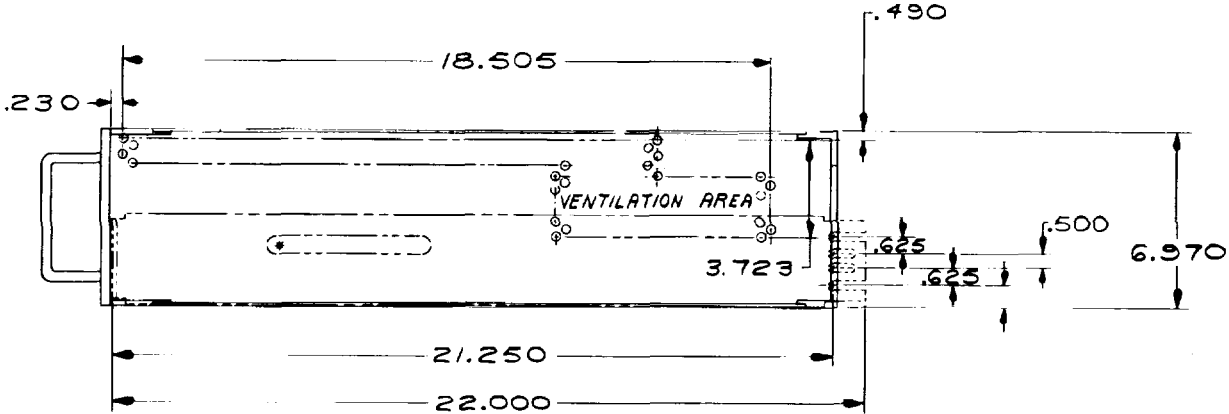
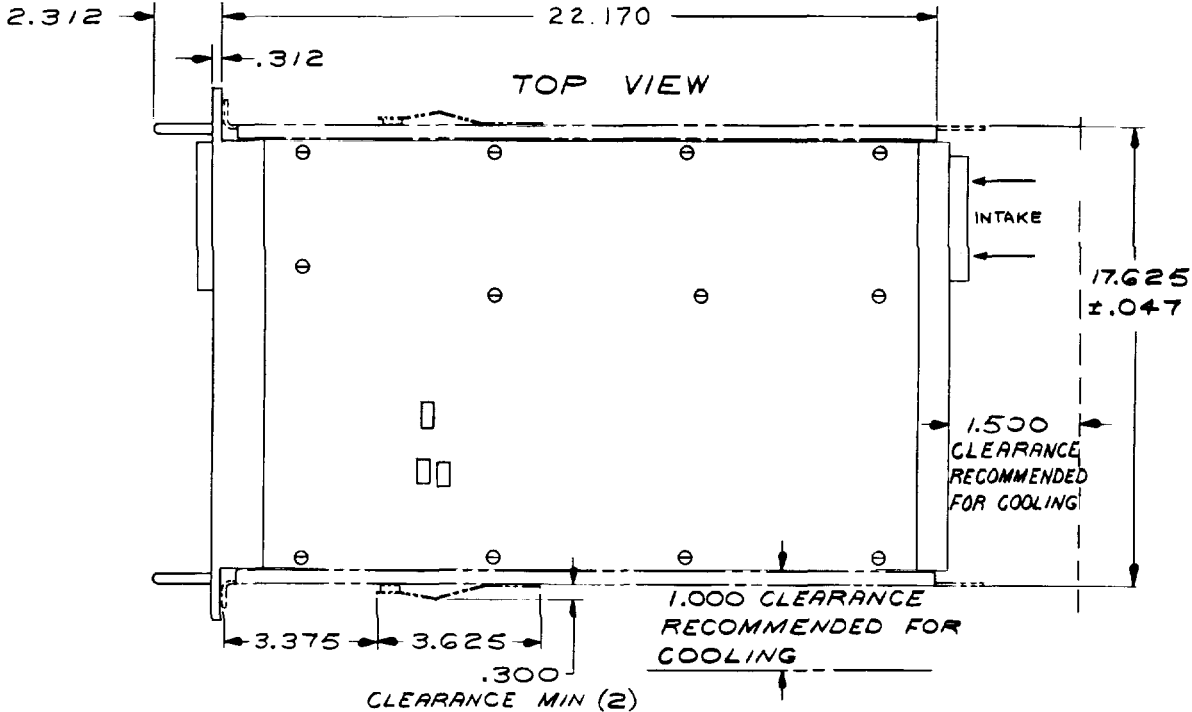


Fig. 6-7. (cont)

**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

REV. D JULY 1978

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
0000A	LEMO USA	2015 2ND STREET	BERKLEY, CA 94710
00213	NYTRONICS, COMPONENTS GROUP, INC., SUBSIDIARY OF NYTRONICS, INC.	ORANGE STREET	DARLINGTON, SC 29532
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01002	GENERAL ELECTRIC COMPANY, INDUSTRIAL AND POWER CAPACITOR PRODUCTS DEPARTMENT	JOHN STREET	HUDSON FALLS, NY 12839
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01282	PARKER STEARNS AND CO., INC.	300 SHEFFIELD AVENUE	BROOKLYN, NY 11207
02114	FERROXCUBE CORPORATION	PO BOX 359, MARION ROAD	SAUGERTIES, NY 12477
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04099	CAPCO, INC.	FORESIGHT INDUSTRIAL PARK, PO BOX 2164	GRAND JUNCTION, CO 81501
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTL BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
05091	TRI-ORDINATE CORPORATION	343 SNYDER AVENUE	BERKELEY HEIGHTS, NJ 07922
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
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12954	SIEMENS CORPORATION, COMPONENTS GROUP	8700 E THOMAS RD, P O BOX 1390	SCOTTSDALE, AZ 85252
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15454	RODAN INDUSTRIES, INC.	2905 BLUE STAR ST.	ANAHEIM, CA 92806
18583	CURTIS INSTRUMENTS, INC.	200 KISCO AVE.	MOUNT KISCO, NY 10549
32159	WEST-CAP ARIZONA	2201 E. ELVIRA ROAD	TUCSON, AZ 85706
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787	MUSKEGON, MI 49445
56289	SPRAGUE ELECTRIC CO.	445 CONCORD AVE.	NORTH ADAMS, MA 01247
71279	CAMBRIDGE THERMIONIC CORP.		CAMBRIDGE, MA 02138
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
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION NO ENTRY FOR 7298	SOUTH PARK AND JOHN STREETS	WILLIMANTIC, CT 06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
73293	HUGHES AIRCRAFT CO., ELECTRON DYNAMICS DIV.	P. O. BOX 2999	TORRANCE, CA 90509
75042	TR;W ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
79727	C-W INDUSTRIES	550 DAVISVILLE RD., P O BOX 96	WARMINISTER, PA 18974
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80740	BECKMAN INSTRUMENTS, INC.	2500 HARBOR BLVD.	FULLERTON, CA 92634
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
87034	ILLUMINATED PRODUCTS INC., A SUB OF OAK INDUSTRIES, INC.	2620 SUSAN ST, PO BOX 11930	SANTA ANA, CA 92711
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
A1	670-0817-00				CKT BOARD ASSY:MAIN INTERFACE	80009	670-0817-00
C1	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C2	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C3	283-0178-00				CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C4	283-0178-00				CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C5	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C6	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
CB	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C9	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C10	283-0178-00				CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C11	283-0178-00				CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C12	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C13	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C18	283-0192-00				CAP.,FXD,CER DI:0.47UF,+80-20%,3V	91418	MX474Z0304RO
C36	283-0178-00				CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C38	283-0178-00				CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C42	281-0529-00				CAP.,FXD,CER DI:1.5PF,+/-0.25PF,500V	72982	301-000COK0159C
CR35	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR37	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR39	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR40	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR41	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR44	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR45	152-0141-02				SEMICONV DEVICE:SILICON,30V,1SOMA	07910	1N4152
J1	131-0767-02	B010100	B069999		CONNECTOR,RCPT,:76 CONTACT	80009	131-0767-02
J1	131-0767-08	B070000			CONNECTOR,RCPT,:PLUG-IN CKT BD,70 CONTACT	80009	131-0767-08
J2	131-0767-02	B010100	B069999		CONNECTOR,RCPT,:76 CONTACT	80009	131-0767-02
J2	131-0767-08	B070000			CONNECTOR,RCPT,:PLUG-IN CKT BD,70 CONTACT	80009	131-0767-08
J3	131-0767-00	B010100	B069999		CONNECTOR,RCPT,:76 CONTACT	80009	131-0767-00
J3	131-0767-07	B070000			CONNECTOR,RCPT,:PLUG-IN CKT BD,70 CONTACT	80009	131-0767-07
J4	131-0767-00	B010100	B069999		CONNECTOR,RCPT,:76 CONTACT	80009	131-0767-00
J4	131-0767-07	B070000			CONNECTOR,RCPT,:PLUG-IN CKT BD,70 CONTACT	80009	131-0767-07
Q24	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q28	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
R1	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R3	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R4	321-0231-00				RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R5	321-0231-00				RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R8	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R9	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R19	315-0202-00				RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R20	315-0202-00				RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R21	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R22	315-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R23	315-0562-00				RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	C85625
R24	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R25	315-0513-00				RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R26	315-0103-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1035
R27	315-0562-00				RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R28	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025

REV. E JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R29	315-0513-00				RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R31	315-0132-00				RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R32	321-0204-00				RES.,FXD,FILM:1.3K OHM,1%,O.125W	91637	MFF1816G13000F
R33	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,O.25W	01121	CB5105
R34	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,O.25W	01121	CB5105
R35	315-0132-00				RES.,FXD,CMPSN:1.3K OHM,5%,O.25W	01121	CB1325
R36	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,O.25W	01121	CB1045
R37	315-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,O.25W	01121	CB1525
R38	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,O.25W	01121	CB1045
R39	315-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,O.25W	01121	CB1525
R40	315-0243-00				RES.,FXD,CMPSN:24K OHM,5%,O.25W	01121	CB2435
R42	315-0511-00	B010100	B080939X		RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R43	315-0511-00	B010100	B080939X		RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R44	315-0472-00				RES.,FXD,CMPSN:4.7K OHM,5%,O.25W	01121	CB4725
R45	321-0222-00				RES.,FXD,FILM:2K OHM,1%,O.125W	91637	MFF1816G2000OF
R46	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,O.25W	01121	CB5105
R47	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,O.25W	01121	CB5105
R48	315-0511-00	B010100	B080939X		RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R49	315-0511-00	B010100	B080939X		RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
A2	670-0848-01	B010100	B019999		CKT BOARD ASSY:LOGIC	80009	670-0848-01
A2	670-0848-02	B020000	B029999		CKT BOARD ASSY:LOGIC	80009	670-0848-02
A2	670-0848-03	B030000	B030000		CKT BOARD ASSY:LOGIC	80009	670-0848-03
A2	670-0848-04	B040000			CKT BOARD ASSY:LOGIC	80009	670-0848-04
C101	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C102	290-0134-00				CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C103	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C104	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C115	283-0003-00				CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C117	283-0668-00				CAP.,FXD,MICA D:184PF,1%,500V	00853	D155F184OFO
C119	281-0564-00				CAP.,FXD,CER DI:24PF,5%,500V	72982	301-000COG0240J
C131	281-0525-00				CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C132	281-0543-00				CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C133	281-0525-00				CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C137	281-0629-00				CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000COGO330J
C139	281-0629-00				CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000COG0330J
C141	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105O
C144	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C163	283-0116-00				CAP.,FXD,CER DI:820PF,5%,500V	72982	801-547B821J
C165	281-0603-00				CAP.,FXD,CER DI:39PF,5%,500V	72982	308-000COG0390J
C166	281-0528-00				CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C172	281-0523-00				CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C176	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
CR128	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR139	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR145	152-0153-00				SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR146	152-0153-00				SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR147	152-0141-02				SEMICONV DEVICE:SILICON,30V,150OMA	07910	1N4152

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
CR156	152-0141-02				SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR157	152-0141-02				SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR175	152-0141-02				SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR176	152-0141-02				SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR177	152-0141-02				SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR178	152-0141-02	XB040000			SEMICOND DEVICE:SILICON,30V,15MA	07910	1N4152
CR181	152-0079-00	XB020000	B069999		SEMICOND DEVICE:GERMANIUM,20V	73293	HD1841
CR181	152-0075-00	B070000			SEMICOND DEVICE:GE,25V,40MA	80009	152-0075-00
CR183	152-0141-02				SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR184	152-0141-02				SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
L101	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
L102	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
L103	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
L104	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
L115	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
L136	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
L138	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
LR134	108-0543-00				COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR151	108-0543-00				COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR180	108-0543-00				COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR190	108-0543-00				COIL,RF:FIXED,1.1UH	80009	108-0543-00
Q146	151-0198-00				TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q162	151-0198-00				TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q168	151-0223-00				TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q182	151-0198-00				TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q192	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q194	151-0192-00				TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q196	151-0192-00				TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
R104	315-0100-00				RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R110	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R111	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R112	301-0241-00				RES.,FXD,CMPSN:240 OHM,5%,0.50W	01121	EB2415
R113	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R114	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R115	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R116	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R117	315-0471-00				RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R118	315-0822-00				RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R119	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R120	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R121	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R122	321-0289-00				RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R123	321-0193-00				RES.,FXD, FILM :1K OHM,1%,0.125W	91637	MFF1816G10000F
R124	315-0223-00				RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R125	321-0193-00				RES.,FXD, FILM :1K OHM,1%,0.125W	91637	MFF1816G10000F
R126	315-0223-00				RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R127	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R128	315-0202-00				RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R135	315-0752-00				RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R136	315-0271-00				RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R137	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R138	315-0271-00				RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715

REV. G JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R139	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R140	311-0807-00	B010100	B069999		RES.,VAR, NONWIR :1K OHM,0.50W		
R140	311-1280-00	B070000			RES.,VAR, NONWIR :1K OHM,10%,0.50W	32997	3329W-L58-102
R141	315-0151-00				RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R142	321-0225-00				RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R143	321-0226-00				RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R144	321-0210-00				RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R145	321-0224-00				RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
R146	315-0242-00				RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R147	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R148	315-0303-00				RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R149	315-0682-00				RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R152	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R153	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R154	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R155	316-0102-00	XBO30000			RES.,FXD,CMPSN: 1K OHM,10%,0.25W	01121	CB1021
R156	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R160	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R161	315-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R162	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R163	315-0183-00				RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R164	315-0102-00				RES.,FXD,CMPSN: 1K OHM,5%,0.25W	01121	CB1025
R165	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R166	315-0153-00				RES.,FXD,CMPSN:1SK OHM,5%,0.25W	01121	CB1535
R167	315-0222-00				RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R168	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R169	315-0182-00				RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R170	315-0271-00	B010100	B039999		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R170	315-0511-00	B040000			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R171	321-0205-00				RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R172	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R173	315-0622-00				RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R174	315-0622-00				RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R175	321-0328-00				RES.,FXD,FILM:25.5K OHM,1%,0.125W	91637	MFF1816G25501F
R176	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R177	315-0363-00				RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
R178	315-0392-00				RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R179	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R180	315-0222-00				RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R181	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R182	315-0102-00				RES.,FXD,CMPSN :1K OHM,5%,0.25W	01121	CB1025
R183	315-0202-00				RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R191	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R192	315-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R193	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R194	315-0303-00				RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R195	315-0222-00				RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R196	315-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R197	315-0301-00				RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R198	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
U120	155-0011-00				MICROCIRCUIT,DI:ML,CLOCK AND CHOP BLANKING	80009	155-0011-00
U130	155-0010-00				MICROCIRCUIT,DI:ML,CHOP DIVIDER/BLANKING	80009	155-0010-00
U150	155-0013-00				MICROCIRCUIT,DI:ML,HORIZ CHOP ALTN BINARY	80009	155-0013-00

REV. G JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
U160	155-0009-00		MICROCIRRCUIT,DI:ML,HORIZ LOCKOUT LOGIC	80009	155-0009-00
U170	155-0012-00		MICROCIRRCUIT,LI :ML,Z-AXIS AND AMPLIFIER	80009	155-0012-00
U180	155-0013-00		MICROCIRRCUIT,DI:ML,HORIZ CHOP ALTN BINARY	80009	155-0013-00
U190	155-0013-00		MICROCIRRCUIT,DI:ML,HORIZ CHOP ALTN BINARY	80009	155-0013-00
VR148	152-0166-00		SEMICONDD DEVICE:ZENER,0.4W,6.2V,5%	81483	69-9035
A3	670-0625-00		CKT BOARD ASSY:TRIGGER SELECTOR	80009	670-0625-00
C303 ¹	SELECTED	XB070600			
C307 ¹	SELECTED	XB070600			
C309	281-0541-00		CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301- 0COH0689D
C318	281-0616-00		CAP.,FXD,CER DI:6.8PF,+/-0.5PF,200V	72982	374- 1COH0689D
C319	281-0616-00		CAP.,FXD,CER DI:6.8PF,+/-0.5PF,200V	72982	374- 1COH0689D
C323 ¹	SELECTED	XB070600			
C325	281-0541-00		CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301- OCOH0689D
C327 ¹	SELECTED	XB070600			
C329	281-0541-00		CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301-00COH0689D
C342	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C346	283-0000-00		CAP.,FXD,CER DI:0.0001UF,+100-0, 500V	72982	831-516E102P
CR342	152-0141-02		SEMICONDD DEVICE:SILICON,30V,150MA	07910	1N4152
CR346	152-0141-02		SEMICONDD DEVICE:SILICON,30V,150MA	07910	1N4152
Q314	151-0221-00		TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q316	151-0221-00		TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q334	151-0259-00		TRANSISTOR:SILICON,NPN	80009	151-0259-00
Q336	151-0259-00		TRANSISTOR:SILICON,NPN	80009	151-0259-00
Q344	151-0221-00		TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q346	151-0221-00		TRANSISTOR:SILICON,PNP	80009	151-0221-00
R301	321-1068-02		RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50R50D
R302	321-1068-02		RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50R50D
R303	321-0741-02		RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R304	322-0184-00		RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBTO-8060F
R305	321-0741-02		RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R306	321-0218-00		RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R307	321-0741-02		RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R308	322-0184-00		RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBTO-8060F
R309	321-0741-02		RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R311	317-0330-00		RES.,FXD,CMPSN:33 OHM,5%,0.125W	01121	BB3305
R312	317-0330-00		RES.,FXD,CMPSN:33 OHM,S%,0.125W	01121	BB3305
R313	323-0155-00		RES.,FXD,FILM:402 OHM,1%,0.50W	75042	CECTo-4020F
R314	323-0155-00		RES.,FXD,FILM:402 OHM,1%,0.50W	75042	CECTO-4020F
R316	317-0331-00		RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R318	321-0214-00		RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R319	321-0214-00		RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R321	321-1068-02		RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50RSOD
R322	321-1068-02		RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50RSOD
R323	321-0741-02		RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R324	322-0184-00		RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBTO-8060F
R325	321-0741-02		RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D

¹Added if necessary.

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R326	321-0218-00				RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R327	321-0741-02				RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R328	322-0184-00				RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBT0-8060F
R329	321-0741-02				RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R331	321-0044-00				RES.,FXD,FILM:28 OHM,1S%,0.125W	91637	MFF1816G28ROOF
R332	321-0044-00				RES.,FXD,FILM:28 OHM,1%,0.125W	91637	MFF1816G28ROOF
R335	321-0220-00				RES.,FXD,FILM:1.91K OHM,1%,0.125W	91637	MFF1816G19100F
R336	321-0143-00				RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301ROF
R337	321-0129-00				RES.,FXD,FILM:215 OHM,1%,0.125W	91637	MFF1816G215ROF
R338	321-0129-00				RES.,FXD,FILM:215 OHM,1%,0.125W	91637	MFF1816G215ROF
R339	321-0097-00				RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100ROF
R341	321-0214-00				RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R342	315-0331-00				RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R343	321-0040-00				RES.,FXD,FILM:25.5 OHM,1%,0.125W	91637	MFF1816G25R50F
R344	315-0561-00				RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R345	321-0040-00				RES.,FXD,FILM:25.5 OHM,1%,0.125W	91637	MFF1816G25R50F
R346	315-0331-00				RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R347	321-0214-00				RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R349	301-0220-00				RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
U304	155-0022-00				MICROCIRCUIT,DI:ML,CHANNEL SWITCH	80009	155-0022-00
U324	155-0022-00				MICROCIRCUIT,DI:ML,CHANNEL SWITCH	80009	155-0022-00
A4	670-0811-01	B010100	B081359		CKT BOARD ASSY:VERTICAL INTERFACE	80009	670-0811-01
A4	670-0811-02	B081360			CKT BOARD ASSY:VERTICAL INTERFACE	80009	670-0811-02
C244	281-0122-00	B010100	B081359		CAP.,VAR,CER DI:2.5-9PF,100V	72982	518-000A2.5-9
C244	281-0123-00	B081360			CAP.,VAR,CER DI:5-25PF,100V	72982	518-00A5-25
C246	283-0103-00				CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C247	281-0557-00				CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-00COK0189B
C249	283-0114-00				CAP.,FXD,CER DI:0.0015UF,5%,200V	72982	805-509B152J
C256	283-0103-00				CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C259	283-0114-00				CAP.,FXD,CER DI:0.0015UF,5%,200V	72982	805-509B152J
C266	281-0504-00				CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-55C0G0100F
C268	281-0504-00				CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-55C0G0100F
C274	281-0122-00	B010100	B081359		CAP.,VAR,CER DI:2.5-9PF,100V	72982	518-00A2.5-9
C274	281-0123-00	B081360			CAP.,VAR,CER DI:5-25PF,100V	72982	518-00A5-25
C276	283-0103-00				CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C286	283-0103-00				CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C287	281-0557-00				CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-00COK0189B
C296	281-0504-00				CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-55COG0100F
CR249	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR259	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR264	152-0153-00				SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR279	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	01N4152
CR289	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR295	152-0153-00				SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
E264	276-0528-00	XB081360			SHIELDING BEAD,;0.1UH	02114	56-0590-65C/3B
E294	276-0528-00	XB081360			SHIELDING BEAD,;0.1UH	02114	56-0590-65C/3B
L240	108-0557-00				COIL,RF:35NH	80009	108-0557-00

REV. F JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
L250	108-0557-00				COIL,RF:35NH	80009	108-0557-00
L270	108-0557-00				COIL,RF:35NH	80009	108-0557-00
L280	108-0557-00				COIL,RF:35NH	80009	108-0557-00
Q244	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
Q248	151-0269-00				TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q249	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q254	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
Q258	151-0269-00				TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q264	151-0222-00	B010100	B081359		TRANSISTOR:SILICON,NPN	80009	151-0222-00
Q264	151-0448-00	B081360			TRANSISTOR:SILICON,NPN	80009	151-0448-00
Q274	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
Q278	151-0269-00				TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q279	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q284	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
Q288	151-0269-00				TRANSISTOR:SILICON,NPN,SEL FROM SE3005	80009	151-0269-00
Q294	151-0222-00	B010100	B081359		TRANSISTOR:SILICON,NPN	80009	151-0222-00
Q294	151-0448-00	B081360			TRANSISTOR:SILICON,NPN	80009	151-0448-00
R240	321-0825-03				RES.,FXD,FILM:50.8 OHM,0.25%,0.125W	91637	MFF1816D50R80C
R241	322-0206-00				RES.,FXD,FILM:1.37K OHM,1%,0.25W	75042	CEBTO-1371F
R242	311-0643-00				RES.,VAR,NONWIR:50 OHM,10%,0.50W	80740	62-52-3
R243	321-0068-00				RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R244	317-0270-00	B010100	B059999		RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R244	315-0270-00	B060000			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R245	321-0160-00				RES.,FXD,FILM:453 OHM,1%,0.125W	91637	MFF1816G453ROF
R246	317-0560-00	B010100	B059999		RES.,FXD,CMPSN:56 OHM,5%,0.125W	01121	BB5605
R246	315-0560-00	B060000			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R247	317-0181-00	B010100	B059999		RES.,FXD,CMPSN:180 OHM,5%,0.125W	01121	BB1815
R247	315-0181-00	B060000			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R248	321-0166-00				RES.,FXD,FILM:523 OHM,1%,0.125W	91637	MFF1816G523ROF
R249	321-0191-00				RES.,FXD,FILM:953 OHM,1%,0.125W	91637	MFF1816G953ROF
R250	321-0825-03				RES.,FXD,FILM:50.8 OHM,0.25%,0.125W	91637	MFF1816D50R80C
R251	322-0206-00				RES.,FXD,FILM:1.37K OHM,1%,0.25W	75042	CEBTO-1371F
R252	317-0560-00	B010100	B059999		RES.,FXD,CMPSN:56 OHM,5%,0.125W	01121	BB5605
R252	315-0560-00	B060000			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R253	321-0068-00				RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R254	311-0605-00				RES.,VAR,NONWIR:200 OHM,10%,0.50W	80740	62-54-3
R255	321-0160-00				RES.,FXD,FILM:453 OHM,1%,0.125W	91637	MFF1816G453ROF
R256	317-0560-00	B010100	B059999		RES.,FXD,CMPSN:56 OHM,5%,0.125W	01121	BB5605
R256	315-0560-00	B060000			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R257	311-0643-00				RES.,VAR,NONWIR:50 OHM,10%,0.50W	80740	62-52-3
R258	321-0166-00				RES.,FXD,FILM:523 OHM,1%,0.125W	91637	MFF1816G523ROF
R259	321-0191-00				RES.,FXD,FILM:953 OHM,1%,0.125W	91637	MFF1816G953ROF
R260	315-0103-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1035
R261	321-0143-00				RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301ROF
R262	321-0123-00				RES.,FXD,FILM:187 OHM,1%,0.125W	91637	MFF1816G187ROF
R263	321-0083-00				RES.,FXD,FILM:71.5 OHM,1%,0.125W	91637	MFF1816G71R50F
R264	321-0091-00				RES.,FXD,FILM:86.6 OHM,1%,0.125W	91637	MFF1816G86R60F
R265	315-0683-00				RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R266	321-0062-00				RES.,FXD,FILM:43.2 OHM,1%,0.125W	91637	MFF1816G43R20F
R268	317-0181-00	B010100	B059999		RES.,FXD,CMPSN:180 OHM,5%,0.125W	01121	BB1815
R268	315-0181-00	B060000			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1815
R270	321-0825-03				RES.,FXD,FILM:50.8 OHM,0.25%,0.125W	91637	MFF1816D50R80C

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R271	322-0206-00				RES.,FXD,FILM:1.37K OHM,1%,0.25W	75042	CEBT0-1371F
R273	321-0068-00				RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R274	311-0605-00				RES.,VAR,NONWIR:200 OHM,10%,0.50W	80740	62-54-3
R275	321-0160-00				RES.,FXD,FILM:453 OHM,1%,0.125W	91637	MFF1816G453ROF
R276	317-0560-00	B010100	B059999		RES.,FXD,CMPSN:56 OHM,5%,0.125W	01121	BB5605
R276	315-0560-00	B060000			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R277	311-0643-00				RES.,VAR,NONWIR:50 OHM,10%,0.5W	80740	62-52-3
R278	321-0166-00				RES.,FXD,FILM:523 OHM,1%,0.125W	91637	MFF1816G523ROF
R279	321-0191-00				RES.,FXD,FILM:953 OHM,1%,0.125W	91637	MFF1816G953ROF
R280	321-0825-03				RES.,FXD,FILM:50.8 OHM,0.25%,0.125W	91637	MFF1816D50R80C
R281	322-0206-00				RES.,FXD,FILM:1.37K OHM,1%,0.25W	75042	CEBTO-1371F
R282	317-0130-00	B010100	B059999		RES.,FXD,CMPSN:13 OHM,5%,0.125W	01121	BB1305
R282	315-0130-00	B060000			RES.,FXD,CMPSN:13 OHM,5%,0.25W	01121	CB1305
R283	321-0068-00				RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R284	317-0270-00	B010100	B059999		RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R284	315-0270-00	B060000			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R285	321-0160-00				RES.,FXD,FILM:453 OHM,1%,0.125W	91637	MFF1816G453ROF
R286	317-0560-00	B010100	B059999		RES.,FXD,CMPSN:56 OHM,5%,0.125W	01121	BB5605
R286	315-0560-00	B060000			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R287	317-0181-00	B010100	B059999		RES.,FXD,CMPSN:180 OHM,5%,0.125W	01121	BB1815
R287	315-0181-00	B060000			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R288	321-0166-00				RES.,FXD,FILM:523 OHM,1%,0.125W	91637	MFF1816G523ROF
R289	321-0191-00				RES.,FXD,FILM:953 OHM,1%,0.125W	91637	MFF1816G953ROF
R290	315-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R291	321-0143-00				RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301ROF
R292	321-0123-00				RES.,FXD,FILM:187 OHM,1%,0.125W	91637	MFF1816G187ROF
R293	321-0083-00				RES.,FXD,FILM:71.5 OHM,1%,0.125W	91637	MFF1816G71R50F
R294	321-0091-00				RES.,FXD,FILM:86.6 OHM,1%,0.125W	91637	MFF1816G86R60F
R295	323-0128-00				RES.,FXD,FILM:210 OHM,1%,0.50W	75042	CECTO-2100F
R296	321-0062-00				RES.,FXD,FILM:43.2 OHM,1%,0.125W	91637	MFF1816G43R20F
A5	670-0812-00				CKT BOARD ASSY:VERTICAL SWITCHING & POWER	80009	670-0812-00
C919	290-0271-00				CAP.,FXD,ELCTLT:9UF,+20-15%,125V	56289	109D905C2125F2
C939	290-0162-00				CAP.,FXD,ELCTLT:22UF,20%,35V	12954	D22C35M1
C959	290-0162-00				CAP.,FXD,ELCTLT:22UF,20%,35V	12954	D22C35M1
C979	290-0162-00				CAP.,FXD,ELCTLT:22UF,20%,35V	12954	D22C35M1
C999	290-0271-00				CAP.,FXD,ELCTLT:9UF,+20-15%,125V	56289	109D905C2125F2
CR200	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR209	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR210	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR224	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR230	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR232	152-0141-02				SEMICONV DEVICE:SILICON,30V,15MA	07910	1N4152
CR233	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR234	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
Q202	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q206	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q212	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q216	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q218	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00

REV. F JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
Q222	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q224	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q234	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q236	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q238	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
R200	315-0392-00				RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R201	315-0242-00				RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R202	315-0153-00				RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R203	315-0122-00				RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R204	315-0111-00				RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R205	323-0226-00				RES.,FXD,FILM:2.21K OHM,1%,0.50W	75042	CECT0-2211F
R206	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R207	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R208	315-0471-00				RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R209	315-0183-00				RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R210	323-0228-00				RES.,FXD,FILM:2.32K OHM,1%,0.50W	75042	CECT0-2321F
R211	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R212	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R213	315-0111-00				RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R214	315-0122-00				RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R215	315-0301-00				RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R216	315-0153-00				RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R217	321-0190-00				RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931ROF
R218	321-0168-00				RES.,FXD,FILM:549 OHM,1%,0.125W	91637	MFF1816G549ROF
R219	315-0102-00				RES.,FXD,CMPSN: 1K OHM,5%,0.25W	01121	CB1025
R220	315-0303-00				RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R221	315-0471-00				RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R222	315-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R223	315-0911-00				RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R224	315-0132-00				RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R225	321-0251-00				RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R226	315-0821-00				RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R227	315-0682-00				RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R228	315-0821-00				RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R229	321-0251-00				RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R230	321-0221-00				RES.,FXD,FILM:1.96K OHM,1%,0.125W	91637	MFF1816G19600F
R232	321-0221-00				RES.,FXD,FILM:1.96K OHM,1%,0.125W	91637	MFF1816G19600F
R233	321-0222-00				RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R234	321-0202-00				RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816G12400F
R235	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R236	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R237	322-0187-00				RES.,FXD,FILM:866 OHM,1%,0.25W	75042	CEBTO-8660F
R238	321-0129-00				RES.,FXD,FILM:215 OHM,1%,0.125W	91637	MFF1816G215ROF
R239	322-0187-00				RES.,FXD,FILM:866 OHM,1%,0.25W	75042	CEBTO-8660F
A6	670-0809-02	B010100	B081359		CKT BOARD ASSY:VERTICAL OUTPUT	80009	670-0809-02
A6	670-0809-03	B081360			CKT BOARD ASSY:VERTICAL OUTPUT	80009	670-0809-03
C401	281-0572-00	B010100	B081359		CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-00COH0689D
C401 ¹	SELECTED	B081360					
C408	281-0572-00	B010100	B081359		CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-00COH0689D

¹Added if necessary.

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont			
C408 ¹	SELECTED	B081360				
C411	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C417	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C426	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-00COJ0279C
C430	281-0122-00			CAP.,VAR,CER DI:2.5-9PF,100V	72982	518-00A2.5-9
C431	283-0115-00	B010100	B010136	CAP.,FXD,CER DI:47PF,5%,200V	72982	805-519-OG0470J
C431	281-0564-00	B010137	B081359	CAP.,FXD,CER DI:24PF,5%,500V	72982	301-00COG0240J
C431	283-0251-00	B081360		CAP.,FXD,CER DI:87 PF,5%,100V	72982	8121B145COG0870J
C435	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C438	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C447 ²						
C448 ³						
C449 ¹	281-0670-00	B010100	B081359	CAP.,FXD,CER DI:1.8PF,(NOM VALUE),SEL	72982	374-05COK0189B
C449	283-0160-00	B081360		CAP.,FXD,CER DI:1.5PF,10%,50V	72982	8101A058COK159B
C450 ¹	281-0670-00	B010100	B081359	CAP.,FXD,CER DI:1.8PF,(NOM VALUE),SEL	7298	374-05COK0189B
C450	283-0160-00	B081360		CAP.,FXD,CER DI:1.5PF,10%,50V	72982	8101A058COK159B
C451	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C458	281-0123-00			CAP.,VAR,CER DI:5-25PF,100V	72982	518-000A5-25
C460	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C465	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C470 ⁴						
C471 ⁵						
C472	281-0645-00			CAP.,FXD,CER DI:8.2PF,+/-0.25PF,500V	72982	374-11COH0829C
C477	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C478	283-0003-00	B010100	B081359X	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C479	283-0003-00	B010100	B081359X	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C495	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C497	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C499	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
CR431	152-0271-00			SEMICONV DEVICE:SILICON,10PF	80009	152-0271-00
CR432	152-0271-00			SEMICONV DEVICE:SILICON,10PF	80009	152-0271-00
L401	108-0260-00			COIL,RF:98NH	80009	108-0260-00
L408	108-0260-00			COIL,RF:98NH	80009	108-0260-00
L421	108-0103-00			COIL,RF:2.45UH	80009	108-0103-00
L422	108-0095-00			COIL,RF:1.4UH	80009	108-0095-00
L423	108-0146-00			COIL,RF:SUH	80009	108-0146-00
L447 ⁶	388-0867-00	B010100	B029999	CIRCUIT BOARD:T COIL,4 TURNS	80009	388-0867-00
L447 ⁶	388-0867-01	B030000		CIRCUIT BOARD:T COIL,4 TURNS	80009	388-0867-01
L448 ⁷	388-0867-00	B010100	B029999	CIRCUIT BOARD:T COIL,4 TURNS	80009	388-0867-00
L448 ⁷	388-0867-01	B030000		CIRCUIT BOARD:T COIL,4 TURNS	80009	388-0867-01
L452	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
L470 ⁸	388-0868-00	B010100	B029999	CIRCUIT BOARD:T COIL,3 TURNS	80009	388-0867-00
L470 ⁸	388-0868-01	B030000		CIRCUIT BOARD:T COIL,3 TURNS	80009	388-0867-01
LAL4 ⁹	388-0868-00	B010100	B029999	CIRCUIT BOARD:T COIL,3 TURNS	80009	388-0867-00
L471 ⁹	388-0868-01	B030000		CIRCUIT BOARD:T COIL,3 TURNS	80009	388-0867-01
L480	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
L497	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
L499	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
Q412	151-0213-00	B010100	B081359	TRANSISTOR:SILICON,NPN	80009	151-0213-00
Q412	151-0127-00	B081360		TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q416	151-0213-00	B010100	B081359	TRANSISTOR:SILICON,NPN	80009	151-0213-00
Q416	151-0127-00	B081360		TRANSISTOR:SILICON,NPN	80009	151-0127-00

¹Added if necessary.

²Furnished as a unit with L447.

³Furnished as a unit with L448.

⁴Furnished as a unit with L470.

⁵Furnished as a unit with L471.

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
Q434	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
Q436	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
Q442	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
0444	151-0202-00				TRANSISTOR:SILICON,PNP	80009	151-0202-00
Q454	151-0222-00	B010100	B081359		TRANSISTOR:SILICON,NPN	80009	151-0222-00
Q454	151-0127-00	B081360			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q456	151-0222-00	B010100	B081359		TRANSISTOR:SILICON,NPN	80009	151-0222-00
Q456	151-0127-00	B081360			TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q466	151-0193-00				TRANSISTOR:SILICON,NPN	04713	SS2110
Q468	151-0193-00				TRANSISTOR:SILICON,NPN	04713	SS2110
Q470	151-0213-00	B010100	B081359		TRANSISTOR:SILICON,NPN	80009	151-0213-00
Q470	151-0448-00	B081360			TRANSISTOR:SILICON,NPN	80009	151-0448-00
Q476	151-0213-00	B010100	B081359		TRANSISTOR:SILICON,NPN	80009	151-0213-00
Q476	151-0448-00	B081360			TRANSISTOR:SILICON,NPN	80009	151-0448-00
R401	321-0067-00				RES.,FXD,FILM:48.7 OHM,1%,0.125W	91637	MFF1816G48R70F
R402	321-0184-00				RES.,FXD,FILM:806 OHM,1%,O.125W	91637	MFF1816G806ROF
R404	323-0229-00				RES.,FXD,FILM:2.37K OHM,1%,0.50W	75042	CECTO-2371F
R405	317-0101-00	B010100	B059999		RES.,FXD,CMPSN:100 OHM,5%,O.125W	01121	BB1015
R405	315-0101-00	B060000			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R406	323-0229-00				RES.,FXD,FILM:2.37K OHM,1%,O.50W	75042	CECTO-2371F
R408	321-0067-00				RES.,FXD,FILM:48.7 OHM,1%,O.125W	91637	MFF1816G48R70F
R411	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R413	315-0222-00				RES.,FXD,CMPSN:2.2K OHM,5%,O.25W	01121	CB2225
R415	315-0161-00				RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R417	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,O.25W	01121	CB2015
R418	321-0105-00				RES.,FXD,FILM:121 OHM,1%,0.125W	91637	MFF1816G121ROF
R419	321-0105-00				RES.,FXD,FILM:121 OHM,1%,0.125W	91637	MFF1816G121ROF
R420	321-0116-00				RES.,FXD,FILM:158 OHM,1%,O.125W	91637	MFF1816G158ROF
R421	311-0622-00	B010100	B081359		RES.,VAR, NONWIR:100 OHM,10%,O.50W	32997	3326H-G48-101
R421	311-0605-00	B081360			RES.,VAR, NONWIR:200 OHM,10%,0.50W	80740	62-54-3
R422	311-0605-00				RES.,VAR, NONWIR:200 OHM,10%,0.50W	80740	62-54-3
R423	311-0643-00				RES.,VAR, NONWIR:50 OHM,10%,O.50W	80740	62-52-3
R424	321-0116-00				RES.,FXD,FILM:158 OHM,11%,0.125W	91637	MFF1816G158ROF
R425	317-0101-00	B010100	B059999		RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R425	315-0101-00	B060000			RES.,FXD,CMPSN:100 OHM,5%,O.25W	01121	CB1015
R426	317-0101-00	B010100	B059999		RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R426	315-0101-00	B060000			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R427	321-0130-00				RES.,FXD,FILM:221 OHM,1%,0.125W	91637	MFF1816G221ROF
R428	321-0105-00				RES.,FXD,FILM:121 OHM,1%,0.125W	91637	MFF1816G121ROF
R429	321-0105-00				RES.,FXD,FILM:121 OHM,11%,0.125W	91637	MFF1816G121ROF
R430	311-0635-00				RES.,VAR, NONWIR: 1K OHM,10%,O.50W	73138	82-32-0
R431	317-0820-00	B010100	B059999		RES.,FXD,CMPSN:82 OHM,5%,0.125W	01121	BB8205
R431	315-0820-00	B060000			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R432	317-0820-00	B010100	B059999		RES.,FXD,CMPSN:82 OHM,5%,O.125W	01121	BB8205
R432	315-0820-00	B060000			RES.,FXD,CMPSN:82 OHM,5%,O.25W	01121	CB8205
R434	315-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R435	317-0390-00	B010100	B059999		RES.,FXD,CMPSN:39 OHM,5%,o.125W	01121	BB3905
R435	315-0390-00	B060000			RES.,FXD,CMPSN:39 OHM,5%,O.25W	01121	CB3905
R436	317-0431-00	B010100	B059999		RES.,FXD,CMPSN:430 OHM,5%,0.125W	01121	BB4315
R436	315-0431-00	B060000			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R437	317-0431-00	B0110100	B059999		RES.,FXD,CMPSN:430 OHM,5%,0.125W	01121	BB4315
R437	315-0431-00	B060000			RES.,FXD,CMPSN:430 OHM,5%,O.25W	01121	CB4315
R438	317-0390-00	B010100	B059999		RES.,FXD,CMPSN:39 OHM,S%,0.125W	01121	BB3905

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R438	315-0390-00	B060000			RES.,FXD,CMPSN:39 OHM,5S%,.25W	01121	CB3905
R439	317-0303-00	B010100	B010136		RES.,FXD,CMPSN:30K OHM,5%,O.125W	01121	BB3035
R439	317-0203-00	B010137	B059999		RES.,FXD,CMPSN:20K OHM,5%,0.125W	01121	BB2035
R439	315-0203-00	B060000	B081359		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R439	317-0153-00	B081360			RES.,FXD,CMPSN:15K OHM,5%,O.125W	01121	BB1535
R441	317-0512-00	B010100	B059999		RES.,FXD,CMPSN:5.1K OHM,S%,0.125	01121	BB5125
R441	315-0512-00	B060000			RES.,FXD,CMPSN:5.1K OHM,S%,0.25W	01121	CB5125
R443	311-0607-00				RES.,VAR, NONWIR:10K OHM,10%,0.50W	73138	82P-59-4-103K
R444	317-0512-00	B010100	B059999		RES.,FXD,CMPSN:5.1K OHM,S%,O.125	01121	BB5125
R444	315-0512-00	B060000			RES.,FXD,CMPSN:5s.K OHM,5%,0.25W	01121	CB5125
R445	315-0221-00				RES.,FXD,CMPSN:220 OHM,5%,O.25W	01121	CB2215
R447	321-0094-00				RES.,FXD,FILM:93.1 OHM,I%,0.125W	91637	MFF1816G93R10F
R448	321-0094-00				RES.,FXD,FILM:93.1 OHM,1%,0.125W	91637	MFF1816G93R10F
R449	301-0331-00				RES.,FXD,CMPSN:330 OHM,5%,0.50W	01121	EB3315
R451	315-0112-00				RES.,FXD,CMPSN:1.1K OHM,5%,O.25W	01121	CB1125
R452	323-0125-00				RES.,FXD,FILM:196 OHM,1%,0.50W	75042	CECTO-1960F
R454	321-0055-00				RES.,FXD,FILM:36.5 OHM,1%,.125W	91637	MFF1816G36R50F
R455	321-0055-00				RES.,FXD,FILM:36.5 OHM,I%,0.125W	91637	MFF1816G36R50F
R456	321-0055-00				RES.,FXD,FILM:36.5 OHM,1%,0.125W	91637	MFF1816G36R50F
R457	321-0055-00				RES.,FXD,FILM:36.5 OHM,1%,0.125W	91637	MFF1816G36R50F
R458	311-0605-00	B010100	B081359		RES.,VAR, NONWIR:200 OHM,10%,0.50W	80740	62-54-3
R458	311-0634-00	B081360			RES.,VAR, NONWIR:500 OHM,10%,0.50W	73138	82-31-0
R460	317-0470-00	8010100	B059999		RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R460	315-0470-00	B060000			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R461	317-0221-00	B010100	B059999		RES.,FXD,CMPSN:220 OHM,5%,0.125W	01121	BB2215
R461	315-0221-00	B060000			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R462	317-0221-00	B010100	B059999		RES.,FXD,CMPSN:220 OHM,5%,0.125W	01121	BB2215
R462	315-0221-00	B060000			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R463	317-0221-00	B010100	B059999		RES.,FXD,CMPSN:220 OHM,5%,0.125W	01121	BB2215
R463	315-0221-00	B060000			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R464	317-0221-00	B010100	B059999		RES.,FXD,CMPSN:220 OHM,5%,0.125W	01121	BB2215
R464	315-0221-00	B060000			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R465	317-0470-00	B010100	B059999		RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R465	315-0470-00	B060000			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R466	315-0181-00				RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R467	317-0101-00	B010100	B059999		RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	881015
R467	315-0101-00	B060000			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R468	311-0633-00	B010100	B081359		RES.,VAR, NONWIR:SK OHM,10%,O.50W	73138	82-30-0
R468	311-1263-00	B081360			RES.,VAR, NONWIR: 1K OHM,10%,0.50W	32997	3329P-L58-102
R469	317-0181-00	B010100	B059999		RES.,FXD,CMPSN:180 OHM,5%,0.125W	01121	BB1815
R469	315-0181-00	B060000			RES.,FXD,CMPSN:180 OHM,5%,O.25W	01121	CB1815
R470	321-0076-00				RES.,FXD,FILM:60.4 OHM,1%,0.125W	91637	MFF1816G60R40F
R471	321-0076-00				RES.,FXD,FILM:60.4 OHM,1%,0.125W	91637	MFF1816G60R40F
R473	321-0036-00				RES.,FXD,FILM:23.2 OHM,I%,O.125W	91637	MFF1816G23R20F
R474	321-0036-00				RES.,FXD,FILM:23.2 OHM,I%,0.125W	91637	MFF1816G23R20F
R475	321-0036-00				RES.,FXD,FILM:23.2 OHM,1%,O.125W	91637	MFF1816G23R20F
R476	321-0036-00				RES.,FXD,FILM:23.2 OHM,I%,O.125W	91637	MFF1816G23R20F
R477	308-0450-00				RES.,FXD, VVV:70 OHM,1%,3W	91637	RS2B-B70R00F
R478	301-0150-00				RES.,FXD,CMPSN:15 OHM,5%,0.50W	01121	EB1505
R479	301-0150-00				RES.,FXD,CMPSN:15 OHM,5%,0.50W	01121	EB1505
R480	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,O.25W	01121	CB2015
RT480	307-0124-00				RES.,THERMAL:5K OHM,10%	50157	1D1618

REV. E JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R490	321-0016-00				RES.,FXD,FILM:14.3 OHM,1%,0.125W	91637	MFF1816G14R30F
R491	301-0180-00				RES.,FXD,CMPSN:18 OHM,5%,0.50W	01121	EB1805
R492	321-0016-00				RES.,FXD,FILM:14.3 OHM,1%,0.125W	91637	MFF1816G14R30F
R494	321-0017-00				RES.,FXD,FILM:14.7 OHM,1%,0.125W	91637	MFF1816G14R70F
R495	323-0034-00				RES.,FXD,FILM:22.1 OHM,1%,0.50W	75042	CECTO-22R1F
RT433	307-0181-00				RES.,THERMAL:100K OHM,10%,4MW/DEG C	15454	1DE104-K-220EC
RT472	307-0127-00				RES.,THERMAL:1K OHM,10%	50157	2D102
RT480	307-0124-00				RES.,THERMAL:5K OHM,10%	50157	1D1618
T466	120-0469-00				XFMR,TOROID:3 TURNS BIFILAR	80009	120-0469-00
VR411	152-0166-00				SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	81483	69-9035
VR417	152-0166-00				SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	81483	69-9035
VR449	152-0166-00				SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	81483	69-9035
VR467	152-0195-00				SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
VR469	152-0195-00				SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
A8	670-0808-00				CKT BOARD ASSY:HORIZONTAL INTERFACE	80009	670-0808-00
C361	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C371	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
Q384	151-0220-00				TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q394	151-0220-00				TRANSISTOR:SILICON,PNP	80009	151-0220-00
R352	321-1068-02				RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50R50D
R354	321-1068-02				RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50R50D
R356	321-1068-02				RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50R50D
R358	321-1068-02				RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816D50R50D
R361	315-0303-00				RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R363	321-0741-02				RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R365	321-0741-02				RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R367	323-0187-00				RES.,FXD,FILM:866 OHM,1%,0.50W	75042	CECTO-8660F
R369	321-0218-00				RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R371	315-0303-00				RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R373	321-0741-02				RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R375	321-0741-02				RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	91637	MFF1816D40R90D
R377	323-0187-00				RES.,FXD,FILM:866 OHM,1%,0.50W	75042	CECTO-8660F
R381	317-0200-00	B010100	B059999		RES.,FXD,CMPSN:20 OHM,5%,0.125W	01121	BB2005
R381	315-0200-00	B060000			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R383	323-0155-00				RES.,FXD,FILM:402 OHM,1%,0.50W	75042	CECTO-4020F
R385	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R387	317-0241-00	B010100	B059999		RES.,FXD,CMPSN:240 OHM,5%,0.125W	01121	BB2415
R387	315-0241-00	B060000			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R389	322-0219-00				RES.,FXD,FILM:1.87K OHM,1%,0.25W	75042	CEBTO-1871F
R391	317-0200-00	B010100	B059999		RES.,FXD,CMPSN:20 OHM,5%,0.125W	01121	BB2005
R391	315-0200-00	B060000			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R393	323-0155-00				RES.,FXD,FILM:402 OHM,1%,0.50W	75042	CECTO-4020F
R395	321-0199-00				RES.,FXD,FILM:1.15K OHM,1%,0.125W	91637	MFF1816G11500F
R397	317-0241-00	B010100	B059999		RES.,FXD,CMPSN:240 OHM,5%,0.125W	01121	BB2415
R397	315-0241-00	B060000			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R399	322-0219-00				RES.,FXD,FILM:1.87K OHM,1%,0.25W	75042	CEBTO-1871F

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
U364	155-0022-00		MICROCIRCUIT,DI:ML,CHANNEL SWITCH	80009	155-0022-00
A9	670-0807-00		CKT BOARD ASSY:HORIZONTAL OUTPUT	80009	670-0807-00
C501	283-0010-00		CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C503	290-0135-00		CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C505	290-0135-00		CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C527	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C537	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C544	283-0083-00		CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C554	283-0041-00		CAP.,FXD,CER DI:0.0033UF,5%,500V	72982	841-541B332J
C560	283-0092-00		CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C563	281-0513-00		CAP.,FXD,CER DI:27PF,+/-5.4PF,500V	72982	301-00P2G0270M
C564	283-0080-00		CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C568	281-0091-00		CAP.,VAR,CER DI:2-8PF	72982	538-011 A2-8
C569	281-0064-00		CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C573	281-0513-00		CAP.,FXD,CER DI:27PF,+/-5.4PF,500V	72982	301-00P2G0270M
C579	281-0064-00		CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C580	283-0092-00		CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C583	290-0305-00		CAP.,FXD,ELCTLT:3UF,20%,150V	56289	109D305X0150C2
C586	290-0327-00		CAP.,FXD,ELCTLT:0.56UF,20%,100V	56289	150D564X0100A2
C590	283-0092-00		CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C593	290-0305-00		CAP.,FXD,ELCTLT:3UF,20%,150V	56289	109D305X0150C2
C596	290-0327-00		CAP.,FXD,ELCTLT:0.56UF,20%,100V	56289	150D564X0100A2
CR528	152-0153-00		SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR538	152-0153-00		SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR544	152-0153-00		SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR554	152-0153-00		SEMICONV DEVICE:SILICON,15V,50MA	80009	152-0153-00
CR558	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR560	152-0333-00		SEMICONV DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR562	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR570	152-0333-00		SEMICONV DEVICE:SILICON,55V,200MA	80009	152-0333-00
L503	108-0245-00		COIL,RF:3.9UH	80009	108-0245-00
L505	108-0245-00		COIL,RF:3.9UH	80009	108-0245-00
L589	276-0543-00		SHLD BEAD,ELEK:FERRITE	80009	276-0543-00
L599	276-0543-00		SHLD BEAD,ELEK:FERRITE	80009	276-0543-00
Q514	151-0190-00		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q526	151-0127-00		TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q536	151-0127-00		TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q544	151-0127-00		TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q548	151-0220-00		TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q554	151-0301-00		TRANSISTOR:SILICON,PNP	04713	2N2907A
Q558	151-0220-00		TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q562	151-0190-00		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q564	151-0127-00		TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q574	151-0127-00		TRANSISTOR:SILICON,NPN	80009	151-0127-00
Q582	151-0270-00		TRANSISTOR:SILICON,PNP	80009	151-0270-00
Q584	151-0274-00		TRANSISTOR:SILICON,NPN	80009	151-0274-00
Q592	151-0270-00		TRANSISTOR:SILICON,PNP	80009	151-0270-00
Q594	151-0274-00		TRANSISTOR:SILICON,NPN	80009	151-0274-00

REV. C JULY 1978

Replaceable Electrical Parls-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R501	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R511	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R513	315-0102-00				RES.,FXD,CMPSN: 1K OHM,5%,0.25W	01121	CB1025
R515	315-0221-00				RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R521	323-0168-00				RES.,FXD,FILM:549 OHM,1%,0.50W	75042	CECTO-5490F
R522	311-0622-01				RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3326H-K28-101
R524	315-0511-00				RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R525	321-0186-00				RES.,FXD,FILM:845 OHM,1%,0.125W	91637	MFF1816G845ROF
R526	321-0073-00				RES.,FXD,FILM:56.2 OHM,1%,0.125W	91637	MFF1816G56R20F
R527	321-0096-00				RES.,FXD,FILM:97.6 OHM,1%,0.125W	91637	MFF1816G97R60F
R528	321-0178-00				RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698ROF
R529	311-0658-00				RES.,VAR,WW:500 OHM,1W		
R531	323-0168-00				RES.,FXD,FILM:549 OHM,1%,0.50W	75042	CECTO-5490F
R532	321-0066-00				RES.,FXD,FILM:47.5 OHM,1%,0.125W	91637	MFF1816G47R50F
R533	321-0071-00				RES.,FXD,FILM:53.6 OHM,1%,0.125W	91637	MFF1816G53R60F
R536	321-0070-00				RES.,FXD,FILM:52.3 OHM,1%,0.125W	91637	MFF1816G52R30F
R537	321-0096-00				RES.,FXD,FILM:97.6 OHM,1%,0.125W	91637	MFF1816G97R60F
R538	321-0178-00				RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698ROF
R543	323-0101-00				RES.,FXD,FILM:110 OHM,1%,0.50W	75042	CECTO-1100F
R544	321-0108-00				RES.,FXD,FILM:130 OHM,1%,0.125W	91637	MFF1816G130ROF
R546	323-0086-00				RES.,FXD,FILM:76.8 OHM,1%,0.50W	75042	CECTO-76R80F
R547	321-0186-00				RES.,FXD,FILM:845 OHM,1%,0.125W	91637	MFF1816G845ROF
R548	321-0244-00				RES.,FXD,FILM:3.4K OHM,1%,0.125W	91637	MFF1816G34000F
R549	315-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R553	323-0133-00				RES.,FXD,FILM:237 OHM,1%,0.50W	75042	CECTO-2370F
R554	321-0120-00				RES.,FXD,FILM:174 OHM,1%,0.125W	91637	MFF1816G174ROF
R556	323-0178-00				RES.,FXD,FILM:698 OHM,1%,0.50W	75042	CECTO-6980F
R557	321-0251-00				RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R558	321-0193-00				RES.,FXD,FILM: 1K OHM,1%,0.125W	91637	MFF1816G10000F
R559	315-0681-00				RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R562	321-0190-00				RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931ROF
R563	322-0126-00				RES.,FXD,FILM:200 OHM,1%,0.25W		
R564	315-0220-00				RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R565	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R566	321-0230-00				RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R567	321-0224-00				RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
R568	311-0633-00				RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	82-30-0
R569	323-0316-00				RES.,FXD,FILM:19.1K OHM,1%,0.50W	75042	CECTO-1912F
R571	311-0622-00				RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3326H-G48-101
R572	321-0177-00				RES.,FXD,FILM:681 OHM,1%,0.125W	91637	MFF1816G681ROF
R573	322-0126-00				RES.,FXD,FILM:200 OHM,1%,0.25W		
R575	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R576	321-0230-00				RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R577	321-0224-00				RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
R579	323-0316-00				RES.,FXD,FILM:19.1K OHM,1%,0.50W	75042	CECTO-1912F
R581	303-0273-00				RES.,FXD,CMPSN:27K OHM,5%,1W	01121	GB2735
R582	323-0233-00				RES.,FXD,FILM:2.61K OHM,1%,0.50W	75042	CECTO-2611F
R583	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R585	303-0202-00				RES.,FXD,CMPSN:2K OHM,5%,1W	01121	GB2025
R586	315-0820-00				RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R588	323-0253-00				RES.,FXD,FILM:4.22K OHM,1%,0.50W	75042	CECTO-4221F
R589	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R591	303-0273-00				RES.,FXD,CMPSN:27K OHM,5%,1W	01121	GB2735

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R592	323-0233-00				RES.,FXD,FILM:2.61K OHM,1%,0.50W	75042	CECT0-2611F
R593	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R595	303-0202-00				RES.,FXD,CMPSN:2K OHM,5%,1W	01121	GB2025
R596	315-0820-00				RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R597	323-0349-00				RES.,FXD,FILM:42.2K OHM,1%,0.50W	75042	CECT0-4222F
R598	323-0349-00				RES.,FXD,FILM:42.2K OHM,1%,0.50W	75042	CECT0-4222F
R599	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
RT534	307-0127-00				RES.,THERMAL:1K OHM,10%	50157	2D102
A10	670-0989-00	B010100	B029999		CKT BOARD ASSY:OUTPUT SIGNAL	80009	670-0989-00
A10	670-0989-01	B030000			CKT BOARD ASSY:OUTPUT SIGNAL	80009	670-0989-01
C609	283-0080-00				CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C612	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C616	281-0603-00				CAP.,FXD,CER DI:39PF,5%,500V	72982	308-
000C0G0390J							
C618	283-0080-00				CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C619	283-0081-00				CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C621	285-0824-00				CAP.,FXD,PLSTC:0.047UF,2%,100V	14752	410B1B473G
C628	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C633	283-0178-00				CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C645	283-0003-00				CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C660	281-0546-00				CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C661	283-0004-00				CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-5V0203Z
C666	283-0204-00				CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C674	283-0081-00				CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C675	281-0510-00				CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	72982	301-0COG0220M
C677	283-0081-00				CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C682	283-0003-00				CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C683	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C686	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C693	281-0540-00				CAP.,FXD,CER DI:51PF,5%,500V	72982	301-000U2J0510J
C695	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C698	283-0000-00				CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
CR614	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR615	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR616	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR637	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR674	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR676	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR696	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR699	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
L619	108-0245-00				COIL,RF:3.9UH	80009	108-0245-00
L682	108-0440-00				COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
Q607	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q608	151-0190-00	B010100	B010139		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q608	151-0190-00	B010140			TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q615	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q624	151-0273-00				TRANSISTOR:SILICON,NPN	80009	151-0273-00

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
Q626	151-0273-00				TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q634	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q636	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q642	151-0276-00				TRANSISTOR:SILICON,PNP	80009	151-0276-00
Q644	151-0276-00				TRANSISTOR:SILICON,PNP	80009	151-0276-00
Q646	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q660	151-0221-00				TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q664	151-0223-00				TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q670	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q672	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q675	151-0220-00				TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q684	151-0221-00				TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q686	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q694	151-0221-00				TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q696	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
R600	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R601	315-0752-00				RES.,FXD,CMPSN:7.SK OHM,5%,0.25W	01121	CB7525
R602	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R603	315-0181-00				RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R604	315-0123-00				RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R605	315-0181-00				RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R606	315-0123-00				RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R607	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R608	323-0193-00				RES.,FXD,FILM:1K OHM,i%,0.50W	75042	CECT0-1001F
R609	315-0821-00				RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R612	315-0561-00				RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R613	321-0143-00				RES.,FXD,FILM:301 OHM,i%,0.125W	91637	MFF1816G301ROF
R614	321-0180-00				RES.,FXD,FILM:732 OHM,i%,0.125W	91637	MFF1816G732ROF
R615	321-0226-00				RES.,FXD,FILM:2.21K OHM,i%,0.125W	91637	MFF1816G22100F
R616	323-0189-00				RES.,FXD,FILM:909 OHM,i%,0.50W	75042	CECT0-9090F
R617	301-0390-00				RES.,FXD,CMPSN:39 OHM,5%,0.50W	01121	EB3905
R618	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R619	315-0220-00				RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R621	321-0364-00				RES.,FXD,FILM:60.4K OHM,1%,0.125W	91637	MFF1816G60401F
R624	308-0647-00				RES.,FXD,WW:2.7K OHM,1%,3W	91637	NS2B-66-27000F
R625	311-0480-00	B010100	B069999		RES.,VAR,NONWIR:500 OHM,20%,0.25W	01121	FR501M
R625	311-1224-00	B070000			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R626	315-0153-00				RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R627	321-0374-00				RES.,FXD,FILM:76.8K OHM,i%,0.125W	91637	MFF1816G76801F
R628	315-0472-00				RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R632	315-0123-00				RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R633	315-0560-00				RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R634	315-0511-00				RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R635	315-0513-00				RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R636	321-0315-00				RES.,FXD,FILM:18.7K OHM,i%,0.125W	91637	MFF1816G18701F
R637	321-0356-00				RES.,FXD,FILM:49.9K OHM,i%,0.125W	91637	MFF1816G49901F
R638	315-0393-00				RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R639	321-0195-00				RES.,FXD,FILM:1.05K OHM,1%,0.125W	91637	MFF1816G10500F
R641	321-0254-00				RES.,FXD,FILM:4.32K OHM,i%,0.125W	91637	MFF1816G43200F
R643	321-1188-06				RES.,FXD,FILM:898 OHM,0.25%,0.125W	91637	MFF1816C898ROC
R644	315-0103-00				RES.,FXD,CMPSN 1K OHM,5%,0.25W	01121	CB1035
R645	315-0102-00				RES.,FXD,CMPSN :1K OHM,5%,0.25W	01121	CB1025
R646	321-0281-06				RES.,FXD,FILM:8.25K OHM,0.25%,0.125W	91637	MFF1816C82500C

REV. E JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R647	321-0820-06				RES.,FXD,FILM:42K OHM,0.25%,0.125W	91637	MFF1816C42001C
R648	315-0913-00				RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R649	311-0510-00	B010100	B069999		RES.,VAR,NONWIR:10K OHM,20%,0.25W	01121	FR103M
R649	311-1228-00	B070000			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-TO4-103
R651	301-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R652	323-0761-07				RES.,FXD,FILM:4.05K OHM,0.1%,0.50W		
R653	321-0815-07				RES.,FXD,FILM:4.1K OHM,0.1%,0.125W	91637	MFF1816C41000B
R654	321-0812-07				RES.,FXD,FILM:455 OHM,0.1%,0.125W	91637	MFF1816C455R08B
R655	321-0811-07				RES.,FXD,FILM:56.3 OHM,0.1%,0.125W	91637	MFF1816C56R30B
R656	321-0813-07				RES.,FXD,FILM:495 OHM,0.1%,0.125W	91637	MFF1816C495ROB
R659	321-0810-07				RES.,FXD,FILM:55 OHM,0.1%,0.125W	91637	MFF1816C55R00B
R658	321-0816-07				RES.,FXD,FILM:5K OHM,0.1%,0.125W	91637	MFF1816C50000B
R659	321-1068-07				RES.,FXD,FILM:50.5 OHM,0.1%,0.125W	91637	MFF1816C50R50B
R660	315-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R661	315-0682-00				RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R662	315-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R663	315-0333-00				RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R664	315-0153-00				RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R665	315-0510-00				RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R666	315-0221-00				RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R667	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R668	315-0102-00	XBO30000			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R669	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R672	315-0222-00				RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R673	315-0241-00				RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R674	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R675	315-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R676	315-0272-00				RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R677	315-0220-00				RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R678	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R679	323-0190-00				RES.,FXD,FILM:931 OHM,i%,0.50W	75042	CECTO-9310F
R681	321-0069-00				RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R682	307-0106-00				RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R683	321-0082-00				RES.,FXD,FILM:69.8 OHM,1%,0.125W	91637	MFF1816G69R80F
R684	321-0091-00				RES.,FXD,FILM:86.6 OHM,1%,0.125W	91637	MFF1816G86R60F
R685	321-0020-00				RES.,FXD,FILM:15.8 OHM,1%,0.125W	91637	MFF1816G15R80F
R686	315-0151-00				RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R687	321-0229-00				RES.,FXD,FILM:2.37K OHM,1%,0.125W	91637	MFF1816G23700F
R688	321-0244-00				RES.,FXD,FILM:3.4K OHM,1%,0.125W	91637	MFF1816G34000F
R692	321-0069-00				RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R693	315-0471-00	B010100	B079999		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R693	315-0240-00	B080000			RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R694	321-0020-00				RES.,FXD,FILM:15.8 OHM,1%,0.125W	91637	MFF1816G15R80F
R695	315-0151-00				RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R696	321-0224-00				RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
R697	323-0208-00				RES.,FXD,FILM:1.43K OHM,1%,0.50W	75042	CECTO-1431F
R698	307-0106-00				RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R699	321-0097-00				RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100ROF
S607	260-0984-00				SWITCH,SLIDE:DP 3 POSN,0.5A,125VAC-DC	79727	G-128-S-0012
S664	260-0723-00				SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
S666	260-0723-00				SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
U632	156-0012-00				MICROCIRCUIT,DI:SINGLE 2 MHZ J-K FLIP-FLOP	07263	U5B92329X

REV. E JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont			
All	670-0806-01	B010100	B081359	CKT BOARD ASSY:HIGH VOLTAGE/Z AXIS AMPLIFIER	80009	670-0806-01
All	670-0806-03	B081360		CKT BOARD ASSY:HIGH VOLTAGE/Z AXIS AMPLIFIER	80009	670-0806-03
C700	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C703	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-55COG0100F
C704	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C706	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C711	290-0305-00			CAP.,FXD,ELCTLT:3UF,20%,150V	56289	109D305X0150C2
C712	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-5V0203Z
C713	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C716	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C718	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-00COH0689D
C719	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C723	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C726	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C727	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C729	290-0149-00			CAP.,FXD,ELCTLT:5UF,+75-10%,150V	56289	30D505G150DD4
C730	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C731	281-0537-00			CAP.,FXD,CER DI:0.68PF,20%,600V	80009	281-0537-00
C732	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C734	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C747	285-0622-00	B010100	B081359	CAP.,FXD,PLSTC:0.1UF,20%,100V	56289	410P10401
C747	285-1098-00	B081360		CAP.,FXD,PLSTC:0.22UF,10%,80V	56289	192P2249R8
C748	285-0604-00			CAP.,FXD,PLSTC:0.01UF,20%,400V	01002	64F22DB103
C755	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C759	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301
C767	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C770	281-0593-00			CAP.,FXD,CER DI:3.9PF,10%,500V	72982	301-00COJ0399C
C774	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-88Z5U104M
C776	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-88Z5U104M
C778	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	72982	308-00COG0330J
C792	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C793	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C797	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
CR708	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR718	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR730	152-0333-00			SEMICONV DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR734	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR735	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR759	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR770	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR777	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR794	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR798	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	80009	152-0107-00
Q704	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q706	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q708	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q712	151-0250-00			TRANSISTOR:SILICON,NPN	80009	151-0250-00
Q718	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
Q724	151-0220-00				TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q732	151-0214-00				TRANSISTOR:SILICON, PNP		
Q734	151-0124-00				TRANSISTOR:SILICON,NPN,SEL FROM 2N3501	80009	151-0124-00
Q752	151-0126-00				TRANSISTOR:SILICON,NPN	80009	151-0126-00
Q756	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q758	151-0260-00				TRANSISTOR:SILICON,NPN	80009	151-0260-00
Q761	151-0280-00				TRANSISTOR:SILICON,PNP	80009	151-0280-00
Q765	151-0280-00				TRANSISTOR:SILICON,PNP	80009	151-0280-00
Q774	151-0223-00				TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q777	151-0274-00				TRANSISTOR:SILICON,NPN	80009	151-0274-00
Q794	151-0274-00				TRANSISTOR:SILICON,NPN	80009	151-0274-00
R700	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R701	315-0471-00				RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R703	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R704	315-0181-00				RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R705	321-0261-00				RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R706	315-0331-00				RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R707	315-0823-00				RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R709	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R711	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R712	315-0335-00				RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R713	323-0139-00				RES.,FXD,FILM:274 OHM,1%,0.50W	75042	CECTO-2740F
R714	315-0121-00				RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R715	321-0060-00				RES.,FXD,FILM:41.2 OHM,1%,0.125W	91637	MFF1816G41R20F
R716	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R717	321-0219-00				RES.,FXD,FILM:1.87K OHM,1%,0.125W	91637	MFF1816G18700F
R718	315-0161-00				RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R719	311-0422-00	B010100	B069999		RES.,VAR,NONWIR:250 OHM,0.25W		
R719	311-1223-00	B070000			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3386F-T04-251
R721	303-0121-00				RES.,FXD,CMPSN:120 OHM,5%,1W	01121	GB1215
R722	315-0131-00				RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R723	315-0750-00				RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R724	303-0471-00				RES.,FXD,CMPSN:470 OHM,5%,1W	01121	GB4715
R726	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R727	323-0145-00				RES.,FXD,FILM:316 OHM,1%,0.50W	91637	MFF1226G316ROF
R728	321-0320-00				RES.,FXD,FILM:21K OHM,1%,0.125W	91637	MFF1816G21001F
R729	323-0360-00				RES.,FXD,FILM:54.9K OHM,1%,0.50W	75042	CECT00-5492F
R730	322-0385-00				RES.,FXD,FILM:100K OHM,1%,0.25W	75042	CEBTO-1003F
R731	315-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R732	323-0307-00				RES.,FXD,FILM:15.4K OHM,1%,0.50W	75042	CECTO-1542F
R733	303-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,1W	01121	GB3325
R734	303-0153-00				RES.,FXD,CMPSN:15K OHM,5%,1W	01121	GB1535
R735	315-0200-00				RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R736	301-0750-00				RES.,FXD,CMPSN:75 OHM,5%,0.50W	01121	EB7505
R737	315-0223-00				RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R738	315-0154-00				RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R739	311-0883-00	B010100	B069999		RES.,VAR,NONWIR:50K OHM,0.5W		
R739	311-1271-00	B070000			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R743	311-0510-00	B010100	B069999		RES.,VAR,NONWIR:10K OHM,20%,0.25W	01121	FR103M
R743	311-1228-00	8070000			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R744	321-0383-00				RES.,FXD,FILM:95.3K OHM,1%,0.125W	91637	MFF1816G95301F
R745	323-0505-00				RES.,FXD,FILM:1.78M OHM,1%,0.5W		

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R746	321-0437-00				RES.,FXD,FILM:348K OHM,1%,0.125W	91637	MFF1816G34802F
R747	315-0473-00				RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R748	315-0153-00				RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R749	315-0471-00				RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R751	315-0474-00				RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R752	321-0349-00				RES.,FXD,FILM:42.2K OHM,1%,0.125W	91637	MFF1816G42201F
R753	315-0102-00				RES.,FXD,CMPSN :1K OHM,5%,0.25W	01121	CB1025
R755	315-0102-00				RES.,FXD,CMPSN :1K OHM,5%,0.25W	01121	CB1025
R757	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R758	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R759	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R760	315-0624-00				RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
R761	311-0698-00				RES.,VAR, NONWIR:1M OHM,0.5W		
R765	315-0625-00				RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R766	315-0625-00				RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R767	315-0392-00				RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R768	321-0335-00				RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R769	311-1035-00				RES.,VAR, NONWIR:50K OHM,10%,0.50W	80740	62-62-3
R770	315-0472-00				RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R772	307-0272-00				RES.,FXD,FILM:	80009	307-0272-00
R773	321-0359-00				RES.,FXD,FILM:53.6K OHM,1%,0.125W	91637	MFF1816G53601F
R774	315-0821-00				RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R775	315-0332-00				RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R776	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R777	301-0562-00				RES.,FXD,CMPSN:5.6K OHM,5%,0.50W	01121	EB5625
R778	305-0123-00				RES.,FXD,CMPSN:12K OHM,5%,2W	01121	HB1235
R791	315-0333-00				RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R792	311-0465-00	B010100	B069999		RES.,VAR, NONWIR:100K OHM,20%,0.25W	01121	FR104M
R792	311-1235-00	B070000			RES.,VAR, NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R794	315-0154-00				RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R795	311-0463-00	B010100	B069999		RES.,VAR, NONWIR:SK OHM,20%,0.25W	01121	FR502M
R795	311-1227-00	B070000			RES.,VAR, NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R796	321-0194-00				RES.,FXD,FILM:1.02K OHM,1%,0.125W	91637	MFF1816G10200F
R797	323-0285-00				RES.,FXD,FILM:9.09K OHM,1%,0.50W	75042	CECTO-9091F
R798	301-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
VR749	152-0282-00				SEMICOND DEVICE:ZENER,0.4W,30V,5%	04713	1N972B
A12	670-0813-01	B010100	B029999		CKT BOARD ASSY:LINE INPUT	80009	670-0813-01
A12	670-0813-03	B030000	B039999		CKT BOARD ASSY:LINE INPUT	80009	670-0813-03
A12	670-0813-02	B040000			CKT BOARD ASSY:LINE INPUT	80009	670-0813-02
DS805	119-0181-00				SURGE VOLTAGE P:230VAC,+/-15%	80009	119-0181-00
DS806	119-0181-00				SURGE VOLTAGE P:230VAC,+/-15%	80009	119-0181-00
DS812	150-0053-00				LAMP,GLOW:55-90V MAX,1.5MA		
C803	285-0587-00				CAP.,FXD,PLSTC:0.1UF,20%,600V	04099	MR104-6-20
C810	290-0414-00				CAP.,FXD,ELCTLT:8UF,+50-10%,200V	90201	TT8ROT200C1C3P
C811	290-0414-00				CAP.,FXD,ELCTLT:8UF,+50-10%,200V	90201	TT8ROT200C1C3P
C812	285-0623-00	B010100	B039999		CAP.,FXD,PLSTC:0.47UF,20%,100V	56289	410P47401
C812	285-0633-00	B040000			CAP.,FXD,PLSTC:0.22UF,20%,100V	56289	410P22491
CR810	152-0396-00				SEMICOND DEVICE:SILICON,400V,3A		

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
L810	108-0585-00				COIL,RF:116UH	80009	108-0585-00
L811	108-0585-00				COIL,RF:116UH	80009	108-0585-00
R803	301-0510-00				RES.,FXD,CMPSN:51 OHM,5%,O.50W	01121	EB5105
RB04	304-0105-00	B010100	B039999X		RES.,FXD,CMPSN:1M OHM,10%,1W	01121	GB1051
R805	301-0433-00				RES.,FXD,CMPSN:43K OHM,5%,O.5DW	01121	EB4335
RB06	301-0433-00				RES.,FXD,CMPSN:43K OHM,5%,O.50W	01121	EB4335
RB07	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,O.25W	01121	CB2015
R808	315-0470-00				RES.,FXD,CMPSN:47 OHM,5%,O.25W	01121	CB4705
RB12	302-0395-00				RES.,FXD,CMPSN:3.9M OHM,10%,O.50W	01121	EB3951
RB13	304-0154-00	B010100	B039999		RES.,FXD,CMPSN:150K OHM,10%,1W	01121	GB1541
R813	303-0164-00	B040000			RES.,FXD,CMPSN:160K OHM,5%,1W	01121	GB1645
RB18	302-0154-00				RES.,FXD,CMPSN:150K OHM,10%,O.50W	01121	EB1541
RT810	307-0157-00	B010100	B029999X		RES.,THERMAL:5 OHM,10%,DISC	15454	5DARO-K-270SIL
RT811	307-0157-00	B010100	B029999X		RES.,THERMAL:5 OHM,10%,DISC	15454	5DARO-K-270SIL
T805	120-0636-00				XFMR,PWR,STPDN:PRI 2.625V,SEC 1V,0.005A	80009	120-0636-00
A13	670-0814-00	B010100	B059999		CKT BOARD ASSY:INVERTER	80009	670-0814-00
A13	670-0814-01	B060000			CKT BOARD ASSY:INVERTER	80009	670-0814-01
C820	283-0044-00				CAP.,FXD,CER DI:0.001UF,3000V	72982	3903BW02Y5S102M
C821	283-0006-00				CAP.,FXD,CER DI:0.02UF,+80-20%,O 500V	72982	0841545Z5V00203Z
C822	283-0044-00				CAP.,FXD,CER DI:0.001UF,3000V	72982	3903BW002Y5S102M
C824	283-0002-00				CAP.,FXD,CER DI:0.01UF,+80-20%,500OV	72982	811-546E103Z
C825	290-0284-00				CAP.,FXD,ELCTLT:4.7UF,10%,35V	56289	150D475X9035B2
C835	290-0284-00				CAP.,FXD,ELCTLT:4.7UF,10%,35V	56289	150D475X9035B2
CR823	152-0061-00				SEMICONV DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR824	152-0061-00				SEMICONV DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR825	152-0413-00				SEMICONV DEVICE:SILICON,400V,750MA	80009	152-0413-00
CR826	152-0413-00				SEMICONV DEVICE:SILICON,400V,750MA	80009	152-0413-00
CR828	152-0400-00				SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR830	152-0401-00				SEMICONV DEVICE:SILICON,3-LAYER,TRIGGER	04713	1N5761
CR831	152-0107-00				SEMICONV DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR835	152-0413-00				SEMICONV DEVICE:SILICON,400V,750MA	80009	152-0413-00
CR836	152-0413-00				SEMICONV DEVICE:SILICON,400V,750MA	80009	152-0413-00
CR838	152-0400-00				SEMICONV DEVICE:SILICON,400OV,1A	80009	152-0400-00
L826	108-0574-00				COIL,RF:30UH	80009	108-0574-00
L836	108-0574-00				COIL,RF:30UH	80009	108-0574-00
Q825	151-0266-00				TRANSISTOR:SILICON,NPN		
Q835	151-0266-00				TRANSISTOR:SILICON,NPN		
R820	315-0331-00				RES.,FXD,CMPSN:330 OHM,5%,O.25W	01121	CB3315
R821	315-0100-00				RES.,FXD,CMPSN:10 OHM,5%,O.25W	01121	CB1005
R823	302-0154-00				RES.,FXD,CMPSN:150K OHM,10%,0.50W	01121	EB1541
R824	321-0365-00				RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R825	308-0574-00				RES.,FXD,WW:10 OHM,5%,2W	91637	RS2B162K10ROOJ
R826	308-0555-00				RES.,FXD,WW:5 OHM,5%,3W	00213	1200S-5ROOOJ
R835	308-0574-00				RES.,FXD,WW:10 OHM,5%,2W	91637	RS2B162K10ROOJ
R836	308-0555-00				RES.,FXD,WW:5 OHM,5%,3W	00213	1200S-5ROOOJ

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.	Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff Dscont				
T820	120-0640-00			XFMR,TOROID:18 TURNS,BIFILAR	80009	120-0640-00
T825						
T839	120-0641-00			XFMR,TOROID:TOROID AND DRIVER	80009	120-0641-00
A14	670-0815-00			CKT BOARD ASSY:RECTIFIER	80009	670-0815-00
C840	290-0284-00			CAP.,FXD,ELCTLT:4.7UF,10%,35V	56289	150D475X9035B2
C852	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C855	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C856	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C858	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C860	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C864	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C867	290-0246-00			CAP.,FXD,ELCTLT:3.3UF,10%,15V	56289	162D335X9015CD2
C872	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C873	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C874	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C877	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C878	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C879	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C880	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C881	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C882	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C883	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C884	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107MO20P1G
C885	290-0296-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	150D107X0020S2
C886	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C887	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107MO20P1G
C888	290-0296-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	150D107X0020S2
C890	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107MO20P1G
C891	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C892	290-0296-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	150D107X0020S2
C893	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C894	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C895	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C898	290-0138-00			CAP.,FXD,ELCTLT:330UF,20%,6V	05397	T110D337M006AS
C899	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
CR840	152-0333-00			SEMICONV DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR841	152-0333-00			SEMICONV DEVICE:SILICON,55V,200MA	80009	152-0333-00
CRB57	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR858	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR859	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR860	152-0333-00			SEMICONV DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR872	152-0414-00			SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR873	152-0414-00			SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR877	152-0414-00			SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR878	152-0414-00			SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR880	152-0414-00			SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR881	152-0414-00			SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR883	152-0397-00			SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
CR884	152-0397-00				SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00
CR886	152-0412-00				SEMICONV DEVICE:SILICON,50V,3A	80009	152-0412-00
CR887	152-0412-00				SEMICONV DEVICE:SILICON,50V,3A	80009	152-0412-00
CR890	152-0412-00				SEMICONV DEVICE:SILICON,50V,3A	80009	152-0412-00
CR891	152-0412-00				SEMICONV DEVICE:SILICON,50V,3A	80009	152-0412-00
CR893	152-0414-00				SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR894	152-0414-00				SEMICONV DEVICE:SILICON,200V,0.75A	80009	152-0414-00
L872	108-0422-00				COIL,RF:80UH	80009	108-0422-00
L877	108-0422-00				COIL,RF:80UH	80009	108-0422-00
L881	108-0422-00				COIL,RF:80UH	80009	108-0422-00
L884	108-0337-00				COIL,RF:25UH	80009	108-0337-00
L887	108-0337-00				COIL,RF:25UH	80009	108-0337-00
L890	108-0337-00				COIL,RF:25UH	80009	108-0337-00
L893	108-0422-00				COIL,RF:80UH	80009	108-0422-00
L897	108-0556-00				COIL,RF:12UH	80009	108-0556-00
L898	108-0554-00				COIL,RF:5UH	80009	108-0554-00
Q843	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q846	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q853	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q855	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q856	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q860	151-0260-00				TRANSISTOR:SILICON,NPN	80009	151-0260-00
Q863	151-0192-00				TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q864	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q868	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q876	151-0505-00				TRANSISTOR:SILICON,SCR	80009	151-0505-00
R840	315-0100-00				RES.,FXD,CMPN:10 OHM,5%,0.25W	01121	CB1005
R842	321-0213-00				RES.,FXD,FILM:1.62K OHM,11%,0.125W	91637	MFF1816G16200F
R843	311-0863-00	B010100	B069999		RES.,VAR,NONWIR:500 OHM,0.5W		
R843	311-1279-00	B070000			RES.,VAR,NONWIR:500 OHM,10%,0.50W	32997	3329W-L58-501
R844	321-0222-00				RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R845	315-0102-00				RES.,FXD,CMPN:1K OHM,5%,0.25W	01121	CB1025
R846	315-0470-00				RES.,FXD,CMPN:47 OHM,5%,0.25W	01121	CB4705
R848	315-0102-00				RES.,FXD,CMPN:1K OHM,5%,0.25W	01121	CB1025
R851	315-0202-00				RES.,FXD,CMPN:2K OHM,5%,0.25W	01121	CB2025
R852	315-0104-00				RES.,FXD,CMPN:100K OHM,5%,0.25W	01121	CB1045
R853	315-0472-00				RES.,FXD,CMPN:4.7K OHM,5%,0.25W	01121	CB4725
R854	315-0242-00				RES.,FXD,CMPN:2.4K OHM,5%,0.25W	01121	CB2425
R855	315-0102-00				RES.,FXD,CMPN:1K OHM,5%,0.25W	01121	CB1025
R856	315-0102-00				RES.,FXD,CMPN:1K OHM,5%,0.25W	01121	CB1025
R858	315-0150-00	B010100	B010109		RES.,FXD,CMPN:15 OHM,5%,0.25W	01121	CB1505
R858	315-0120-00	B010110			RES.,FXD,CMPN:12 OHM,5%,0.25W	01121	CB1205
RB60	315-0473-00				RES.,FXD,CMPN:47K OHM,5%,0.25W	01121	CB4735
R861	315-0104-00				RES.,FXD,CMPN:100K OHM,5%,0.25W	01121	CB1045
R863	315-0272-00				RES.,FXD,CMPN:2.7K OHM,5%,0.25W	01121	CB2725
R864	315-0471-00				RES.,FXD,CMPN:470 OHM,5%,0.25W	01121	CB4715
R866	315-0102-00				RES.,FXD,CMPN:1K OHM,5%,0.25W	01121	CB1025
R867	315-0104-00				RES.,FXD,CMPN:100K OHM,5%,0.25W	01121	CB1045
R868	315-0472-00				RES.,FXD,CMPN:4.7K OHM,5%,0.25W	01121	CB4725
R876	315-0102-00				RES.,FXD,CMPN:1K OHM,5%,0.25W	01121	CB1025
T874	120-0638-00				XFMR,TOROID:15 TURNS,BIFILAR	80009	120-0638-00
T879	120-0638-00				XFMR,TOROID:15 TURNS,BIFILAR	80009	120-0638-00

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.	Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff Dscont				
T882	120-0638-00			XFMR,TOROID:15 TURNS,BIFILAR	80009	120-0638-00
T885	120-0639-00			XFMR,TOROID:8 TURN,BIFILAR	80009	120-0639-00
T888	120-0639-00			XFMR,TOROID:8 TURN,BIFILAR	80009	120-0639-00
T892	120-0639-00			XFMR,TOROID:8 TURN,BIFILAR	80009	120-0639-00
T895	120-0638-00			XFMR,TOROID:15 TURNS,BIFILAR	80009	120-0638-00
T899	120-0637-00			XFMR,TOROID:5 TURNS BIFILAR	80009	120-0637-00
VRB48	152-0212-00			SEMICONV DEVICE:ZENER,0.5W,9V,5%	80009	152-0212-00
VR876	152-0289-00			SEMICONV DEVICE:ZENER,0.4W,180V,5%	04713	1N991B
A15	670-0816-00			CKT BOARD ASSY:LOW VOLTAGE REGULATOR	80009	670-0816-00
C903	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C905	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C907	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C910	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131NO39 E 105Z
C911	283-0190-00			CAP.,FXD,CER DI:0.47UF,5%,50V	72982	
	8141N077X7RO474J					
C921	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131NO39 E 105Z
C925	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C933	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	72982	805-509B152J
C935	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C941	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131NO39 E 105Z
C945	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C950	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C961	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C968	283-0041-00			CAP.,FXD,CER DI:0.0033UF,5%,500V	72982	841-541B332J
C981	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C982	290-0187-00			CAP.,FXD,ELCTLT:4.7UF,20%,35V	56289	150D475X0035B2
C990	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100F,100V	72982	805-518-
	Z5DO102J					
C992	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
CR905	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR906	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR909	152-0061-00			SEMICONV DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR914	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR922	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR923	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR924	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR935	152-0061-00			SEMICONV DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR938	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR941	152-0066-00			SEMICONV DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR942	152-0066-00			SEMICONV DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR948	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR949	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR961	152-0418-00			SEMICONV DEVICE:RECT,SI,300V,3MA	80009	152-0418-00
CR964	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR965	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR972	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR984	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR991	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR994	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Tektronix		Serial/Model No.		Name & Description	Mfr	Mfr Part Number
Ckt No.	Part No.	Eff	Dscont		Code	
F901	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4
F902	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4
F921	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250OV,FAST-BLOW	71400	AGC 2
F957	159-0022-00			FUSE,CARTRIDGE:3AG,1A,250V,FAST-BLOW	71400	AGC 1
M941	149-0030-00	B010100	B069999X	METER,T TOTAL:CIRCUIT BOARD MOUNT,DC	18583	120-LC
Q906A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q910	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q912	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q914	151-0250-00			TRANSISTOR:SILICON,NPN	80009	151-0250-00
Q922A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q928	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q930	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q936	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q944	151-0216-00			TRANSISTOR:SILICON,PNP	80009	151-0216-00
Q946	151-0216-00			TRANSISTOR:SILICON,PNP	80009	151-0216-00
Q948	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q952	151-0260-00			TRANSISTOR:SILICON,NPN	80009	151-0260-00
Q954	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q964A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q966	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q970	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q984A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q988	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q992	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q994	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
R904	315-0434-00			RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R905	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R906	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R907	323-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.50W	75042	CECT9-1002B
R908	323-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.50W	75042	CECT9-1002B
R909	301-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R911	307-0108-00			RES.,FXD,CMPSN:6.8 OHM,5%,0.25W	80009	307-0108-00
R912	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	
	MFF1816G49901F					
R913	321-0155-00			RES.,FXD,FILM:402 OHM,1%,0.125W	91637	
	MFF1816G402ROF					
R914	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R915	308-0292-00			RES.,FXD,WW:2.2K OHM,5%,3W		
R916	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R917	307-0093-00			RES.,FXD,CMPSN:1.2 OHM,5%,0.50W	01121	EB12G5
R918	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R922	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R923	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R925	323-0758-07			RES.,FXD,FILM:3K OHM,0.1%,0.50W		
R926	323-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.50W	75042	CECT9-1002B
R928	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	
	MFF1816G15001F					
R929	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R930	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R931	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R932	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R933	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R934	321-0150-00			RES.,FXD,FILM:357 OHM,1%,0.125W	91637	
	MFF1816G357ROF					
R935	301-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.50W	01121	EB6215
R936	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535

REV. E JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff Dscont		Code	
R937	306-0180-00		RES.,FXD,CMPSN:18 OHM,10%,2W	01121	HB1801
R938	315-0151-00		RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R939	308-0560-00		RES.,FXD,WW:0.12 OHM,5%,5W		
R941	301-0395-00	B010100 B069999X	RES.,FXD,CMPSN:3.9M OHM,5%,0.50W	01121	EB3955
R943	315-0222-00		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R944	315-0473-00		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R945	315-0390-00		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R946	321-0193-07		RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	
	MFF1816C10000B				
R947	323-0289-07		RES.,FXD,FILM:10K OHM,0.1%,0.50W	75042	CECT9-1002B
R948	315-0471-00		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R949	315-0471-00		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R950	315-0101-00		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R951	306-0180-00		RES.,FXD,CMPSN:18 OHM,10%,2W	01121	HB1801
R952	315-0151-00		RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R953	315-0472-00		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R954	315-0331-00		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R955	308-0560-00		RES.,FXD,WW:0.12 OHM,5%,5W		
R962	323-0758-07		RES.,FXD,FILM:3K OHM,0.1%,0.50W		
R963	323-0763-07		RES.,FXD,FILM:7K OHM,0.1%,0.50W		
R964	315-0434-00		RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R965	315-0164-00		RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R966	321-0306-00		RES.,FXD,FILM:15K OHM,1%,0.125W	91637	
	MFF1816G15001F				
R967	321-0150-00		RES.,FXD,FILM:357 OHM,1%,0.125W	91637	
	MFF1816G357ROF				
R968	315-0162-00		RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R969	301-0621-00		RES.,FXD,CMPSN:620 OHM,5%,0.50W	01121	EB6215
R971	315-0153-00		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R972	306-0180-00		RES.,FXD,CMPSN:18 OHM,10%,2W	01121	HB1801
R973	315-0151-00		RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R974	308-0560-00		RES.,FXD,WW:0.12 OHM,5%,5W		
R982	323-0264-00		RES.,FXD,FILM:5.49K OHM,1%,0.50W	91637	
	MFF1226G54900F				
R983	315-0474-00		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R984	315-0204-00		RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R985	323-0771-09		RES.,FXD,FILM:1.375K OHM,1%,0.50W		
R986	311-0515-00		RES.,VAR,WW:250 OHM,1W		
R987	323-0772-09		RES.,FXD,FILM:6.71K OHM,1%,0.50W		
R988	321-0356-00		RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	
	MFF1816G49901F				
R989	321-0150-00		RES.,FXD,FILM:357 OHM,1%,0.125W	91637	
	MFF1816G357ROF				
R990	315-0302-00		RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R991	301-0103-00		RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R992	315-0470-00		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R995	301-0621-00		RES.,FXD,CMPSN:620 OHM,5%,0.50W	01121	EB6215
R996	315-0121-00		RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R997	307-0093-00		RES.,FXD,CMPSN:1.2 OHM,5%,0.50W	01121	EB12G5
R998	307-0093-00		RES.,FXD,CMPSN:1.2 OHM,5%,0.50W	01121	EB12G5
VR981	152-0294-00		SEMICOND DEVICE:ZENER,1W,36V,5%	04713	1N3033B
VR910	152-0168-00		SEMICOND DEVICE:ZENER,0.4W,12V,5%	04713	1N963B
VR927	152-0280-00		SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR930	152-0195-00		SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
VR982	152-0411-00		SEMICOND DEVICE:ZENER,0.25W,9V,5%	04713	1N937

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont	Code			
A17	670-0821-00	B010100	B029999		CKT BOARD ASSY:B TRIGGER SOURCE SWITCH	80009	670-0821-00
A17	670-0821-01	B030000			CKT BOARD ASSY:B TRIGGER SOURCE SWITCH	80009	670-0821-01
DS1001	150-0057-01	B010100	B029999		LAMP,INCAND:5V,0.115A,WIRE LD,SEL	87034	17AS15
DS1001	150-0048-01	B030000			LAMP,INCAND:5V,0.06A,SEL	08806	683AS15
S10011	670-0821-00	B010100	B029999		PUSH BUTTON:B TRIG SOURCE	80009	670-0821-00
S10011	670-0821-01	B030000			PUSH BUTTON:B TRIG SOURCE	80009	670-0821-01
A18	670-0792-00	B010100	B029999		CKT BOARD ASSY:A TRIGGER SOURCE SWITCH	80009	670-0792-00
A18	670-0792-01	B030000			CKT BOARD ASSY:A TRIGGER SOURCE SWITCH	80009	670-0792-01
DS1011	150-0057-01	B010100	B029999		LAMP,INCAND:5V,0.115A,WIRE LD,SEL	87034	17AS15
DS1011	150-0048-01	B030000			LAMP,INCAND:5V,0.06A,SEL	08806	683AS15
S10111	670-0792-00	B010100	B 029999		PUSH BUTTON:A TRIG SOURCE	80009	670-0792-00
S10111	670-0792-01	B030000			PUSH BUTTON:A TRIG SOURCE	80009	670-0792-01
A19	670-0991-00				CKT BOARD ASSY:VERTICAL MODE SWITCH	80009	670-0991-00
DS1021	150-0057-02				LAMP,INCAND:5V,0.115A,WIRE LD,SEL	80009	150-0057-02
DS1023	150-0057-02				LAMP,INCAND:5V,0.115A,WIRE LD,SEL	80009	150-0057-02
DS1025	150-0057-02				LAMP,INCAND:5V,0.11SA,WIRE LD,SEL	80009	150-0057-02
DS1027	150-0057-02				LAMP,INCAND:5V,O.115A,WIRE LD,SEL	80009	150-0057-02
DS1029	150-0057-02				LAMP,INCAND:5V,O. 11SA,WIRE LD,SEL	80009	150-0057-02
CR1021	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1022	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1023	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1027	152-0141-02				SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
R1023	315-0153-00				RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
S10211	670-0991-00				PUSH BUTTON:VERTICAL MODE	80009	670-0991-00
A20	670-1330-00				CKT BOARD ASSY:HORIZONTAL MODE SWITCH	80009	670-1330-00
DS1031	150-0057-02				LAMP,INCAND:5V, O.115A,WIRE LD,SEL	80009	150-0057-02
DS1032	150-0057-02				LAMP,INCAND:5V,0.115A,WIRE LD,SEL	80009	150-0057-02
DS1033	150-0057-02				LAMP,INCAND:5V,0.115A,WIRE LD,SEL	80009	150-0057-02
DS1034	150-0057-02				LAMP,INCAND:SV,0.11SA,WIRE LD,SEL	80009	150-0057-02
R1025	316-0270-00				RES.,FXD,CMPSN:27 OHM,10o%,0.25W	01121	CB2701
R1031	315-0160-00	XB020165			RES.,FXD,CMPSN:16 OHM,5%,0.25W	01121	CB1605
R1033	315-0160-00	XB020165			RES.,FXD,CMPSN:16 OHM,5%,O.25W	01121	CB1605
S10311	670-1330-00				PUSH BUTTON:HORIZONTAL MODE	80009	670-1330-00

¹See Mechanical Parts List for replacement parts.

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
A21	670-0635-03	B010100	B029999	CKT BOARD ASSY:READOUT SYSTEM	80009	670-0635-03
A21	670-0635-04	B030000	B039999	CKT BOARD ASSY:READOUT SYSTEM	80009	670-0635-04
A21	670-0635-05	B040000	B049999	CKT BOARD ASSY:READOUT SYSTEM	80009	670-0635-05
A21	670-0635-07	B050000	B059999	CKT BOARD ASSY:READOUT SYSTEM	80009	670-0635-07
A21	670-0635-08	B060000	CKT BOARD	ASSY:READOUT SYSTEM	80009	670-0635-08
C1141	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C1166	283-0004-00	XB040000		CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-
ZSV0203Z						
C1180	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C1186	283-0004-00	XB040000		CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-
ZSV0203Z						
C1190	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1214	285-0698-00			CAP.,FXD,PLSTC:0.0082UF,5%,100V	56289	410P82251
C1222	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C1227	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C1230	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1237	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1267	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1268	283-0177-00			CAP.,FXD,CER DI:IUF,+80-20%,25V	72982	8131N039 E 105Z
C1291	283-0177-00			CAP.,FXD,CER DI:IUF,+80-20%,25V	72982	8131N039 E 105Z
C1294	283-0177-00			CAP.,FXD,CER DI:IUF,+80-20%,25V	72982	8131N039 E 105Z
C1297	283-0177-00			CAP.,FXD,CER DI:IUF,+80-20%,25V	72982	8131N039 E 105Z
CR1112	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1113	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1117	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1118	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1122	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1123	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1127	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1128	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1132	152-0141-02	XB030000		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1133	152-0141-02	XB030000		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1135	152-0141-02	XB030000		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1137	152-0141-02	XB030000		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1141	152-0141-02		B010100	B039999X	SEMICONV	
DEVI	CE:SILICON,30V,150MA		07910	1N4152		
CR1142	152-0141-02	XB010110	B039999X	SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1155	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1206	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1207	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1208	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1213	152-0141-02	XB030000		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1216	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1217	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1222	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1223	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1224	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1227	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR1231	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
L1270	108-0331-00			COIL,RF:0.75UH	80009	108-0331-00
Q1143A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q1150	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1152	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1155	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q1163	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00

REV. D JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
Q1185	151-0192-00				TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q1223	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q1226	151-0190-00				TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1274	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q1278	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q1284	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q1288	151-0188-00				TRANSISTOR:SILICON,PNP	80009	151-0188-00
R1111	317-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.125W	01121	BB1025
R1112	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1113	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1116	317-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.125W	01121	BB1025
R1117	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1118	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1121	317-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.125W	01121	BB1025
R1122	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1123	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1126	317-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.125W	01121	BB1025
R1127	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1128	317-0751-00				RES.,FXD,CMPSN:750 OHM,5%,0.125W	01121	BB7515
R1131	317-0513-00				RES.,FXD,CMPSN:51K OHM,5%,0.125W	01121	BB5135
R1132	317-0133-00				RES.,FXD,CMPSN:13K OHM,5%,0.125W	01121	BB1335
R1133	317-0133-00				RES.,FXD,CMPSN:13K OHM,5%,0.125W	01121	BB1335
R1134	317-0753-00				RES.,FXD,CMPSN:75K OHM,5%,0.125W	01121	BB7535
R1135	321-0310-00	B010100	B029999		RES.,FXD,FILM:16.SK		
	OHM,1%,0.125W	91637	MFF1816G16501F				
R1135	321-0308-00	B030000			RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	
	MFF1816G15801F						
R1136	317-0513-00				RES.,FXD,CMPSN:51K OHM,5%,0.125W	01121	BB5135
R1137	321-0321-00	B010100	B029999		RES.,FXD,FILM:21.5K		
	OHM,1%,0.125W	91637	MFF1816G21501F				
R1137	321-0319-00	B030000			RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	
	MFF1816G20501F						
R1138	321-0335-00				RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	
	MFF1816G30101F						
R1140	317-0752-00				RES.,FXD,CMPSN:7.5K OHM,5%,0.125W	01121	BB7525
R1141	321-0261-00	B010100	B049999		RES.,FXD,FILM:5.11K		
	OHM,1%,0.125W	91637	MFF1816G51100F				
R1141	321-0258-00	B040000			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	
	MFF1816G47500F						
R1142	311-0634-00	XB050000	B059999		RES.,VAR,NONWIR:500 OHM,10%,0.50W	73138	82-31-0
R1142	311-1279-00	B060000			RES.,VAR,NONWIR:500 OHM,10%,0.50W	32997	3329W-L58-501
R1143	317-0133-00				RES.,FXD,CMPSN:13K OHM,5%,0.125W	01121	BB1335
R1144	317-0154-00	B010100	B 039999		RES.,FXD,CMPSN:150K		
	OHM,5%,0.125	01121	BB1545				
R1144	317-0124-00	B040000			RES.,FXD,CMPSN:120K OHM,5%,0.125W	01121	BB1245
R1146	321-0181-00				RES.,FXD,FILM:750 OHM,1%,0.125W	91637	
	MFF1816G750ROF						
R1147	321-0297-00	B010100	B039999		RES.,FXD,FILM:12.1K		
	OHM,1%,0.125W	91637	MFF1816G12101F				
R1147	321-0299-00	B040000			RES.,FXD,FILM:12.7K OHM,1%,0.125W	91637	
	MFF1816G12701F						
R1148	321-0212-00	B010100	B010109		RES.,FXD,FILM:1.58K		
	OHM,1%,0.125W	91637	MFF1816G15800F				
R1148	317-0102-00	B010110	B039999		RES.,FXD,CMPSN:1K		
	OHM,5%,0.125W	01121	BB1025				
R1148	321-0212-00	B040000			RES.,FXD,FILM:1.58K OHM,1%,0.125W	91637	
	MFF1816G15800F						
R1152	317-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,0.125W	01121	BB1525
R1155	317-0222-00				RES.,FXD,CMPSN:2.2K OHM,5%,0.125W	01121	BB2225
R1156	321-0268-00				RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	
	MFF1816G60400F						
R1163	317-0243-00	B010100	B010109		RES.,FXD,CMPSN:24K		
	OHM,5%,0.125W	01121	BB2435				
R1163	321-0329-00	B010110	B029999		RES.,FXD,FILM:26.1K		
	OHM,1%,0.125W	91637	MFF1816G26101F				
R1163	317-0243-00	B030000			RES.,FXD,CMPSN:24K OHM,5%,0.125W	01121	BB2435
R1171	317-0154-00				RES.,FXD,CMPSN:150K OHM,5%,0.125	01121	BB1545
R1172	321-0335-00				RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	
	MFF1816G30101F						
R1173	321-0344-00				RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	
	MFF1816G37401F						

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R1174	321-0335-00				RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	
	MFF1816G30101F						
R1175	317-0513-00				RES.,FXD,CMPSN:51K OHM,5%,0.125W	01121	BB5135
R1176	317-0154-00				RES.,FXD,CMPSN:150K OHM,5%,0.125	01121	BB1545
R1177	321-0335-00				RES.,FXD,FILM:30.1K OHM,1%,O.125W	91637	
	MFF1816G30101F						
R1178	321-0335-00				RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	
	MFF1816G30101F						
R1180	321-0262-00	B010100	B029999		RES.,FXD,FILM:5.23K		
	OHM,1%,0.125W	91637	MFF1816G52300F				
R1180	321-0264-00	B030000	B049999		RES.,FXD,FILM:5.49K		
	OHM,1%,0.125W	91637	MFF1816G54900F				
R1180	321-0261-00	B050000			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	
	MFF1816G51100F						
R1181	321-0371-00	B010100	B010109		RES.,FXD,FILM:71.SK		
	OHM,1%,0.125W	91637	MFF1816G71501F				
R1181	321-0367-00	B010110	B039999		RES.,FXD,FILM:64.9K		
	OHM,1%,0.125W	91637	MFF1816G64901F				
R1181	321-0372-00	B040000	B059999		RES.,FXD,FILM:73.2K		
	OHM,1%,0.125W	91637	MFF1816G73201F				
R1181	321-0371-00	B060000			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	
	MFF1816G71501F						
R1182	311-0634-00	XB050000	B059999		RES.,VAR,NONWIR:500 OHM,10%,O.50W	73138	82-31-0
R1182	311-1279-00	B060000			RES.,VAR,NONWIR:500 OHM,10%,O.50W	32997	3329W-L58-501
R1183	321-0401-00	B010100	B039999		RES.,FXD,FILM:147K		
	OHM,1%,0.125W	91637	MFF1816G14702F				
R1183	321-0407-00	B040000	B059999		RES.,FXD,FILM:169K		
	OHM,1%,0.125W	91637	MFF1816G16902F				
R1183	321-0403-00	B060000			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	
	MFF1816G15402F						
R1185	317-0103-00				RES.,FXD,CMPSN:IOK OHM,5%,0.125W	01121	BB1035
R1190	317-0303-00				RES.,FXD,CMPSN:30K OHM,5%,0.125W	01121	BB3035
R1191	317-0203-00				RES.,FXD,CMPSN:20K OHM,5%,0.125W	01121	BB2035
R1193	317-0203-00				RES.,FXD,CMPSN:20K OHM,5%,0.125W	01121	BB2035
R1195	317-0203-00				RES.,FXD,CMPSN:20K OHM,5%,0.125W	01121	BB2035
R1197	317-0203-00				RES.,FXD,CMPSN:20K OHM,5%,0.125W	01121	BB2035
R1205	317-0432-00				RES.,FXD,CMPSN:4.3K OHM,5%,0.125W	01121	BB4325
R1206	317-0683-00				RES.,FXD,CMPSN:68K OHM,5%,0.125W	01121	BB6835
R1210	317-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.125W	01121	BB1045
R1214	317-0393-00				RES.,FXD,CMPSN:39K OHM,5%,0.125W	01121	BB3935
R1215	317-0332-00	B010100	B029999		RES.,FXD,CMPSN:3.3K		
	OHM,5%,0.125W	01121	BB3325				
R1215	317-0302-00	B030000			RES.,FXD,CMPSN:3K OHM,5%,0.125W	01121	BB3025
R1216	315-0152-00				RES.,FXD,CMPSN:1.SK OHM,5%,0.25W	01121	CB1525
R1218	317-0183-00				RES.,FXD,CMPSN:18K OHM,5%,0.125W	01121	BB1835
R1219	311-0634-00	B010100	B029999		RES.,VAR,NONWIR:500		
	OHM,10%,0.50W	73138	82-31-0				
R1219	311-0635-00	B030000			RES.,VAR,NONWIR:1K OHM,10%,0.50W	73138	82-32-0
R1220	317-0103-00				RES.,FXD,CMPSN:100K OHM,5%,0.125W	01121	BB1035
R1221	317-0752-00				RES.,FXD,CMPSN:7.5K OHM,5%,0.125W	01121	BB7525
R1223	315-0242-00				RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R1226	317-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,0.125W	01121	BB1525
R1227	317-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.125	01121	BB5125
R1230	317-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.125	01121	BB5125
R1231	317-0332-00	XB040000			RES.,FXD,CMPSN:3.3K OHM,5%,0.125W	01121	BB3325
R1235	317-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.125	01121	BB5125
R1237	317-0222-00				RES.,FXD,CMPSN:2.2K OHM,5%,0.125W	01121	BB2225
R1255	321-0176-00				RES.,FXD,FILM:665 OHM,1%,0.125W	91637	
	MFF1816G665ROF						
R1256	321-0153-00				RES.,FXD,FILM:383 OHM,1%,0.125W	91637	
	MFF1816G383ROF						
R1257	321-0250-00				RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	
	MFF1816G39200F						
R1258	317-0223-00				RES.,FXD,CMPSN:22K OHM,5%,O.125W	01121	BB2235
R1260	317-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.125W	01121	BB1025
R1264	317-0272-00				RES.,FXD,CMPSN:2.7K OHM,5%,0.125W	01121	BB2725
R1265	317-0512-00				RES.,FXD,CMPSN:5.1K OHM,5%,0.125	01121	BB5125
R1266	317-0822-00	B010100	B010109		RES.,FXD,CMPSN:8.2K		
	OHM,5%,0.125W	01121	BB8225				
R1266	317-0103-00	8010110	B029999		RES.,FXD,CMPSN:10K		
	OHM,5%,0.125W	01121	BB1035				
R1266	317-0912-00	B030000			RES.,FXD,CMPSN:9.IK OHM,5%,O.125W	01121	BB9125

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
R1269	317-0823-00				RES.,FXD,CMPSN:82K OHM,5%,0.125W	01121	BB8235
R1270	321-0222-00				RES.,FXD,FILM:2K OHM,1%,0.125W	91637	
	MFF1816G20000F						
R1271	321-0216-00				RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	
	MFF1816G17400F						
R1272	321-0245-00				RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	
	MFF1816G34800F						
R1274	321-0209-00				RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	
	MFF1816G14700F						
R1276	321-0241-00				RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	
	MFF1816G31600F						
R1277	321-0255-00				RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	
	MFF1816G44200F						
R1278	315-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1280	321-0273-00				RES.,FXD,FILM:6.81K OHM,1%,0.125W	91637	
	MFF1816G68100F						
R1281	321-0193-00				RES.,FXD,FILM:1K OHM,1%,0.125W	91637	
	MFF1816GIOOOOF						
R1284	321-0199-00				RES.,FXD,FILM:1.15K OHM,1%,0.125W	91637	
	MFF1816G11500F						
R1285	311-0635-00				RES.,VAR,NONWIR:1K OHM,10%,0.50W	73138	82-32-0
R1286	321-0204-00				RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	
	MFF1816G13000F						
R1287	321-0245-00				RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	
	MFF1816G34800F						
R1288	315-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1289	315-0511-00				RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
U1130	155-0015-00	B010100	B059999		MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-00
U1130	155-0015-01	B060000			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01
U1166	155-0014-00	B010100	B059999		MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-00
U1166	155-0014-01	B060000			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U1170	155-0015-00	B010100	B059999		MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-00
U1170	155-0015-01	B060000			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01
U1186	155-0014-00	B010100	B059999		MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-00
U1186	155-0014-01	B060000			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U1190	155-0018-00				MICROCIRCUIT,DI:ZERO LOGIC	80009	155-0018-00
U1210	155-0021-01	B010100	B080849		MICROCIRCUIT,DI:ML,TIMING GENERATOR	80009	155-0021-01
U1210	155-0021-01	B080850			MICROCIRCUIT,DI:ML,TIMING GENERATOR	80009	155-0021-01
U1226	155-0017-00				MICROCIRCUIT,DI:ML,ZERO LOGIC COUNTER	80009	155-0017-00
U1227	156-0043-00				MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U1230	156-0012-00				MICROCIRCUIT,DI:SINGLE 2 MHZ J-K FLIP-FLOP	07263	U5B92329X
U1231	156-0012-00				MICROCIRCUIT,DI:SINGLE 2 MHZ J-K FLIP-FLOP	07263	U5B92329X
U1232	156-0012-00				MICROCIRCUIT,DI:SINGLE 2 MHZ J-K FLIP-FLOP	07263	U5B92329X
U1236	156-0011-00				MICROCIRCUIT,DI:DUAL 2-INPUT POS NOR GATE	07263	9914HC
U1251	155-0023-00				MICROCIRCUIT,DI:ML,CHAR GEN NUMERALS	80009	155-0023-00
U1252	155-0024-00				MICROCIRCUIT,DI:ML,CHAR GEN SPCL SYMBOLS	80009	155-0024-00
U1253	155-0025-00				MICROCIRCUIT,DI:ML,CHAR GEN PREFIXES	80009	155-0025-00
U1254	155-0026-00				MICROCIRCUIT,DI:ML,CHAR GEN LETTERS	80009	155-0026-00
U1255	155-0027-00				MICROCIRCUIT,DI:ML,CHAR GEN SPCL ALPHA	80009	155-0027-00
U1260	155-0019-00				MICROCIRCUIT,DI:ML,DECIMAL POINT AND SPACE	80009	155-0019-00
U1270	155-0020-00				MICROCIRCUIT,DI:ML,CHANNEL SW OUTPUT ASSY	80009	155-0020-00
VR1260	152-0405-00				SEMICONV DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
VR1261	152-0405-00				SEMICONV DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
VR1262	152-0405-00				SEMICONV DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
A22	670-0702-00				CKT BOARD ASSY:GRATICULE LIGHT	80009	670-0702-00
DS957	150-0029-00				LAMP,INCAND:6.3V,0.20A	08806	349
DS958	150-0029-00				LAMP,INCAND:6.3V,0.20A	08806	349
DS959	150-0029-00				LAMP,INCAND:6.3V,0.20A	08806	349

REV. E JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
A23	670-0839-00			CKT BOARD ASSY:Z-Y DELAY COMP	80009	670-0839-00
C53	283-0633-00			CAP.,FXD,MICA D:77PF,1%,100V	00853	D151E770FO
C55	281-0125-00			CAP.,VAR,MICA D:90-400PF,175V	72136	T51917-1
C56	283-0671-00			CAP.,FXD,MICA D:164PF,1%,500V		
C58	283-0670-00			CAP.,FXD,MICA D:375PF,1%,500V	00853	D155F3750FO
C66	283-0671-00			CAP.,FXD,MICA D:164PF,1%,500V		
C68	283-0670-00			CAP.,FXD,MICA D:375PF,1%,500V	00853	D155F3750FO
C73	283-0633-00			CAP.,FXD,MICA D:77PF,1%,100V	00853	D151E770FO
C75	281-0125-00			CAP.,VAR,MICA D:90-400PF,175V	72136	T51917-1
C76	283-0671-00			CAP.,FXD,MICA D:164PF,1%,500V		
C78	283-0670-00			CAP.,FXD,MICA D:375PF,1%,500V	00853	D155F3750FO
C86	283-0671-00			CAP.,FXD,MICA D:164PF,1%,500V		
C88	283-0670-00			CAP.,FXD,MICA D:375PF,1%,500V	00853	D155F3750FO
CR50	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR70	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
K50	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K60	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K70	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K80	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
L51	108-0559-00			COIL,RF:1.605UH	80009	108-0559-00
L55	108-0560-00			COIL,RF:1.59UH	80009	108-0560-00
L56	108-0561-00			COIL,RF:3.75UH	80009	108-0561-00
L61	108-0559-00			COIL,RF:1.605UH	80009	108-0559-00
L65	108-0560-00			COIL,RF:1.59UH	80009	108-0560-00
L66	108-0561-00			COIL,RF:3.75UH	80009	108-0561-00
L71	108-0559-00			COIL,RF:1.605UH	80009	108-0559-00
L75	108-0560-00			COIL,RF:1.59UH	80009	108-0560-00
L76	108-0561-00			COIL,RF:3.75UH	80009	108-0561-00
L81	108-0559-00			COIL,RF:1.605UH	80009	108-0559-00
L85	108-0560-00			COIL,RF:1.59 UH	80009	108-0560-00
L86	108-0561-00			COIL,RF:3.75UH	80009	108-0561-00
R51	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	
	MFF1816G49R90F					
R61	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	
	MFF1816G49R90F					
R71	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	
	MFF1816G49R90F					
R81	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	
	MFF1816G49R90F					
S50	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
S70	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028

CHASSIS PARTS

B801	119-0147-01			FAN,VENTILATING:115V,14W, 3200RPM		
DS780	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T

REV. C JULY 1978

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont	Code			
DS781	150-0030-00				LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS785	150-0030-00				LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS786	150-0030-00				LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS787	150-0030-00				LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS788	150-0030-00				LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS1035	150-0048-01				LAMP,INCAND:5V,0.06A,SEL	08806	683AS15
DS1037	150-0048-01				LAMP,INCAND:5V,0.06A,SEL	08806	683AS15
C400	281-0670-00				CAP.,FXD,CER DI:1.8PF,+/-O.1PF,500V	72982	374-
005COK0189B							
C483	281-0064-00				CAP.,VAR,PLSTC:0.25-1.SPF,600V	72982	530-002
C484	281-0064-00				CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C489	283-0003-00				CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C742	283-0021-00	B010100	B049999		CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y55-
102M							
C742	283-0033-00	B050000			CAP.,FXD,CER DI:0.001UF,+100-0%,6000V	72982	
3906BW200E102P							
C762	290-0312-00				CAP.,FXD,ELCTLT:47UF,10%,35V	56289	150D476X9035S2
C763	290-0135-00				CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C764	285-0629-00				CAP.,FXD,PLSTC:0.047UF,20%,1000V	56289	410P47301
C771	290-0305-00				CAP.,FXD,ELCTLT:3UF,20%,150V	56289	109D305X0150C2
C772	283-0082-00				CAP.,FXD,CER DI:0.01UF,+80-20%,4000V	56289	112C29
C779	283-0082-00				CAP.,FXD,CER DI:0.01UF,+80-20%,4000V	56289	112C29
C780	290-0305-00				CAP.,FXD,ELCTLT:3UF,20%,150V	56289	109D305X0150C2
C781	283-0082-00				CAP.,FXD,CER DI:0.01UF,+80-20%,4000V	56289	112C29
C782 ¹							
C783 ¹							
C784 ¹							
C785 ¹							
C786 ¹							
C787 ¹							
C788	283-0082-00				CAP.,FXD,CER DI:0.01UF,+80-20%,4000V	56289	112C29
C789	283-0082-00				CAP.,FXD,CER DI:0.01UF,+80-20%,4000V	56289	112C29
C790	283-0082-00				CAP.,FXD,CER DI:0.01UF,+80-20%,4000V	56289	112C29
C791	283-0077-00				CAP.,FXD,CER DI:330PF,5%,500V	56289	40C94A3
C798	283-0033-01				CAP.,FXD,CER DI:1000PF,+100-0%,6000V		
C799	283-0002-00				CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C800 ²							
C801 ²							
C813	290-0413-00				CAP.,FXD,ELCTLT:980UF,+50-10%,100V	56289	32D5636
C814	290-0413-00				CAP.,FXD,ELCTLT:980UF,+50-100,100V	56289	32D5636
C870 ³							
C896	290-0426-00				CAP.,FXD,ELCTLT:330UF,20%,6V		
C897	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1056	281-0501-00				CAP.,FXD,CER DI:4.7PF,+/-1PF,500V	72982	301-00052H0479F
C1057	281-0625-00				CAP.,FXD,CER DI:35PF,5%,50V	72982	308-
OOOCOG0350J							
C1081	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1082	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1083	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1084	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1085	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1086	283-0177-00				CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
CR771	152-0242-00				SEMICONV DEVICE:SILICON,225V,200MA	80009	152-0242-00
CR772	152-0408-00				SEMICONV DEVICE:SILICON,10KV,5MA	83003	H345
CR780	152-0107-00				SEMICONV DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR781	152-0408-00				SEMICONV DEVICE:SILICON,10KV,5MA	83003	H345

¹Furnished as a unit with HV Power Supply subassembly (119-0268-00).

²Furnished as a unit with Line Filter (119-0228-00).

³Furnished as a unit with LV Power Supply subassembly (119-0229-00).

Replaceable Electrical Parts-R7704

Tektronix		Serial/Model No.		Name & Description	Mfr	Mfr Part Number
Ckt No.	Part No.	Eff	Dscont		Code	
CR782 ¹						
CR783 ¹						
CR784 ¹						
CR785 ¹						
CR786 ¹						
CR896	152-0397-00			SEMICOND DEVICE:SILICON,50V,12A	80009	152-0397-00
CR897	152-0397-00			SEMICOND DEVICE:SILICON,50V,12A	80009	152-0397-00
CR1040	152-0274-00	B010100	B010127X	SEMICOND DEVICE:SILICON,100V,10A	80009	152-0274-00
CR1041	152-0274-00			SEMICOND DEVICE:SILICON,100V,10A	80009	152-0274-00
F800	159-0017-00			FUSE,CARTRIDGE:3AG,4A,250V,FAST BLOW	71400	MTH4
F810	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
F1040	159-0014-00			FUSE,CARTRIDGE:3AG,5A,250V,FAST-BLOW	71400	MTH5
FL8012						
DL400	119-0265-00			DELAY LINE,ELEC:11SNS,100 OHM	80009	119-0265-00
J618	131-0818-00			CONNECTOR,RCPT,;BNC,FEMALE	91836	KC19-153BNC
J650	136-0387-00			JACK,TIP:GRAY	71279	450-4352-01-0318
J651	136-0387-00			JACK,TIP:GRAY	71279	450-4352-01-0318
J652	136-0387-00			JACK,TIP:GRAY	71279	450-4352-01-0318
J653	131-0387-00			JACK,TIP:GRAY	71279	450-4352-01-0318
J679	131-0818-00			CONNECTOR,RCPT,;BNC,FEMALE	91836	KC19-153BNC
J699	131-0818-00			CONNECTOR,RCPT,;BNC,FEMALE	91836	KC19-153BNC
J1055	131-0955-00			CONNECTOR,RCPT,;BNC,FEMALE,W/HARDWARE	05091	31-279
J1060	131-0955-00			CONNECTOR,RCPT,;BNC,FEMALE,W/HARDWARE	05091	31-279
J1075	136-0089-00			CONNECTOR,RCPT,;9 PIN CHASSIS MOUNT	02660	165-16
J1080	131-0771-00			CONNECTOR,RCPT,;4 CONT,QUICK DISCONNECT	0000A	ROA-304NYL
J1085	131-0771-00			CONNECTOR,RCPT,;4 CONT,QUICK DISCONNECT	0000A	ROA-304NYL
L481	108-0241-00			COIL,RF:0.05UH	80009	108-0241-00
L482	108-0241-00			COIL,RF:0.05UH	80009	108-0241-00
L483	114-0232-00			COIL,RF:VARIABLE,130-220NH	80009	114-0232-00
L484	114-0232-00			COIL,RF:VARIABLE,130-220NH	80009	114-0232-00
L762	108-0422-00			COIL,RF:80UH	80009	108-0422-00
L764	108-0231-00			COIL,RF:4.5UH	80009	108-0231-00
L781	108-0553-00			COIL,RF:47MH	32159	647,000M
L788	108-0553-00			COIL,RF:47MH	32159	647,000M
L790	108-0544-00			COIL,TUBE DEFLE:TRACE ROTATOR	80009	108-0544-00
L795	108-0546-00			COIL,TUBE DEFLE:Y ALIGNMENT	80009	108-0546-00
LB003						
LB013						
L8704						
P1041	131-0765-00			TERM,FEEDTHRU:0.584 L X 0.625 OD BRS	80009	131-0765-00
Q480	151-0211-00	B010100	B080899	TRANSISTOR:SILICON,NPN	01282	2N3866
Q480	151-0211-01	B080900		TRANSISTOR:SILICON,NPN		
Q482	151-0211-00	B010100	B080899	TRANSISTOR:SILICON,NPN	01282	2N3866
Q482	151-0211-01	B080900		TRANSISTOR:SILICON,,NPN		
Q764	151-0140-00			TRANSISTOR:SILICON,NPN	80009	151-0140-00
Q766	151-0140-00			TRANSISTOR:SILICON,NPN	80009	151-0140-00
Q918	151-0140-00			TRANSISTOR:SILICON,NPN	80009	151-0140-00
Q938	151-0148-00			TRANSISTOR:SILICON,NPN	02735	39539
Q939	151-0141-00			TRANSISTOR:SILICON,NPN		
Q956	151-0141-00			TRANSISTOR:SILICON,NPN		

¹Furnished as a unit with HV Power Supply sub-assembly (119-0268-00).

²See Mechanical Parts List for replaceable parts.

³Furnished as a unit with Line Filter (119-0228-00).

⁴Furnished as a unit with LV Power Supply subassembly (119-0229-00).

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
Q972	151-0148-00		TRANSISTOR:SILICON,NPN	02735	39539
Q974	151-0141-00		TRANSISTOR:SILICON,NPN		
Q998	151-0140-00		TRANSISTOR:SILICON,NPN	80009	151-0140-00
R231	311-0091-00		RES.,VAR,NONWIR:1K OHM,10%,0.50W	01121	W-3083E
R483	315-0122-00		RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R484	315-0122-00		RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R485	308-0425-00		RES.,FXD,WW:0.35 OHM,1%,BW		
R487	308-0425-00		RES.,FXD,WW:0.35 OHM,1%,8W		
R489	305-0510-00		RES.,FXD,CMPSN:51 OHM,5%,2W	01121	HB5105
R740A					
R740B					
R740C					
R740D	307-0271-00		RES.,FXD,FILM:(4) INDEPENDENT	80009	307-0271-00
R740E					
R740F					
R779	315-0205-00		RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R780	315-0273-00		RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R782	301-0205-00		RES.,FXD,CMPSN:2M OHM,5%,0.50W	01121	EB2055
R783	301-0225-00		RES.,FXD,CMPSN:2.2M OHM,5%,0.50W	01121	EB2255
R784	301-0225-00		RES.,FXD,CMPSN:2.2M OHM,5%,0.50W	01121	EB2255
R785	311-0254-00		RES.,VAR,NONWIR:5M OHM,10%,1W	12697	CM29709
R786A ¹					
R786B ¹					
R786C ¹					
R786D ¹					
R786E ¹					
R787 ¹					
R788	316-0470-00		RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R789	301-0471-00		RES.,FXD,CMPSN:470 OHM,5%,0.50W	01121	EB4715
R790	311-0964-00		RES.,VAR,WW:2.5K OHM,10%	71590	BAS105-036
R793	311-0467-00		RES.,VAR,NONWIR:100K OHM,20%,0.50W	11237	300SF-41334
R799	315-0471-00		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R800	301-0204-00		RES.,FXD,CMPSN:200K OHM,5%,0.50W	01121	EB2045
R801 ²					
R802	301-0104-00		RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R957	311-0939-00		RES.,FXD,WW:PNL,25 OHM,12.5W		
R1034	307-0093-00	XB010125	RES.,FXD,CMPSN:1.2 OHM,5%,0.50W	01121	EB12G5
R1035	311-0310-00		RES.,VAR,NONWIR:5K OHM,20%,0.50W	01121	W-7350A
R1037 ³	311-0973-00	B010100 B081194	RES.,VAR,NONWIR:5K OHM,0.5W,W/SW		
R1037 ³	311-1839-00	B081195	RES.,VAR,NONWIR:5K OHM,20%,0.50W,W/4PST SW	01121	14M083
R1040 ⁴	311-1104-00		RES.,VAR,NONWIR:10K OHM,10%,0.50W	12697	381-CM40095
R1056	315-0562-00		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1058	315-0113-00		RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R1060	315-0241-00		RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
RT810	307-0157-00	XB030000	RES.,THERMAL:5 OHM,10%,DISC	15454	5DAR0-K-270SIL
RT811	307-0157-00	XB030000	RES.,THERMAL:5 OHM,10%,DISC	15454	5DAR0-K-270SIL
S455A,B ⁵					
S800	260-1196-00		SWITCH,TOGGLE:DPST,15A,250 VAC,OFF/ON		
S801	260-0879-00		SW,THERMOSTATIC:10A,240V,OPEN 88.3 DEG C	93410 110221	
S8106					
S10407					

¹Furnished as a unit with HV Power Supply subassembly (119-0268-00).

²Furnished as a unit with Line Filter (119-0228-00).

³Furnished as a unit with 5455A,B.

⁴Furnished as a unit with S1040.

⁵Furnished as a unit with R1037.

⁶See Mechanical Parts List. Line Voltage Selector Body.

⁷Furnished as a unit with R1040.

Replaceable Electrical Parts-R7704

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Dscont				
S1041	260-1195-00				SWITCH,SLIDE:DP3T,0.5A,125VAC	82389	XW-3029
T198	276-0525-00				CORE,FERRITE:0.196 ID X 0.437"OD	01121	T037C351A
T701	276-0549-00	B010100	B059999		CORE,EM:TOROID,FERRITE,0.437 OD X 0.21 ID		
T701	276-0525-00	B060000			CORE,FERRITE:0.196 ID X 0.437"OD 01121 T037C351A		
T702	276-0549-00	B010100	B059999		CORE,EM:TOROID,FERRITE,0.437 OD X 0.21 ID		
T702	276-0525-00	B060000			CORE,FERRITE:0.196 ID X 0.437"OD 01121 T037C351A		
T762	276-0591-00				CORE,EM:TOROID FERRITE,1.0 OD X 0.5 ID		
T764	120-0634-01				XFMR,PWR,STU:HV 80009 120-0634-01		
T800 ¹							
T801	120-0690-00				XFMR,PWR,STPDN:FAN	80009	120-0690-00
T870 ²							
V799	154-0609-00	B010100	B019999		ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0609-00
V799	154-0609-05	B020000			ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0609-05
VR786	152-0247-00				SEMICONV DEVICE:ZENER,0.4W,150V,5%	04713	1N989B

¹Furnished as a unit with Line Filter (119-0228-00).

²Furnished as a unit with LV Power Supply subassembly (119-0229-00).

REV. D JULY 1978

All HIGH VOLTAGE/Z AXIS AMPLIFIER Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Description		
Resistors (cont)						
R730	322-0385-00			100 k Ω	1/4 W	Prec 1X
R731	315-0102-00			1 k Ω	1/4 W	5%
R732	323-0307-00			15.4 k Ω	1/2 W	Prec 1X
R733	303-0332-00			3.3 k Ω	1 W	5%
R734	303-0153-00			15 k Ω	1 W	5%
R735	315-0200-00			20 Ω	1/4 W	5%
R736	301-0750-00			75 Ω	1/2 W	5%
R737	315-0223-00			22 k Ω	1/4 W	5%
R738	315-0154-00			150 k Ω	1/4 W	5%
R739	311-0883-00	B010100	B069999	50 k Ω , Var		
R739	311-1271-00	B070000		50 k Ω , Var		
R743	311-0510-00	B010100	B069999	10 k Ω , Var		
R743	311-1228-00	B070000		10 k Ω , Var		
R744	321-0383-00			95.3 1k	1/8 W	Prec 1X
R745	323-0505-00			1.78 M Ω	1/2 W	Prec 1%
R746	321-0437-00			348 k Ω	1/8 W	Prec 1Z
R747	315-0473-00			47 k Ω	1/4 W	5%
R748	315-0153-00			5 k Ω	1/4 W	5%
R749	315-0471-00			470k Ω	1/4 W	5%
R751	315-0474-00			470 k Ω	1/4 W	5%
R752	321-0349-00			42.2 k Ω	1/8 W	Prec 1X
R753	315-0102-00			1 k Ω	1/4 W	5%
R755	315-0102-00			1 k Ω	1/4 W	5%
R757	315-0101-00			100 n	1/4 W	5%
R758	315-0104-00			100 k Ω	1/4 W	5%
R759	315-0302-00			3 k Ω	1/4 W	5X
R760	315-0624-00			620 k Ω	1/4 W	5%
R761	311-0698-00			1 M Ω , Var		
R765	315-0625-00			6.2 MN	1/4 W	5X
R766	315-0625-00			6.2 MJ	1/4 W	5%
R767	315-0392-00			3.9 k Ω	1/4 W	5X
R768	321-0335-00			30.1 k Ω	1/8 W	Prec 1X
R769	311-1035-00			50 k Ω Var		
R770	315-0472-00			4.7 k Ω	1/4 W	5%
R772	*307-0272-00			130 k Ω	Film	
R773	321-0359-00			53.6 k Ω	1/8 W	Prec 1%
R774	315-0821-00			820 Ω	1/4 W	5%

All HIGH VOLTAGE/Z AXIS AMPLIFIER Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Description		
Resistors (cont)						
R775	315-0332-00			3.3 kΩ	1/4 W	5%
R776	315-0101-00			100 Ω	1/4 W	5%
R777	301-0562-00			5.6 kΩ	1/2 W	5X
R778	305-0123-00			12 kΩ	12 W	5X
R791	315-0333-00			33 kΩ	1/4 W	5%
R792	311-0465-00	B010100	B069999	100 kΩVar		
R792	311-1235-00		B070000	100 kΩVar		
R794	315-0154-00			150 kΩ	1/4 W	5X
R795	311-0463-00	B010100	B069999	5 kΩ, Var		
R795	311-1227-00		B070000	5 kΩ, Var		
R796	321-0194-00			1.02 kΩ	1/8 W	Prec 1Z
R797	323-0285-00			9.09 kΩ	1/2 W	Prec 1%
R798	301-0101-00			100 n	1/2 W	5X

A12 LINE INPUT Circuit Board Assembly

*670-0813-01	B010100	B029999	Complete Board
*670-0813-03	B030000	B039999	Complete Board
*670-0813-02	B040000		Complete Board

Bulbs

DS805	119-0181-00		Surge voltage protector
DS806	119-0181-00		Surge voltage protector
DS812	150-0053-00		Neon NE, 86T

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C803	285-0587-00		0.1 μF	PTM	600 V	
C810	290-0414-00		8 μF	Elect.	200 V	+50%-10%
C811	290-0414-00		8 μF	Elect.	200 V	+50%-10%
C812	285-0623-00	B010100	0.47 μF	PTM	100 V	+50%-10%
C812	285-0633-00		0.22 μF	PTM	100 V	10X%

A12 HIGH VOLTAGE/Z AXIS AMPLIFIER Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Description
---------	--------------------	----------------------	--------	-------------

Semiconductor Device, Diode

CR810	152-0396-00			Silicon Full wave, 400 V Inductors
L810	*108-0585-00			116 μ H
L811	*108-0585-00			116 μ H

Resistors

Resistors are fixed, composition, \pm 10% unless otherwise indicated.

R803	301-0510-00			51 Ω	1/2 W	5%
R804	304-0105-00	B010100	B039999X	1 M Ω	1 W	
R805	301-0433-00			43 k Ω	1/2 W	5%
R806	301-0433-00			43 k Ω	1/2 W	5X
R807	315-0201-00			200 Ω	1/4 W	5%
R808	315-0470-00			47 Ω	1/4 W	5%
RT810	307-0157-00	B010100	B029999X	5 Ω	Thermal	
RT811	307-0157-00	B010100	B029999X	5 Ω	Thermal	
R812	302-0395-00			3.9 M Ω	1/2 W	
R813	304-0154-00	B010100	B039999	150 k Ω	1 W	
R813	303-0164-00		B040000	160 k Ω	1 W	5%
R818	302-0154-00			150 k Ω	1/2 W	

Transformer

T805	*120-0636-00			Line trigger
------	--------------	--	--	--------------

A13 INVERTER Circuit Board Assembly

*670-0814-00	B010100	B059999	Complete Board
*670-0814-01	B060000		Complete Board

A13 INVERTER Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No.		Description
		Eff	Dscont	

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C820	283-0044-00		0.001 μ F	Cer	3000 V	
C821	283-0006-00		0.02 μ f	Cer	500 V	
C822	283-0044-00		0.001 μ F	Cer	3000 V	
C824	283-0002-00		0.01 μ F	Cer	500 V	
C825	290-0284-00		4.7 μ F	Elect.	35 V	10%
C835	290-0284-00		4.7 μ F	Elect.	35 V	10%

Semiconductor Device, Diodes

CR823	*152-0061-00		Silicon	Tek Spec		
CR824	*152-0061-00		Silicon	Tek Spec		
CR825	152-0413-00		Silicon	Fast recovery, 400 V maximum		
CR826	152-0413-00		Silicon	Fast recovery, 400 V maximum		
CR828	152-0400-00		Silicon	Fast recovery, 400 V maximum		
CR830	152-0401-00		Silicon	Voltage trigger (32 +3 V)		
CR831	*152-0107-00		Silicon	Replaceable by 1N647		
CR835	152-0413-00		Silicon	Fast recovery, 400 V maximum		
CR836	152-0413-00		Silicon	Fast recovery, 400 V maximum		
CR838	152-0400-00		Silicon	Fast recovery, 400 V maximum		

Inductors

L826	*108-0574-00		30 μ H		
L836	*108-0574-00		30 μ H		

Transistors

Q825	151-0266-00		Silicon	NPN	TO-3 2N3902
Q835	151-0266-00		Silicon	NPN	TO-3 2N3902

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R820	315-0331-00		330 Ω	1/4 W	5%
R821	315-0100-00		10 Ω	1/4 W	5%

A13 INVERTER Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No.		Description			
		Eff	Dscont				
Resistors (cont)							
R823	302-0154-00		150 kΩ	1/2	W		
R824	321-0365-00		61.9 kΩ	1/8	W	Prec	1%
R825	308-0574-00		10 Ω		2 W	WW	5%
R826	308-0555-00		5 Ω		3 W	W W	5%
R835	308-0574-00		10 Ω		2 W	WW	5X
R836	308-0555-00		5 Ω		3 W	WW	5%
Transformers							
T820	*120-0640-00					Toroid, 18 turns, bifilar	
TT882951	*120-0641-00					Toroid, assembly	
T839							

A14 RECTIFIER Circuit Board Assembly

*670-0815-00 Complete Board

Capacitors							
Tolerance ±20% unless otherwise indicated.							
C840	290-0284-00		4.7 μF		Elect.	35 V	10X%
C852	283-0067-00		0.001 μF	Cer	200 V	10%	
C855	283-0028-00		0.0022 μF	Cer	50 V		
C856	283-0028-00		0.0022 μF	Cer	50 V		
C858	283-0178-00		0.1 μF	Cer		100 V	+80%-
20%							
C860	283-0067-00		0.001 μF	Cer	200 V	10%	
C864	283-0067-00		0.001 μF	Cer	200 V	10%	
C867	290-0246-00		3.3 μF	Elect.		15 V	10X%
C872	290-0194-00		10 μF	Elect.		100 V	
C873	283-0178-00		0.1 μF	Cer		100 V	+80%-
20%							
C874	290-0194-00		10 μF	Elect.		100 V	
C877	290-0194-00		10 μF	Elect.		100 V	
C878	283-0178-00		0.1 μF	Cer		100 V	+80%-
20%							
C879	290-0194-00		10 μF	Elect.		100 V	
C880	283-0178-00		0.1 μF	Cer		100 V	+80%-
20%							

A14 RECTIFIER Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No.		Description
		Eff	Dscont	
Capacitors (cont)				
C881	290-0194-00		10 μ F	Elect. 100 V
C882	290-0194-00		10 μ F	Elect. 100 V
C883	283-0177-00		1 μ F	Cer 25 V +80%-
C884	290-0425-00		100 μ F	Elect. 20 V
C885	290-0296-00		100 μ F	Elect. 20 V
C886	283-0177-00		1 μ F	Cer 25 V +80%-
C887	290-0425-00		100 μ F	Elect. 20 V
C888	290-0296-00		100 μ F	Elect. 20 V
C890	290-0425-00		100 μ F	Elect. 20 V
C891	283-0177-00		1 μ F	Cer 25 V +80%-
C892	290-0296-00		100 μ F	Elect. 20 V
C893	290-0194-00		10 μ F	Elect. 100 V
C894	283-0178-00		0.1 μ F	Elect. 100 V +80%-
C895	290-0194-00		10 μ F	Elect. 100 V
C898	290-0138-00		330 μ F	Elect. 6 V
C899	283-0177-00		1 μ F	Cer 25 V +80%-
Semiconductor Device, Diodes				
CR840	152-0333-00		Silicon	High speed and conductance
CR841	152-0333-00		Silicon	High speed and conductance
CR857	*152-0185-00		Silicon	Replaceable by 1N4152
CR858	*152-0185-00		Silicon	Replaceable by 1N4152
CR859	*152-0185-00		Silicon	Replaceable by 1N4152
CR860	152-0333-00		Silicon	High speed and conductance
CR872	152-0414-00		Silicon	Fast recovery, 200 V maximum
CR873	152-0414-00		Silicon	Fast recovery, 200 V maximum
CR877	152-0414-00		Silicon	Fast recovery, 200 V maximum
CR878	152-0414-00		Silicon	Fast recovery, 200 V maximum
CR880	152-0414-00		Silicon	Fast recovery, 200 V maximum
CR881	152-0414-00		Silicon	Fast recovery, 200 V maximum
CR883	152-0397-00		Silicon	Fast recovery, 50 V maximum
CR884	152-0397-00		Silicon	Fast recovery, 50 V maximum
CR886	152-0412-00		Silicon	Fast recovery, 50 V maximum
CR887	152-0412-00		Silicon	Fast recovery, 50 V maximum
CR890	152-0412-00		Silicon	Fast recovery, 50 V maximum
CR891	152-0412-00		Silicon	Fast recovery, 50 V maximum
CR893	152-0414-00		Silicon	Fast recovery, 200 V maximum
CR894	152-0414-00		Silicon	Fast recovery, 200 V maximum
VR848	152-0212-00		Zener	1N936, 500 mW, 9 V, 5%
VR876	152-0289-00		Zener	1N991B, 400 mW, 180 V, 5%

A14 RECTIFIER Circuit Board Assembly (cont)
Serial/Model No.

Ckt No.	Tektronix Part No.	Eff	Dscont	Description		
Inductors						
L872	*108-0422-00			80 μ H		
L877	*108-0422-00			80 μ H		
L881	*108-0422-00			80 μ H		
L884	*108-0337-00			25 μ H		
L887	*108-0337-00			25 μ H		
L890	*108-0337-00			25 μ H		
L893	*108-0422-00			80 μ H		
L897	*108-0556-00			12 μ H		
L898	*108-0554-00			5 μ H		
Transistors						
Q843	151-0188-00			Silicon	PNP	TO-92 2N3906
Q846	151-0188-00			Silicon	PNP	TO-92 2N3906
Q853	151-0190-00			Silicon	NPN	TO-92 2N3904
Q855	151-0190-00			Silicon	NPN	TO-92 2N3904
Q856	151-0190-00			Silicon	NPN	TO-92 2N3904
Q860	151-0260-00			Silicon	NPN	TO-39 2N5189
Q863	*151-0192-00			Silicon	NPN	TO-92 Replaceable by MPS 6521
Q864	151-0190-00			Silicon	NPN	TO-92 2N3904
Q868	151-0190-00			Silicon	NPN	TO-92 2N3904
Q876	151-0505-00			Silicon		Controlled rectifier
Resistors						
Resistors are fixed, composition, +10Z unless otherwise indicated.						
R840	315-0100-00			10 Ω	1/4 W	5%
R842	321-0213-00			1.62 k Ω	1/8 W	Prec 1%
R843	311-0863-00	B010100	B069999	500 Ω , Var		
R843	311-1279-00	B070000		500 Ω Var		
R844	321-0222-00			2 k Ω	1/8 W	Prec 1%
R845	315-0102-00			1 k Ω	1/4 W	5%
R846	315-0470-00			47 Ω	1/4 W	5%
R848	315-0102-00			1 k Ω	1/4 W	5%
R851	315-0202-00			2 k Ω	1/4 W	5%
R852	315-0104-00			100 k Ω	1/4 W	5%
R853	315-0472-00			4.7 k Ω	1/4 W	5X

A14 RECTIFIER Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No.		Description
		Eff	Dscont	
Resistors (cont)				
R854	315-0242-00		2.4 kΩ	1/4 W 5%
R855	315-0102-00		1 kΩ	1/4 W 5%
R856	315-0102-00		1 kΩ	1/4 W 5%
R858	315-0150-00	B010100	B010109	15 Ω 1/4 W 5%
R858	315-0120-00		B010100	12Ω 1/4 W 5%
R860	315-0473-00		47 kΩ	1/4 W 5%
R861	315-0104-00		100 kΩ	1/4 W 5%
R863	315-0272-00		2.7 kΩ	1/4 W 5%
R864	315-0471-00		470 Ω	1/4 W 5X
R866	315-0102-00		1 kΩ	1/4 W 5%
R867	315-0104-00		100 kΩ	1/4 W 5%
R868	315-0472-00		4.7 kΩ	1/4 W 5X
R876	315-0102-00		1 kΩ	1/4 W 5%
Transformers				
T874	*120-0638-00			Toroid, 15 turns bifilar
T879	*120-0638-00			Toroid, 15 turns bifilar
T882	*120-0638-00			Toroid, 15 turns bifilar
T885	*120-0639-00			Toroid, 8 turns, bifilar
T888	*120-0639-00			Torois, 8 turns, bifilar
T892	*120-0639-00			Toroid, 8 turns, bifilar
T895	*120-0638-00			Toroid, 15 turns, bifilar
T899	*120-0637-00			Toroid, 5 turns, bifilar

A15 LOW VOLTAGE REGULATOR Circuit Board Assembly

*670-0816-00 Complete Board

Capacitors

Tolerance +20% unless otherwise indicated.

C903	283-0178-00	0.1 μF	Cer	100 V	+80%-20X
C905	281-0546-00	330 μF	Cer	500 V	10%
C907	283-0083-00	0.0047 μF	Cer	500 V	5%
C910	283-0177-00	1 μF	Cer	25 V	+80%-20%
C911	283-0190-00	0.47 μF	Cer	50 V	5%

A15 LOW VOLTAGE REGULATOR Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Description
Capacitors(cont)				
C921	283-0177-00		1 μ m	Cer 25 V +80%-20%
C925	283-0003-00		0.01 μ m	Cer 150 V
C933	283-0114-00		0.0015 μ m	Cer 200 V 5%
C935	283-0081-00		0.1 μ m	Cer 25 V +80Z-20X
C941	283-0177-00		1 μ m	Cer 25 V +80%-20%
C945	283-0081-00		0.1 μ m	Cer 25 V +80%-20%
C950	283-0177-00		1 μ m	Cer 25 V +80%-20%
C961	283-0177-00		1 μ m	Cer 25 V +80%-20%
C968	283-0041-00		0.003 μ m	Cer 500 V 5%
C981	283-0178-00		0.1 μ m	Cer 100 V +80%-20%
C982	290-0187-00		4.7 μ m	Elect. 35 V
C990	283-0065-00		0.001 μ m	Cer 100 V 5%
C992	283-0177-00		1 μ m	Cer 25 V +80%-20%

Semiconductor Device, Diodes

CR905	*152-0185-00		Silicon	Replaceable by 1N4152
CR906	*152-0185-00		Silicon	Replaceable by 1N4152
CR909	*152-0061-00		Silicon	Tek Spec
CR914	*152-0185-00		Silicon	Replaceable by 1N4512
CR922	*152-0185-00		Silicon	Replaceable by 1N4152
CR923	*152-0185-00		Silicon	Replaceable by 1N4152
CR924	*152-0185-00		Silicon	Replaceable by 1N4152
CR935	*152-0061-00		Silicon	Tek Spec
CR938	*152-0185-00		Silicon	Replaceable by 1N4152
CR941	152-0066-00		Silicon	1N3194
CR942	152-0066-00		Silicon	1N3194
CR948	*152-0185-00		Silicon	Replaceable by 1N4152
CR949	*152-0185-00		Silicon	Replaceable by 1N4152
CR961	152-0418-00		Silicon	300 V, 3 A
CR964	*152-0185-00		Silicon	Replaceable by 1N4152
CR965	*152-0185-00		Silicon	Replaceable by 1N4152
CR972	*152-0185-00		Silicon	Replaceable by 1N4152
CR981	152-0118-00		Silicon	300 C, 3 A
CR984	*152-0185-00		Silicon	Replaceable by 1N4152
CR991	*152-0185-00		Silicon	Replaceable by 1N4152
CR994	*152-0185-00		Silicon	Replaceable by 1N4152
VR910	152-0168-00		Zener,	1N963A 400 mW, 12 V, 5%
VR927	152-0280-00		Zener,	1N753A 400 mW, 6.2 V, 5%
VR930	152-0195-00		Zener	1N751A 400 mW, 5.1 V, 5%
VR982	152-0411-00		Zener	1N937, 250 mW, 9 V, 5%

A15 LOW VOLTAGE REGULATOR Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Description
Fuses				
F901	159-0028-00		1/4 A 3AG	Fast-Blo
F902	159-0028-00		1/4 A 3AG	Fast-Blo
F921	159-0021-00		2 A 3AG	Fast-Blo
F957	159-0022-00		1 A 3AG	Fast-Blo
Meter				
M941	149-0030-00	B010100	B069999X	Elapsed time
Transistors				
Q906	151-0232-00		Silicon	NPN TO-77 Dual, NS7348
Q910	*151-0192-00		Silicon	NPN TO-92 Replaceable by MPS 6521
Q912	151-0190-00		Silicon	NPN TO-92 2N3904
Q914	151-0250-00		Silicon	NPN TO-104 2N5184
Q922	151-0232-00		Silicon	NPN TO-77 Dual, NS7348
Q928	151-0190-00		Silicon	NPN TO-92 2N3904
Q930	151-0188-00		Silicon	PNP TO-92 2N3906
Q936	*151-0192-00		Silicon	NPN TO-92 Replaceable by MPS-6521
Q944	*151-0216-00		Silicon	PNP TO-92 Replaceable by MPS 6523
Q946	*151-0216-00		Silicon	PNP TO-92 Replaceable by MPS 6523
Q948	151-0188-00		Silicon	PNP TO-92 2N3906
Q952	151-0260-00		Silicon	NPN TO-39 2N5189
Q954	151-0188-00		Silicon	PNP TO-92 2N3906
Q964	151-0232-00		Silicon	PNP TO-77 Dual, NS7348
Q966	151-0190-00		Silicon	NPN TO-92 2N3904
Q970	*151-0192-00		Silicon	NPN TO-92 Replaceable by MPS 6521
Q984	151-0232-00		Silicon	NPN TO-77 Dual, NS7348
Q988	151-0190-00		Silicon	NPN TO-92 2N3904
Q992	*151-0192-00		Silicon	NPN TO-92 Replaceable by MPS 6521
Q994	151-0188-00		Silicon	PNP TO-92 2N3906
Resistors				
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.				
R904	315-0434-00		430 k Ω	1/4 W 5%
R905	315-0823-00		82 k Ω	1/4 W 5X
R906	315-0274-00		270 k Ω	1/4 W 5%
R907	323-0289-07		10 k Ω	1/2 W Prec 1/10%IO
R908	323-0289-07		10 k Ω	1/2 W Prec 1/10%

A15 LOW VOLTAGE REGULATOR Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No.		Description	
		Eff	Dscont		
Resistors (cont)					
R909	301-0103-00		10 kΩ	1/2 W	5X
R911	307-0108-00		6.8 n	1/4 W	5%
R912	321-0356-00		49.9 kΩ	1/8 W	Prec 1%
R913	321-0155-00		402 Ω	1/8 W	Prec 1%
R914	315-0513-00		51 kΩ	1/4 W	5%
R915	308-0292-00		2.2 kΩ	3 W WW	5%
R916	315-0121-00		120 Ω	1/4 W	5%
R917	307-0093-00		1.2 Ω	1/2 W	5X
R918	307-0103-00		2.7 Ω	1/L W	5%
R922	315-0274-00		270 kΩ	1/4 W	5%
R923	315-0204-00		200 kΩ	1/4 W	5%
R925	323-0758-07		3 kΩ	1/2 W	Prec 1/10%
R926	323-0289-07		10 kΩ	1/2 W	Prec 1/10%
R928	321-0306-00		15 kΩ	1/8 W	Prec 1X
R929	315-0201-00		200 Ω	1/4 W	5%
R930	315-0621-00		620 Ω	1/4 W	5%
R931	301-0102-00		1 kΩ	1/2 W	5%
R932	315-0474-00		470 kΩ	1/4 W	5%
R933	315-0222-00		2.2 kΩ	1/4 W	5X
R934	321-0150-00		357 Ω	1/8 W	Prec 1%
R935	301-0621-00		620 Ω	1/2 W	5%
R936	315-0153-00		15 kΩ	1/4 W	5%
R937	306-0180-00		18 Ω	2 W	
R938	315-0151-00		150 Ω	1/4 W	5%
R939	*308-0560-00		0.12 Ω	5 W WW	5X
R941	301-0395-00	B010100 B069999X	3.9 MΩ	1/2 W	5X
R943	315-0222-00		2.2 kΩ	1/4 W	5%
R944	315-0473-00		47 kΩ	1/4 W	5%
R945	315-0390-00		39 Ω	1/4 W	5%
R946	321-0193-07		1 kΩ	1/8 W	Prec 1/10%
R947	323-0289-07		10 kΩ	1/2 W	Prec 1/10%IOX
R948	315-0471-00		470 n	1/4 W	5X
R949	315-0471-00		470 Q	1/4 W	5%
R950	315-0101-00		100 Q	1/4 W	5X
R951	306-0180-00		18 Q	2 W	
R952	315-0151-00		150 Ω	1/4 W	5%
R953	315-0472-00		4.7 kΩ	1/4 W	5%
R954	315-0331-00		330 Ω	1/4 W	5%
R955	*308-0560-00		0.12 Ω	5 W	WW 5%
R962	323-0758-07		3 kΩ	1/2 W	Prec 1/10%IOX

A15 LOW VOLTAGE REGULATOR Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Description		
Resistors (cont)						
R963	323-0763-07		7 k Ω	1/2 W	Prec	1/10%
R964	315-0434-00		430 k Ω	1/4 W		5Z
R965	315-0164-00		160 k Ω	1/4 W		5%
R966	321-0306-00		15 k Ω	1/8 W	Prec	1%
R967	321-0150-00		357 Ω	1/8 W	Prec	1X
R968	315-0162-00		1.6 k Ω	1/4 W		5%
R969	301-0621-00		620 Ω	1/2 W		5X
R971	315-0153-00		15 k Ω	1/4 W		5%
R972	306-0180-00		18 Ω	2 W		
R973	315-0151-00		150 Ω	1/4 W		5X
R974	*308-0560-00		0.12 Ω	5 W	WW	5%
R982	323-0264-00		5.49 k Ω	1/2 W	Prec	1%
R983	315-0474-00		470 k Ω	1/4 W		5Z
R984	315-0204-00		200 k Ω	1/4 W		5X
R985	323-0771-09		1.375 k Ω	1/2 W	Prec	1%
R986	311-0515-00		250 Ω , Var			
R987	323-0772-09		6.71 k Ω	1/2 W	Prec	1%
R988	321-0356-00		49.9 k Ω	1/8 W	Prec	1%
R989	321-0150-00		357 n	1/8 W	Prec	1%
R990	315-0302-00		3 k Ω	1/4 W		5X
R991	301-0103-00		10 k Ω	1/2 W		5%
R992	315-0470-00		47 Ω	1/4 W		5%
R995	301-0621-00		620 Ω	1/2 W		5Z
R996	315-0121-00		120 Ω	1/4 W		5X
R997	307-0093-00		1.2 Ω	1/2 W		
R998	307-0093-00		1.2 Ω	1/2 W		

A17 B TRIGGER SOURCE SWITCH Circuit Board Assembly

Ckt No.	Tektronix Part No.	Serial/Model No.		Description
		Eff	Dscont	
	*670-0821-00	B010100	B029999	Complete Board
	*670-0821-01	B030000	Complete Board	
			Bulb	
DS1001	*150-0057-01	BO10100	B029999	Incandescent, 7153AS15, selected
DS1001 Switch	*150-0048-01	B030000		Incandescent, #683, selected
			Wired or Unwired	
S10010	*670-0821-00	BO10100	B029999	Pushbutton B TRIG SOURCE
S10011	*670-0821-01	B030000		Pushbutton B TRIG SOURCE

A18 A TRIGGER SOURCE SWITCH Circuit Board Assembly

	*670-0792-00	BO10100	B029999	Complete Board
	*670-0792-01	B030000		Complete Board
			Bulb	
DS1011	150-0057-01	BO110100	B029999	Incandescent, 7153AS15, selected
DS1011	*150-0048-01	B030000		Incandescent, #683, selected
			Switch	
			Wired or Unwired	
S1011 ¹	*670-0792-00	BO10100	B029999	Pushbutton A TRIG SOURCE
S1011 ¹	*670-0792-01	B030000		Pushbutton A TRIC SOURCE

A19 VERTICAL MODE SWITCH Circuit Board Assembly

	*670-0991-00			Complete Board
			Bulbs	
DS1021	*150-0057-02			Incandescent,assembly
DS1023	*150-0057-02			Incandescent,assembly
DS1025	*150-0057-02			Incandescent,assembly
DS1027	*150-0057-02			Incandescent,assembly
DS1029	*150-0057-02			Incandescent,assembly

¹See Mechanical Parts List for replacement parts.

A19 VERTICAL MODE SWITCH Circuit Board Assembly (cont)

Ckt No.	Tektronix Part No.	Serial/Model No.		Description
		Eff	Dscont	
Semiconductor Device, Diodes				
CR1021	*152-0185-00		Silicon	Replaceable by 1N4152
CD1022	*152-0185-00		Silicon	Replaceable by 1N4152
CR1023	*152-0185-00		Silicon	Replaceable by 1N4152
CR1027	*152-0185-00		Silicon	Replaceable by 1N4152

Resistor

Resistors are fixed, composition, +10% unless otherwise indicated.

R1023	315-0153-00	15 kΩ	1/4 W	5%
-------	-------------	-------	-------	----

Switch

Wired or Unwired

S1021 ₁	*670-0991-00	Pushbutton	VERTICAL MODE
--------------------	--------------	------------	---------------

A20 HORIZONTAL MODE SWITCH Circuit Board Assembly

*670-1330-00 Complete Board

Bulbs

DS1031	*150-0057-02		Incandescent, assembly
DS1032	*150-0057-02		Incandescent, assembly
DS1033	*150-0057-02		Incandescent, assembly
DS1034	*150-0057-02		Incandescent, assembly

Resistors

Resistors are fixed, composition, +10% unless otherwise indicated.

R1025	316-0270-00		27 Ω	1/4 W	
R1031	315-0160-00	XB020165	16 Ω	1/4 W	5%
R1033	315-0160-00	XB020165	16 Ω	1/4 W	5X

Switch

Wired or Unwired

S10311 ¹	*670-1330-00	Pushbutton	HORIZONTAL MODE
---------------------	--------------	------------	-----------------

¹see Mechanical Parts List for replacement parts.

REV. MAY 1974

A21 READOUT SYSTEM Circuit Board Assembly

Ckt No.	Tektronix Part No.	Serial/Model No.		Description
		Eff	Dscont	
	*670-0635-03	B010100	B029999	Complete Board
	*670-0635-04	B030000	B039999	Complete Board
	*670-0635-05	B040000	B049999	Complete Board
	*670-0635-07	B050000	B059999	Complete Board
	*670-0635-08	B060000		Complete Board
Capacitors				
Tolerance $\pm 20\%$ unless otherwise indicated.				
C1141	283-0032-00		470 μF	Cer 500 V 5%
C1166	283-0004-00	XB040000	0.02 μF	Cer 150 V
C1180	283-0032-00		470 μF	Cer 500 V 5%
C1186	283-0004-00	XB040000	0.02 μF	Cer 150 V
C1190	283-0000-00		0.001 μF	Cer 500 V
C1214	285-0698-00		0.0082 μF	PTM 100 V 5X
C1222	283-0103-00		180 μF	Cer 500 V 5%
C1227	283-0103-00		180 μF	Cer 500 V 5X
C1230	283-0000-00		0.001 μF	Cer 500 V
C1237	283-0000-00		0.001 μF	Cer 500 V
C1267	283-0000-00		0.001 μF	Cer 500 V
C1268	283-0177-00		1 μ	Cer 25 V +80%-20%
C1291	283-0177-00		1 μF	Cer 25 V +80%-20%
C1294	283-0177-00		1 μF	Cer 25 V +80%-20%
C1297	283-0177-00		1 μF	Cer 25 V +80%-20Z
Semiconductor Device, Diodes				
CR1112	*152-0185-00		Silicon	Replaceable by IN4152
CR1113	*152-0185-00		Silicon	Replaceable by 1N4152
CR1117	*152-0185-00		Silicon	Replaceable by 1N4152
CR1118	*152-0185-00		Silicon	Replaceable by IN4152
CR1122	*152-0185-00		Silicon	Replaceable by IN4152
CR1123	*152-0185-00		Silicon	Replaceable by 1N4152
CR1127	*152-0185-00		Silicon	Replaceable by IN4152
CR1128	*152-0185-00		Silicon	Replaceable by 1N4152
CR1132	*152-0185-00	XB030000	Silicon	Replaceable by IN4152
CR1133	*152-0185-00	XB030000	Silicon	Replaceable by IN4152

A21 READUUT SYSTEM Circuit Board Assembly (cont)

Tektronix
Ckt. No. Serial/Model No.
Part No. Eff Disc Description

Semiconductor Device, Diodes (cont)

CR1135	*152-0185-00	XB030000	Silicon	Replaceable by 1N4152
CR1137	*152-0185-00	XB030000	Silicon	Replaceable by 1N4152
CR1141	*152-0185-00	B010100 B039999X	Silicon	Replaceable by 1N4152
CR1142	*152-0185-00	XBO10110 B039999X	Silicon	Replaceable by 1N4152
CR1155	*152-0185-00		Silicon	Replaceable by 1N4152
CR1206	*152-0185-00		Silicon	Replaceable by 1N4152
CR1207	*152-0185-00		Silicon	Replaceable by 1N4152
CR1208	*152-0185-00		Silicon	Replaceable by 1N4152
CR1213	*152-0185-00	XB030000	Silicon	Replaceable by 1N4152
CR1216	*152-0185-00		Silicon	Replaceable by 1N4152
CR1217	*152-0185-00		Silicon	Replaceable by 1N4152
CR1222	*152-0185-00		Silicon	Replaceable by 1N4152
CR1223	*152-0185-00		Silicon	Replaceable by 1N4152
CR1224	*152-0185-00		Silicon	Replaceable by 1N4152
CR1227	*152-0185-00		Silicon	Replaceable by 1N4152
CR1231	*152-0185-00		Silicon	Replaceable by 1N4152
VR1260	*152-0405-00		Zener	Tek Spec, 1 W, 15 V, 5%
VR1261	*152-0405-00		Zener	Tek Spec, 1 W, 15 V, 5%
VR1262	*152-0405-00		Zener	Tek Spec, 1 W, 15 V, 5%

Inductor

L1270	*108-0331-00		0.75 pH
-------	--------------	--	---------

Transistors

Q1143	151-0232-00		Silicon	NPN	TO-77 Dual NS7348
Q1150	151-0190-00		Silicon	NPN	TO-92 2N3964
Q1152	151-0190-00		Silicon	NPN	TO-92 2N3904
Q1155	151-0188-00		Silicon	PNP	TO-92 2N3906
Q1163	151-0190-00		Silicon	NPN	TO-92 2N3904
Q1185	*151-0192-00		Silicon	NPN	TO-92 Replaceable by MPS 6521
Q1223	151-0188-00		Silicon	PNP	TO-92 2N3906
Q1226	151-0190-00		Silicon	NPN	TO-92 2Nt3904
Q1274	151-0188-00		Silicon	PNP	TO-92 2N3906
Q1278	151-0188-00		Silicon	PNP	TO-92 2N3906
Q1284	151-0188-00		Silicon	PNP	TO-92 2N3906
Q1228	151-0188-00		Silicon	PNP	TO-92 2N3906

(A)

A21 READOUT SYSTEM Circuit Board Assembly (cont)

Ckt No.	Tektronix		Serial/Model No.		Description		
	Part No.	Eff	Dscont				
Resistors							
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.							
R1111	317-0102-00			1 k Ω	1/8 W		5%
R1112	317-0751-00			750 Ω	1/8 W		5%
R1113	317-0751-00			750 Ω	1/8 W		5%
R1116	317-0102-00			1 k Ω	1/8 W		5%
R1117	317-0751-00			750 Ω	1/8 W		5%
R1118	317-0751-00			750 Ω	1/8 W		5%
R1121	317-0102-00			1 k Ω	1/8 W		5%
R1122	317-0751-00			750 Ω	1/8 W		5X
R1123	317-0751-00			750 Ω	1/8 W		5%
R1126	317-0102-00			1 k Ω	1/8 W		5%
R1127	317-0751-00			750 Ω	1/8 W		5%
R1128	317-0751-00			750 Ω	1/8 W		5%
R1131	317-0513-00			51 k Ω	1/8 W		5%
R1132	317-0133-00			13 k Ω	1/8 W		5%
R1133	317-0133-00			13 k Ω	1/8 W		5X
R1134	317-0753-00			75 k Ω	1/8 W		5%
R1135	321-0310-00	B010100	B029999	165 k Ω	1/8 W	Prec	1%
R1135	321-0308-00	B030000		15.8 k Ω	1/8 W	Prec	1%
R1136	317-0513-00			51 k Ω	1/8 W		5%
R1137	321-0321-00	B010100-	B029999	21.5 k Ω	1/8 W	Prec	1%
R1137	321-0319-00	B030000	20.	5 k Ω	1/8 W	Prec	1Z
R1138	321-0335-00			30.1 k Ω	1/8 W	Prec	1%
R1140	317-0752-00			7.5 k Ω	1/8 W		5%
R1141	321-0261-00	B010100	B049999	5.11 k Ω	1/8 W	Prec	1%
R1141	321-0258-00	B040000		4.75 k Ω	1/8 W	Prec	1%
R1142	311-0634-00	XB050000	B059999	500 Ω , Var			
R1142	311-1279-00	B060000		500 Ω , Var			
R1143	317-0133-00			13 k Ω	1/8 W		5%
R1144	317-0154-00	BO10100	B039999	150 k Ω	1/8 W		5%
R1144	317-0124-00	B050000		120 k Ω	1/8 W		5%
R1146	321-0181-00			750 Ω	1/8 W	Prec	1%
R1147	321-0297-00	B010100	B039999	12.1 k Ω	1/8 W	Prec	1%
R1147	321-0299-00	B040000		12.7 k Ω	1/8 W	Prec	1%
R1148	321-0212-00	BO10100	B010109	1.58 k Ω	1/8 W	Prec	1%
R1148	317-0102-00	BO10110	B039999	1 k Ω	1/8 W		5%
R1148	321-0212-00	B040000		1.58 k Ω	1/8 W	Prec	1%

A21 READOUT SYSTEM Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description		
				Resistors	(cont)	
R1152	317-0152-00			1.5 k Ω	1/8 W	5%
R1155	317-0222-00			2.2 k Ω	1/8 W	5%
R1156	321-0268-00			6.04 k Ω	1/8 W	Prec 1%
R1163	317-0243-00	B010100	B010109	24 k Ω	1/8 W	5%
R1163	321-0329-00	B010110	B029999	26.1 k Ω	1/8 W	Prec 1%
R1163	317-0243-00	B030000		24 k Ω	1/8 W	5%
R1171	317-0154-00			150 k Ω	1/8 W	5%
R1172	321-0335-00			30.1 k Ω	1/8 W	Prec 1%
R1173	321-0344-00			37.4 k Ω	1/8 W	Prec 1%
R1174	321-0335-00			30.1 k Ω	1/8 W	Prec 1%
R1175	317-0513-00			51 k Ω	1/8 W	5%
R1176	317-0154-00			150 k Ω	1/8 W	5%
R1177	321-0335-00			30.1 k Ω	1/8 W	Prec 1%
R1178	321-0335-00			30.1 k Ω	1/8 W	Prec 1%
R1180	321-0262-00	B010100	B029999	5.23 k Ω	1/8 W	Prec 1%
R1180	321-0264-00	B030000	B049999	5.49 k Ω	1/8 W	Prec 1Z
R1180	321-0261-00	B050000		5.11 k Ω	1/8 W	Prec 1%
R1181	321-0371-00	B010100	B010109	71.5 k Ω	1/8 W	Prec 1%
R1181	321-0367-00	B010110	B039999	64.9 k Ω	1/8 W	Prec 1X
R1181	321-0372-00	B040000	B059999	73.2 k Ω	1/8 W	Prec 1X
R1181	321-0371-00	B060000		71.5 k Ω	1/8 W	Prec 1%
R1182	311-0634-00	XB050000	B059999	500 Ω , Var		
R1182	311-1279-00	B060000		500 Ω , Var		
R1183	321-0401-00	B010100	B039999	147 k Ω	1/8 W	Prec 1%
R1183	321-0407-00	B040000	B059999	169 k Ω	1/8 W	Prec 1%
R1183	321-0403-00	B060000		154 k Ω	1/8 W	Prec 1%
R1185	317-0103-00			10 k Ω	1/8 W	5%
R1190	317-0303-00			30 k Ω	1/8 W	5%
R1191	317-0203-00			20 k Ω	1/8 W	5%
R1193	317-0203-00			20 k Ω	1/8 W	5%
R1195	317-0203-00			20 k Ω	1/8 W	5%
R1197	317-0203-00			20 k Ω	1/8 W	5%
R1205	317-0432-00			4.3 k Ω	1/8 W	5%
R1206	317-0683-00			68 k Ω	1/8 W	5%
R1210	317-0104-00			100 k Ω	1/8 W	5%
R1214	317-0393-00			39 k Ω	1/8 W	5%

(A)

7-57

A21 READOUT SYSTEM Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description		
R1215	317-0332-00	BO10100	B029999	3.3 k Ω	1/8 W	5X
R1215	317-0302-00	B030000		3 k Ω	1/8 W	5%
R1216	315-0152-00			1.5 k Ω	1/4 W	5X
R1218	317-0183-00			18 k Ω	1/8 W	5X
R1219	311-0634-00	B010100	B029999	500 Ω , Var		
R1219	311-0635-00	B030000		1 k Ω , Var		
R1220	317-0103-00			10 k Ω	1/8 W	5X
R1221	317-0752-00			7.5 k Ω	1/8 W	5%
R1223	315-0242-00			2.4 k Ω	1/4 W	5X
R1226	317-0152-00			1.5 k Ω	1/8 W	5%
R1227	317-0512-00			5.1 k Ω	1/8 W	5%
R1230	318-0512-00			5.1 k Ω	1/8 W	5%
R1231	317-0332-00	XB040000		3.3 k Ω	1/8 W	5X
R1235	317-0512-00			5.1 k Ω	1/8 W	5%
R1237	317-0222-00			2.2 k Ω	1/8 W	5%
R1255	321-0176-00			665 Ω	1/8 W	Prec 1'
R1256	321-0153-00			383 Ω	1/8 W	Prec 1%
R1257	321-0250-00			3.92 k Ω	1/8 W	Prec 1%
R1258	317-0223-00			22 k Ω	1/8 W	5Z
R1260	317-0102-00			1 k Ω	1/8 W	5%
R1264	317-0272-00			2.7 k Ω	1/8 W	5%
R1265	317-0512-00			5.1 k Ω	1/8 W	5%
R1266	317-0822-00	BO10100	B010109	8.2 k Ω	1/8 W	5%
R1266	317-0103-00	B010110	B029999	10 k Ω	1/8 W	5X
R1266	317-0912-00	B030000		9.1 k Ω	1/8 w	5%
R1268	321-0296-00			11.8 k Ω	1/8 W	Prec 1%
R1269	317-0823-00			82 k Ω	1/8 W	5%
R1270	321-0222-00			2 k Ω	1/8 W	Prec 1%
R1271	321-0216-00			1.74 k Ω	1/8 W	Prec 1%
R1272	321-0245-00			3.48 k Ω	1/8 W	Prec 1X
R1274	321-0209-00			1.47 k Ω	1/8 W	Prec 1%
R1276	321-0241-00			3.16 k Ω	1/8 W	Prec 1Z
R1277	321-0255-00			4.42 k Ω	1/8 W	Prec 1%
R1278	315-0152-00			1.5 k Ω	1/4 W	5%
R1280	321-0273-00			6.81 k Ω	1/8 W	Prec 1%

A21 READOUT SYSTEM Circuit Board Assembly (cont)-

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
Resistors (cont)				
R1281	321-0193-00		1 k Ω	1/8 W Prec 1%
R1284	321-0199-00		1.15 k Ω	1/8 W Prec 1%
R1285	311-0635-00		1 k Ω , Var	
R1286	321-0204-00		1.3 k Ω	1/8 W Prec 1X
R1287	321-0245-00		3.48 k Ω	1/8 W Prec 1%
R1288	315-0152-00		1.5 k Ω	1/4 W 5%
R1289	315-0511-00		510 Ω	1/4 W 5X
Integrated Circuits				
U1130	*155-0015-00	B010100	B059999	Monolithic
U1130	*155-0015-01	B060000		Monolithic
U1166	*155-0014-00	BO10100	B059999	Monolithic
U1166	*155-0014-01	B060000		Monolithic
U1170	*155-0015-00	BO10100	B059999	Monolithic
U1170	*155-0015-01	B060000		Monolithic
U1186	*155-0014-00	BO10100	B059999	Monolithic
U1186	*155-0014-01	B060000		Monolithic
U1190	*155-0018-00			Monolithic
U1210	*155-0021-00			Monolithic
U1226	*155-0017-00			Monolithic
U1227	156-0043-00			Quad 2-input NOR Gate, Replaceable by T.I. SN7402N
U1230	156-0012-00			Clocked J-K flip-flop, Replaceable by Fairchild uL923
U1231	156-0012-00			Clocked J-K flip-flop, Replaceable by Fairchild pL923
U1232	156-0012-00			Clocked J-K flip-flop. Replaceable by Fairchild pL923
U1236	156-0011-00			Dual 2-input Gate, Replaceable by Fairchild pL914
U1251	*155-0023-00			Monolithic
U1252	*155-0024-00			Monolithic
U1253	*155-0025-00			Monolithic
U1254	*155-0026-00			Monolithic
U1255	*155-0027-00			Monolithic
U1260	*155-0019-00			Monolithic
U1270	*155-0020-00			Monolithic

(A)

A22 GRATICULE LIGHT Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
	*670-0702-00			Complete Board
				Bulbs
DS957	150-0029-00			Incandescent GE349
DS958	150-0029-00			Incandescent GE349
DS959	150-0029-00			Incandescent GE349

INSTRUMENT OPTIONS

Option 1-without READOUT Circuit Board Assembly (*670-0635-08)

Option 2-with X-Y DELAY COMP Circuit Board Assembly (*670-0839-00)

A23 X-Y DELAY COMP Circuit Board Assembly

*670-0839-00 Complete Board

Capacitors

Tolerance +20% unless otherwise indicated.

C53	283-0633-00	77 pF	Mica	100 V	1%
C55	281-0125-00	90-400 pF, Var	Mica	500 V	
C56	283-0671-00	164 pF	Mica	500 V	1%
C58	283-0670-00	375 pF	Cer	500 V	1%
C66	283-0671-00	164 pF	Mica	500 V	1%
C68	283-0670-00	375 pF	Cer	500 V	1%
C73	283-0633-00	77 pF	Mica	100 V	1%
C75	281-0125-00	90-400 pF, Var	Mica	500 V	
C76	283-0671-00	164 pF	Mica	500 V	1%
C78	283-0670-00	375 pF	Cer	500 V	1%
C86	283-0671-00	164 pF	Mica	500 V	1%
C88	283-0670-00	375 pF	Cer	500 V	1%

Semiconductor Device, Diodes

CR50	*152-0185-00	Silicon		Replaceable by 1N4152
CR70	*152-0185-00	Silicon		Replaceable by 1N4152

A23 X-Y DELAY COMP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description		
Relays						
K50	*148-0034-00			Armature, dpdt, 15 V DC		
K60	*148-0034-00			Armature, dpdt, 15 V DC		
K70	*148-0034-00			Armature, dpdt, 15 V DC		
K80	*148-0034-00			Armature, dpdt, 15 V DC		
Inductors						
L51	*108-0559-00			1.605 μ H		
L55	*108-0560-00			1.64 μ H		
L56	*108-0561-00			3.75 μ H		
L61	*108-0559-00			1.605 μ H		
L65	*108-0560-00			1.64 μ H		
L66	*108-0561-00			3.75 μ H		
L71	*108-0559-00			1.605 μ H		
L75	*108-0560-00			1.64 μ H		
L76	*108-0561-00			3.75 μ H		
L81	*108-0559-00			1.605 μ H		
L85	*108-0560-00			1.64 μ H		
L86	*108-0561-00			3.75 μ H		
Resistors						
Resistors are fixed, composition, +10% unless otherwise indicated.						
R51	321-0068-00			49.9 Ω	1/8 W	Prec 1%
R61	321-0068-00			49.9 Ω	1/8 W	Prec 1%
R71	321-0068-00			49.9 Ω	1/8 W	Prec 1%
R81	321-0068-00			49.9 Ω	1/8 W	Prec 1X
Switches						
Wired or Unwired						
S50	260-0723-00			Slide		DELAY DISABLE B
S70	260-0723-00			Slide		DELAY DISABLE A
(A)			7-61			

**PART NUMBER - NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX**

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
108-0095-00	80009	5950-00-799-3677	150-0029-00	80009	6240-00-962-0525
108-0103-00	80009	5950-00-463-2718	150-0048-01	80009	6240-00-060-2941
108-0146-00	80009	5915-00-835-2984	150-0053-00	80009	6240-00-820-1705
108-0245-00	80009	5950-00-417-3838	150-0057-01	80009	6240-00-183-0669
108-0260-00	80009	5915-00-914-4106	151-0126-00	80009	5961-00-051-5975
108-0331-00	80009	5950-00-401-2963	151-0127-00	80009	5961-00-923-9775
108-0337-00	80009	5950-00-234-0515	151-0140-00	80009	5961-00-724-2138
108-0422-00	80009	5950-00-790-3703	151-0148-00	80009	5961-00-905-2926
108-0440-00	80009	5950-00-472-0357	151-0188-00	80009	5961-00-931-0372
108-0543-00	80009	5950-00-234-0517	151-0188-00	80009	5961-00-457-5187
108-0544-00	80009	5950-00-234-0521			5961-00-931-0372
108-0546-00	80009	5950-00-234-0522	151-0190-00	80009	5961-00-892-8706
108-0553-00	80009	5950-00-234-0523	151-0192-00	80009	5961-00-879-7461
108-0554-00	80009	5950-00-234-0524	151-0193-00	80009	5961-00-490-8385
108-0556-00	80009	5950-00-234-0532	151-0198-00	80009	5961-00-879-7450
108-0557-00	80009	5950-00-234-0533	151-0202-00	80009	5961-00-134-7095
108-0559-00	80009	5950-00-234-0534	151-0213-00	80009	5961-01-030-4860
108-0574-00	80009	5950-00-234-0541	151-0216-00	80009	5961-00-350-2246
108-0585-00	80009	5950-00-243-2238	151-0222-00	80009	5961-01-030-4859
120-0469-00	80009	5950-00-448-2654	151-0223-00	80009	5961-00-404-6720
120-0636-00	80009	5950-00-234-0552	151-0232-00	80009	5961-00-689-1454
120-0637-00	80009	5950-00-234-0553	151-0250-00	80009	5961-00-450-5368
120-0638-00	80009	5950-00-234-0555	151-0259-00	80009	5961-00-497-9207
120-0639-00	80009	5950-00-234-0556	151-0260-00	80009	5961-00-493-1102
120-0640-00	80009	5950-00-234-0557	151-0269-00	80009	5961-00-452-0515
120-0641-00	80009	5950-00-234-0558	151-0270-00	80009	5961-00-896-6038
131-0767-07	80009	5935-00-549-1818	151-0273-00	80009	5961-00-436-3285
131-0767-08	80009	5935-00-549-1826	151-0274-00	80009	5961-00-472-0365
131-0771-00	80009	5935-00-234-0563	151-0276-00	80009	5961-00-404-5537
131-0955-00	80009	5935-00-00R-7558	151-0280-00	80009	5961-00-554-9442
136-0089-00	80009	5935-00-721-0431	152-0061-00	80009	5961-00-905-6871
136-0387-00	80009	5935-00-359-8926	152-0066-00	80009	5961-00-923-9763
148-0034-00	80009	5945-00-234-0564	152-0075-00	80009	5961-00-908-7598

**PART NUMBER - NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX**

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
152-0079-00	80009	5961-00-854-3158	155-0026-00	80009	5962-00-236-8586
152-0107-00	80009	5961-00-879-7531	155-0027-00	80009	5962-00-236-8587
152-0141-02	80009	5961-00-105-7681	156-0011-00	80009	5962-00-081-0977
152-0153-00	80009	5961-00-923-9773	159-0022-00	80009	5920-00-477-1449
152-0166-00	80009	5961-00-936-7720	260-0723-00	80009	5930-00-232-3806
152-0185-00	80009	5961-00-936-7604	260-0879-00	80009	5930-00-448-2655
152-0195-00	80009	5961-00-936-7719	260-0984-00	80009	5930-00-197-1548
152-0212-00	80009	5961-00-237-2353	276-0543-00	80009	5950-00-879-9258
152-0242-00	80009	5961-00-131-1196	276-0549-00	80009	5950-00-460-1570
152-0246-00	80009	5961-00-858-5686	281-0064-00	80009	5910-00-932-9453
152-0271-00	80009	5961-00-551-9443	281-0091-00	80009	5910-00-767-4977
152-0274-00	80009	5961-00-131-1197	281-0122-00	80009	5910-00-013-9658
152-0280-00	80009	5961-00-436-2890	281-0123-00	80009	5910-00-013-9660
152-0333-00	80009	5961-00-728-7198	281-0501-00	80009	5910-00-682-3246
152-0405-00	80009	5961-00-254-1621	281-0504-00	80009	5910-00-577-1315
152-0408-00	80009	5961-00-233-7532	281-0510-00	80009	5910-00-806-4283
152-0412-00	80009	5961-00-896-6229	281-0513-00	80009	5910-00-682-3250
152-0414-00	80009	5961-00-896-6805	281-0513-00	80009	5910-00-682-3250
155-0009-00	80009	5962-00-236-8549	281-0523-00	80009	5910-00-713-2011
155-0010-00	80009	5962-00-236-8550	281-0525-00	80009	5910-00-682-3251
155-001A-00	80009	5962-00-236-8551	281-0525-00	80009	5910-00-682-3251
155-0012-00	80009	5962-00-374-8606	281-0528-00	80009	5910-00-765-0380
155-0013-00	80009	5962-00-243-2505	281-0529-00	80009	5910-00-082-0042
155-0014-01	80009	5962-00-236-8554	281-0537-00	80009	5910-00-794-3269
155-0015-01	80009	5962-00-236-8556	108-0054-00	80009	5915-00-683-8248
155-0017-00	80009	5962-00-236-8557	281-0541-00	80009	5910-00-984-2337
155-0018-00	80009	5962-00-236-8568	281-0543-00	80009	5910-00-792-0065
155-0019-00	80009	5962-00-236-8570	108-0240-00	80009	5950-00-835-6417
155-0020-00	80009	5962-00-236-8571	281-0546-00	80009	5910-00-984-2340
155-0022-00	80009	5962-00-236-8573	281-0547-00	80009	5910-00-226-0475
155-0023-00	80009	5962-00-243-2529	281-0557-00	80009	5910-00-754-9826
155-0024-00	80009	5962-00-243-2532	281-0564-00	80009	5910-00-879-6852
155-0025-00	80009	5962-00-236-8578	281-0603-00	80009	5910-00-879-6813

**PART NUMBER - NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX**

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
281-0629-00	80009	5910-00-436-4428	290-0194-00	80009	5910-00-061-3191
281-0670-00	80009	5910-00-185-4273	290-0246-00	80009	5910-00-725-7858
283-0000-00	80009	5910-00-688-8702	290-0296-00	80009	5910-00-820-0209
283-0001-00	80009	5910-00-794-3281	290-0305-00	80009	5910-00-436-6173
283-0002-00	80009	5910-00-721-2030	290-0425-00	80009	5910-00-500-9676
283-0003-00	80009	5910-00-801-1005	301-0220-00	80009	5905-00-246-0676
283-0004-00	80009	5910-00-577-1346	305-0123-00	80009	5905-00-434-5251
283-0006-00	80009		307-0093-00	80009	5905-00-475-8191
		5910-00-713-4314	307-0124-00	80009	5905-00-359-9589
283-0010-00	80009	5910-00-879-5921	307-0181-00	80009	5905-00-551-9251
283-0032-00	80009	5910-00-113-2375	308-0647-00	80009	5905-00-234-0577
283-0041-00	80009	5910-00-903-5457	311-0091-00	80009	5905-00-814-3978
283-0044-00	80009	5910-00-882-7003	311-0254-00	80009	5905-00-968-0112
283-0065-00	80009	5910-00-465-4042	311-0310-00	80009	5905-00-841-7218
283-0067-00	80009	5910-00-912-9342	311-0422-00	80009	5905-00-900-1187
283-0077-00	80009	5910-00-916-8010	311-0463-00	80009	5905-00-064-9441
283-0078-00	80009	5910-00-938-4696	311-0467-00	80009	5905-00-472-7323
283-0080-00	80009	5910-00-931-7067	311-0515-00	80009	5905-00-463-2771
283-0081-00	80009	5910-00-782-7614	311-0605-00	80009	5905-00-481-8441
283-0082-00	80009	5910-00-916-8014	311-0607-00	80009	5905-00-481-8442
283-0083-00	80009	5910-00-901-9555	311-0622-00	80009	5905-00-879-7782
283-0092-00	80009	5910-00-848-6590	311-0633-00	80009	5905-00-231-3204
283-0103-00	80009	5910-00-485-4854	311-0634-00	80009	5905-00-497-0820
283-0110-00	80009	5910-00-453-0532	311-0635-00	80009	5905-00-497-4330
283-0111-00	80009	5910-00-436-7154	311-0643-00	80009	5905-00-432-6464
283-0114-00	80009	5910-00-071-7369	311-0658-00	80009	5905-00-483-3832
283-0116-00	80009	5910-00-465-7896	311-0698-00	80009	5905-00-337-6537
283-0177-00	80009	5910-00-451-3206	311-0863-00	80009	5905-00-243-1432
283-0178-00	80009	5910-00-451-5671	311-0883-00	80009	5905-00-483-3829
283-0204-00	80009	5910-00-488-9888	311-1035-00	80009	5905-00-325-9219
283-0670-00	80009	5910-00-551-9377	311-1223-00	80009	5905-00-496-1369
285-0698-00	80009	5910-00-433-7788	311-1224-00	80009	5905-00-487-8294
290-0149-00	80009	5910-00-932-7104	311-1227-00	80009	5905-00-487-8290

**PART NUMBER -- NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX**

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
311-1228-00	80009	5905-00-430-6273	315-0302-00	80009	5905-00-464-1958
311-1235-00	80009	5905-00-048-6797	315-0332-00	80009	5905-00-496-9488
311-1279-00	80009	5905-00-434-5433	315-0333-00	80009	5905-00-496-9490
311-1280-00	80009	5905-00-553-8796	315-0390-00	80009	5905-00-436-9884
315-0100-00	80009	5905-00-434-5438	315-0392-00	80009	5905-00-436-9924
315-0101-00	80009	5905-00-102-5294	315-0431-00	80009	5905-00-445-3863
315-0102-00	80009	5905-00-434-5439	315-0470-00	80009	5905-00-437-0891
315-0103-00	80009	5905-00-434-5442	315-0471-00	80009	5905-00-436-9952
315-0104-00	80009	5905-00-434-5443	315-0473-00	80009	5905-00-437-0164
315-0112-00	80009	5905-00-445-3781	315-0510-00	80009	5905-00-437-0272
315-0120-00	80009	5905-00-445-3801	315-0511-00	80009	5905-00-437-0282
315-0121-00	80009	5905-00-445-3804	315-0512-00	80009	5905-00-437-0283
315-0122-00	80009	5905-00-445-3825	315-0561-00	80009	5905-00-437-0288
315-0123-00	80009	5905-00-445-3826	315-0562-00	80009	5905-00-437-0423
315-0131-00	80009	5905-00-445-3827	315-0681-00	80009	5905-00-577-9492
315-0151-00	80009	5905-00-577-9598	315-0683-00	80009	5905-00-496-9491
315-0161-00	80009	5905-00-445-3704	315-0752-00	80009	5905-00-437-0921
315-0162-00	80009	5905-00-445-3705	315-0820-00	80009	5905-00-437-0934
315-0181-00	80009	5905-00-445-3707	315-0821-00	80009	5905-00-437-0936
315-0200-00	80009	5905-00-445-3709	315-0911-00	80009	5905-00-437-0888
315-0201-00	80009	5905-00-445-3714	316-0470-00	80009	5905-00-794-3697
315-0202-00	80009	5905-00-445-3739	317-0560-00	80009	5905-00-900-1107
315-0204-00	80009	5905-00-445-3762	321-0055-00	80009	5905-00-437-1313
315-0205-00	80009	5905-00-445-3764	321-0068-00	80009	5905-00-437-1696
315-0222-00	80009	5905-00-436-9299	321-0094-00	80009	5905-00-105-9728
315-0223-00	80009	5905-00-436-9680	321-0097-00	80009	5905-00-893-1290
315-0240-00	80009	5905-00-442-9356	321-0129-00	80009	5905-00-974-6076
315-0242-00	80009	5905-00-436-9764	321-0150-00	80009	5905-00-105-7713
315-0271-00	80009	5905-00-436-9804	321-0155-00	80009	5905-00-441-7814
315-0272-00	80009	5905-00-436-9832	321-0160-00	80009	5905-00-105-7714
315-0273-00	80009	5905-00-436-9839	321-0178-00	80009	5905-00-105-7715
315-0274-00	80009	5905-00-436-9864	321-0184-00	80009	5905-00-405-7962
315-0301-00	80009	5905-00-437-0875	321-0186-00	80009	5905-00-405-7969

**PART NUMBER - NATIONAL STOCK NUMBER
CROSS REFERENCE INDEX**

PART NUMBER	FSCM	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	NATIONAL STOCK NUMBER
321-0193-00	80009	590500-434-5059			
321-0204-00	80009	5905-00-724-5713			
321-0205-00	80009	5905-00-105-9725			
321-0210-00	80009	5905-00-109-9848			
321-0212-00	80009	5905-00-434-5058			
321-0213-00	80009	5905-00-426-7700			
		5905-00-788-0302			
321-0216-00	80009	5905-00-426-7701			
321-0219-00	80009	5905-00-426-7705			
321-0222-00	80009	5905-00-426-7707			
321-0229-00	80009	5905-00-426-7723			
321-0230-00	80009	5905-00-426-7726			
321-0231-00	80009	5905-00-021-6494			
321-0254-00	80009	5905-00-426-7785			
321-0258-00	80009	5905-00-475-8262			
321-0260-00	80009	5905-00-922-9925			
321-0260-00	80009	5905-00-426-7791			
321-0289-00	80009	5905-00-434-5068			
321-0296-00	80009	5905-00-434-5069			
321-0299-00	80009	5905-00-105-9724			
321-0320-00	80009	5905-00-483-3929			
321-0321-00	80009	5905-00-98R-7513			
321-0329-00	80009	5905-00-426-7763			
321-0335-00	80009	5905-00-017-8107			
321-0344-00	80009	5905-00-441-7812			
321-0437-00	80009	5905-00-401-7931			
322-0385-00	80009	5905-00-256-9880			
323-0168-00	80009	5905-00-469-2905			

**SECTION 8
DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS**

Symbols and Reference Designators

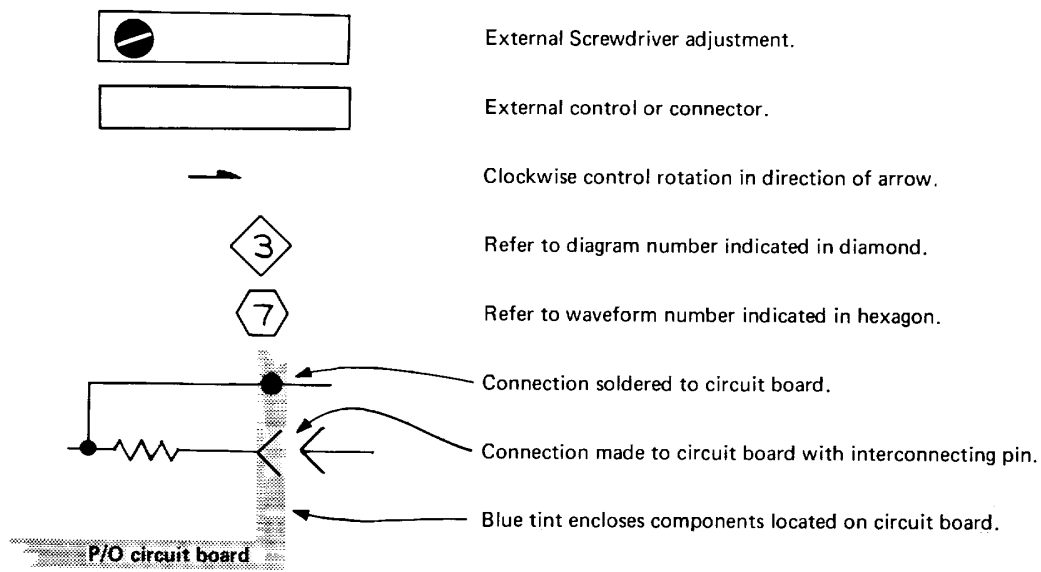
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



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

- | | | | |
|----|--|----|--|
| A | Assembly, separable or repairable (circuit board, etc.) | LR | Inductor/resistor combination |
| AT | Attenuator, fixed or variable | M | Meter |
| B | Motor | Q | Transistor or silicon-controlled rectifier |
| BT | Battery | P | Connector, movable portion |
| C | Capacitor, fixed or variable | R | Resistor, fixed or variable |
| CR | Diode, signal or rectifier | RT | Thermistor |
| DL | Delay line | S | Switch |
| DS | Indicating device (lamp) | T | Transformer |
| F | Fuse | TP | Test point |
| FL | Filter | U | Assembly, inseparable or non-repairable (integrated circuit, etc.) |
| H | Heat dissipating device (heat sink, heat radiator, etc.) | V | Electron tube |
| HR | Heater | VR | Voltage regulator (zener diode, etc.) |
| J | Connector, stationary portion | Y | Crystal |
| K | Relay | | |
| L | Inductor, fixed or variable | | |

VOLTAGE AND WAVEFORM TEST CONDITIONS

Typical voltage measurements and waveform photographs were obtained under the following conditions unless noted otherwise on the individual diagrams:

Test Oscilloscope (with 10X Probe)	
Frequency response	DC to 30 Mhz
Deflection factor (with probe)	50 millivolts to 50 volts/division
Input impedance	10 megohm, 13 picofarads
Probe ground	R7704 chassis ground
Trigger source	External from +GATE connector to indicate true time relationship between signals
Recommended type (as used for waveforms on diagrams)	Tektronix 7504 with 7A16 and 7B50 plug-in units

Voltmeter	
Type	Non-loading digital multimeter
Input impedance	0 to 1.5 volts; >1 kMΩ
	15 to 1000 volts; 10 MΩ
Range	0 to 1000 volts
Reference voltage	R7704 chassis ground
Recommended type (as used for voltages on diagrams)	Fairchild Model 7050

R7704 Conditions	
Line voltage	115 volts
Signal applied	No signal applied for voltage measurements. Apply 4 volts of 1 kHz calibrator signal from test scope to +INPUT of 7A22 for waveforms only.
Connectors	No connections for voltage measurements. For waveforms 4 V Calibrator signal is applied to external trigger input of test scope. Also see Signal applied above.
Trace position	Centered
Control settings	As follows except as noted otherwise on individual diagrams.

R7704	
A INTENSITY	Counterclockwise
B INTENSITY	Counterclockwise
BEAM FINDER	Released
READOUT	OFF
CONTROL ILLUM	OFF
GRAT ILLUM	Counterclockwise
VERTICAL MODE	LEFT
A TRIGGER SOURCE	VERT MODE
HORIZONTAL MODE	A
VERT TRACE	Midrange
VERT TRACE SEPARATION (B)	Midrange
B TRIGGER SOURCE	VERT MODE
SWEEP	A
GATE	A
READOUT MODE	REMOTE-FREE RUN

Left Vertical Plug-In (7A22)	
Position	Centered
Volts/Div	1 V
Variable	Cal
Offset	Centered
HF -3 dB Point	1 MHz
LF -3 dB Point	DC
+Input	Gnd
-Input	Gnd

Right Vertical Plug-In (7A16)	
Position	Centered
Polarity	+ UP
Input Coupling	Gnd
BW	Full
Volts/Div	Variable
	Cal
A Horiz Plug-In (7871)	
Level/Slope	Midrange, positive slope
Position	Centered
B Delay Mode	Independent
Delay Time Mult	0.0
Triggering	
Mode	NORM
Coupling	AC
Source	Int
Magnifier	X1
Time/Div	1 ms
Variable	Cal
	Cal
	7B70)
Level/Slope	
Position	Midrange, positive slope
Display Mode	Centered
Variable	Time Base
Triggering	Centered
Mode	NORM
Coupling	AC
Source	Int
Magnifier	X1
Time/Div	1 ms
Variable	Cal

The following control settings and connections were changed to obtain waveform photographs.

Left Vet (7A22)	
+Input	DC
Position	Vertically center display
Apply 4 volts of 1 kHz calibrator to the +Input	
A Horiz (7B71)	
Triggering Mode	P-P Auto
B Horiz (7B70)	
Triggering Mode	P-P Auto

All voltages given on the diagrams are in volts. Waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Readouts are simulated in larger-than-normal type. Voltages and waveforms on the diagrams (shown in blue) are not absolute and may vary between instruments because of differing component tolerances, internal calibration or front-panel control settings.

NOTE

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

APPENDIX A REFERENCES

The following is a list of applicable references that are available to the operator and maintenance personnel of TEKTRONIX R7704 oscilloscope.

DA Pam 310-4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	US Army Index of Modification Work Orders.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies and Equipment Used by the Army.
SC 5180-91-CL-R07	Tool Kit, Electronic Equipment TK-105/G.
SC 5180-91-CL-R13	Tool Kit, Electronic Equipment TK-101/G.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronic Command).

APPENDIX D
MAINTENANCE ALLOCATION
Section I. INTRODUCTION

D-1. General

This appendix provides a summary of the maintenance operations for R7704. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services C(inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as

prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

D-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next 'higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3.

This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of taskhours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

- C - Operator/Crew
- O - Organizational

- F - Direct Support
- H - General Support
- D - Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

D-4. Tool and Test Equipment Requirements (Sect. III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.
(Next printed page is D-3)

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NA TO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

D-5. Remarks (Sect. IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

(Next printed page is D-3)

**SECTION II MAINTENANCE ALLOCATION CHART
FOR
OSCILLOSCOPE, TEKTRONIX MODEL R7704**

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
00	OSCILLOSCOPE (TEK 7704)	Inspect Service		0.1 0.1					
01	MAIN PCB ASSY, LISTED FOR REFERENCE ONLY, NOT A MAINTENANCE ITEM	Test Repair Test Repair Calibrate		0.1 0.3		2.5 3.0 2.5	14 2 thru 13 1 thru 14 2 thru 14	A C	
0101	MAIN INTERFACE (670-0817-00) (A1)	Repair					B		
0102	LOGIC PCB (670-0848-04) (A2)	Repair						B	
0103	TRIGGER SELECTOR ASSY (670-0625-00) (A3)	Repair						B	
0104	VERT INTERFACE ASSY (670-0811-01) (A4)	Repair						B	
0105	VERT SWITCHING & PWR ASSY (670-0812-02) (AS)	Repair						B	
0106	HORIZ INTERFACE ASSY (670-0808-00) (A8)	Repair	Repair					B	
02	VERT OUTPUT ASSY (670-0809-02) (A6)	Repair	Repair					B	
03	HORIZ OUTPUT ASSY (670-0807-00) (A9)	Repair	Repair					B	
04	OUTPUT SIGNAL ASSY (670-0989-01) (A10)	Repair	Repair					B	
05	HIGH VOLT/Z AXIS AMP ASSY (670-0806-00) (A11)	Repair						B	
06	POWER UNIT, NOT A MAINTENANCE ITEM, LISTED FOR REFERENCE ONLY								
0601	LINE INPUT ASSY (670-0813-02) (A12)	Repair						B	
0602	INVERTER ASSY (670-0814-01) (A13)	Repair						B	
0603	RECTIFIER ASSY (670-0815-00) (A14)	Repair						B	
0604	LOW VOLT RECTIFIER ASSY (670-0816-00) (A15)	Repair Repair		0.2			14	D B	
07	VERT MODE SWITCH ASSY (670-0991-00) (A19)	Replace Repair				0.3 0.5	14	B	
08	HORIZ MODE SWITCH ASSY (670-1330-00) (A20)	Replace Repair				0.3 0.5	14	B	
D9	READOUT SYSTEM ASSY (670-0635-08) (A21)	Repair						B	
10	GRATICULE LIGHT ASSY (670-0702-00) (A22)	Repair Replace		0.3		0.3	14 14	C	
DRSEL-MA Form 6031, (1 Jul 76)							HISA-FM 2314-79		

**SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR**

OSCILLOSCOPE, TEKTRONIX MODEL R7704

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	O, H	MULTIMETER AN/USM-223	6625-00-999-7465	
2	H	OSCILLOSCOPE (DC-75 MHZ) OS-261/U	6625-00-127-0079	
3	H	PROBE P6053 (X100)	6625-01-014-0391	
4	H	PROBE P6021 (CURRENT)	6625-01-022-8319	
5	H	ISOLATION TRANSFORMER (500 VA)		
6	H	VARIAC (GRW 10MT 3W)	6120-00-054-7794	
7	H	DCVM (HP3490A-K24)	6625-01-006-3228	
8	H	TIME MARK GEN (TM 501)	6625-00-534-2638	
9	H	GENERATOR (GR 1310-A)	6625-00-213-5812	
10	H	GENERATOR (TEK SG503)	6625-00-520-5143	
11	H	(TEK 7A26) AM-6785/U	6625-00-361-5318	
12	H	TEK 7B92A (TIME BASE)	6625-01-027-0265	
13	H	TRANSISTOR TESTER (TEK 577)	6625-00-202-3475	
14	O, H	TOOL KIT, TK-105	5180-00-610-8177	

DRSEL-MA Form
1 Oct 77

(Edition of 1 Oct 74 may be used until exhausted)

HISA-FM 2132-77

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A B C D	OPERATIONAL TEST ONLY. REPAIR AS PART OF NHA. REPAIR BY REPLACING BULBS. REPAIR BY REPLACING FUSES.

D-5/(D-6 blank)

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear either on the back of the diagrams or on pullout pages immediately following the diagrams of the instruction manual.

INDENTATION SYSTEM

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

Assembly and/or Component
 Detail Part of Assembly and/or Component
 mounting hardware for Detail Part
 Parts of Detail Part
 mounting hardware for Parts of Detail Part
 mounting hardware for Assembly and/or Component

Mounting hardware always appears 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.

Mounting hardware must be purchased separately, unless otherwise specified.

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 or model 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.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

**INDEX OF
MECHANICAL PARTS LIST & ILLUSTRATIONS**

Title	Page Nos. of Parts List
Figure 1 Front.....	9-1 thru 9-4
Figure 2 Plug-In Housing & Delay Line	9-5 thru 9-11
Figure 3 Horiz & Vert Chassis	9-12 thru 9-15
Figure 4 LV Power Supply	9-16 thru 9-21
Figure 5 Cabinet & Rear.....	9-22 thru 9-23
Figure 6 Standard Accessories	(parts list combined with illustration)
Figure 7 Instrument Options.....	(parts list combined with illustration)
Figure 8 Repackaging	(parts list combined with illustration)

**REPLACEABLE
MECHANICAL PARTS**

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

“	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELCTLT	ELECTROLYTIC	INSUL	INSULATOR	SEMICOND	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EOPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVING
AWG	AMERICAN WIRE GAGE	FLH		FLAT HEADNON WIRE		NOT WIRE WOUND	SPR
	SPRING						
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SO	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 I	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDENT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

Replaceable Mechanical Parts-R7704

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
0000A	LEMO USA	2015 2ND STREET	BERKLEY, CA 94710
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
05091	TRI-ORDINATE CORPORATION	343 SNYDER AVENUE	BERKELEY HEIGHTS, NJ
07922			
06540	AMATOM ELECTRONIC HARDWARE, DIV. OF MITE CORP.	446 B1AKE ST.	NEW HAVEN, CT 06515
07700	TECHNICAL WIRE AND PRODUCTS, INC.	129 DERMODY ST.	CRANFORD, NJ 07016
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
13103	THERMALLOY COMPANY, INC.	2021 W VALLEY VIEW LANE	
		P O BOX 34829	DALLAS, TEXAS 75234
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA
17070			
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL
60007			
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74921	ITEN FIBRE CO., THE	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
77820	BENDIX CORP., THE, ELECTRICAL COMPONENTS DIVISION	SHERMAN AVE.	SIDNEY, NY 13838
77969	RUBBERCRAFT CORP. OF CALIF., LTD.	1800 W. 220TH ST.	TORRANCE, CA 90507
78189	ILLINOIS TOOL WORKS, INC.		
	SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
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
80112	G. C. ELECTRONICS COMPANY, A DIVISION OF HYDROMETALS, INC.	3225 EXPOSITION PLACE	LOS ANGELES, CA 90018
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
82647	TEXAS INSTRUMENTS, INC., CONTROL PRODUCTS DIV.	34 FOREST ST.	ATTLEBORO, MA 02703
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
97913	INDUSTRIAL ELECTRONIC HARDWARE CORP.	109 PRINCE STREET	NEW YORK, NY 10012
98159	RUBBER TECK, INC.	19115 HAMILTON AVE., P O BOX 389	GARDENA, CA 90247
98291	SEAELECTRO CORP.	225 HOYT	MAMARONECK, NY 10544
98376	ZERO MFG. COMPANY, ZERO-WEST DIV.	777 FRONT STREET	BURBANK, CA 91503
98978	INTERNATIONAL ELECTRONIC RESEARCH CORP.	135 W. MAGNOLIA BLVD.	BURBANK, CA 91502

REV. C JULY 1978

Replaceable Mechanical Parts-R7704

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	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	331-0258-00	B010100	B059999	1		MASK,CRT SCALE:	80009	331-0258-00
331-0258-03		B060000		1		MASK,CRT SCALE:	80009	331-0258-03
-4	204-0380-00			1		BODY,TERMINAL:	80009	204-0380-00
131-0765-00				3		TERM,FEEDTHRU:0.584 L X 0.625 OD,W/CONT	80009	131-0765-00
-5	200-0939-01			1		RTNR,CRT SCALE:5.55 X 5.068 X 0.475,AL (ATTACHING PARTS)	80009	200-0939-01
-6	212-0023-00	B010100	B194214	4		SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
	212-0008-00	B194215		4		SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL ---*---	83385	OBD
-7	337-1159-00			1		WINDOW,OBS:4.78 X 3.93 X 0.07"PLSTC	80009	337-1159-00
-8	670-0702-00			1		CKT BOARD ASSY:GRATICULE LAMPS(SEE A22 EPL)	80009	670-0702-00
-9	378-0614-00			1		REFLECTOR,LIGHT:MOLDED PLASTIC (ATTACHING PARTS)	80009	378-0614-00
-10	211-0062-00			2		SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL	83385	OBD
-11	344-0179-00			2		CLIP,REFL RTNG:PLASTIC	80009	344-0179-00
-12	331-0245-00			1		MASK,CRT SCALE:	80009	331-0245-00
-13	386-1884-01			1		SUPPORT,CRT:	80009	386-1884-01
-14	386-1517-00			4		SUPPORT,CRT: (ATTACHING PARTS)	80009	386-1517-00
-15	212-0040-00			2		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
-16	407-0868-00			1		BRACKET,CRT:	80009	407-0868-00
-17	212-0001-00			1		SCREW,MACHINE:8-32 X 0.250 INCH,PNH STL	77250	OBD
	212-0002-00			1		SCREW,MACHINE:8-32 X 0.250",FLH,100 DEG	83385	OBD
-18	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-19	211-0538-00			2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-20	367-0138-00			2		HANDLE,BOW:U SHAPED (ATTACHING PARTS)	06540	14053-A-1032-1B
-21	212-0509-00			1		SCREW,MACHINE:10-32 X 0.625INCH,PNH STL	83385	OBD
-22	212-0559-00			1		SCREW,MACHINE:10-32 X 0.375.FLH,100DEG,STL ---*---	83385	OBD
-23	366-1122-00			1		KNOB :GRAY	80009	366-1122-00
	213-0153-00			1		SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-24	366-1120-00			1		KNOB:GRAY,0.600 INCH HIGH	80009	366-1120-00
	213-0153-00			2		SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-25	366-0497-00			1		KNOB:GRAY	80009	366-0497-00
	213-0153-00			1		SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-26	366-1189-00			1		KNOB:GRAY	80009	366-1189-00
	213-0153-00			1		SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-27	366-1189-00			1		KNOB:GRAY	80009	366-1189-00
	213-0153-00			1		SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-28	358-0301-02			2		BUSHING,SLEEVE:GRAY PLASTIC	80009	358-0301-02
-29	358-0378-00			1		BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
-30	384-1044-00			1		KNOB:11.45 LONG X 0.125 OD SST	80009	384-1044-00
	129-0053-00			1		POST,BDG,ELEC:UNINSULATED	80009	129-0053-00
-31	200-0103-00			1		NUT,PLAIN,KNURL:0.25-28 X 0.375" OD,BRASS	80009	200-0103-00
-32	355-0507-00			1		STUD,SHOULDERED:BINDING POST	80009	355-0507-00
-33	210-0455-00			1		NUT,PLAIN,HEX :0.25-28 X 0.375 INCH,BRASS	73743	3089-402
-34	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-35	333-1374-00	B010100	B236159	1		PANEL,FRONT:	80009	333-1374-00
	333-1374-01	B236160		1		PANEL,FRONT: (ATTACHING PARTS)	80009	333-1374-01
-36	211-0022-00	1				SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL ---*---	83385	OBD
-37	378-0635-01	1				LENS,LIGHT:WHITE,MARKED A,PLASTIC	80009	378-0635-01
-38	378-0635-02	1				LENS,LIGHT:WHITE,MARKED B,PLASTIC	80009	378-0635-02
-39	384-1050-00	1				KNOB:7.093 LONG X 0.125 OD STEEL	80009	384-1050-00
-40	352-0157-00	2				LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-41	331-0262-00	2				DIFFUSER,LIGHT:INDICATOR LIGHTS	80009	331-0262-00
-42	200-0935-00	2				BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00

REV. C JULY 1978

Replaceable Mechanical Parts-R7704

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
1-43	136-0387-00			3		JACK,TIP:GRAY	71279	450-4352-01-0318
-44	136-0387-01			1		JACK,TIP:BLACK	71279	450-4252-01-0310
-45	131-0771-00			1		CONNECTOR,RCPT:4 CONT,QUICK DISCONNECT (ATTACHING PARTS)	0000A	ROA-304NYL
-46	220-0551-00			1		NUT,PLAIN,HEX. :9 MM X 0.437 INCH	73743	OBD
-47	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL ---*---	78189	1220-02-00-0541C
-48	-----			1		RESISTOR,VAR:(SEE EPL) (ATTACHING PARTS)		
-49	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-50	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL ---*---	78189	1220-02-00-0541C
-51	-----			2		RESISTOR,VAR:(SEE EPL) (ATTACHING PARTS)		
-52	358-0409-00			1		BSHG,MACH.THD:0.25-32 X 0.159 ID X 0.24	80009	358-0409-00
-53	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-54	210-0471-00			1		NUT,SLEEVE:HEX.,0.312 X 0.594 INCH LONG ---*---	80009	210-0471-00
-55	200-0608-00			1		COVER,VAR RES. :PLASTIC	80009	200-0608-00
-56	-----			2		RESISTOR,VAR:(SEE EPL) (ATTACHING PARTS)		
-57	210-0583-00			1		NUT,PLAIN,HEX. :0.25-32 X 0.312 INCH,BRS ---*---	73743	2X20224-402
-58	-----			1		RESISTOR,VAR:(SEE EPL) (ATTACHING PARTS)		
-59	210-0583-00			1		NUT,PLAIN,HEX. :0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-60	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL ---*---	78189	1214-05-00-0541C
-61	134-0119-00			1		PLUG,PLASTIC:0.17 OD X 0.144 INCH LONG	80009	134-0119-00
-62	348-0031-00			1		GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
-63	386-1894-00			1		SPRT,ELEC SHLD: (ATTACHING PARTS)	80009	386-1894-00
-64	211-0038-00			4		SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-65	210-0586-00			4		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL ---*---	78189	211-041800-00
-66	348-0204-00			2		SHLD GSKT,ELEK:FINGER TYPE,10.65 INCH LONG	80009	348-0204-00
-67	386-1893-00			1		SUPT ELEC SHLD: (ATTACHING PARTS)	80009	386-1893-00
-68	211-0038-00			4		SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-69	210-0586-00			4		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL ---*---	78189	211-041800-00
-70	351-0202-00			4		GUIDE,SLIDE:UPPER (ATTACHING PARTS)	80009	351-0202-00
-71	211-0105-00			2		SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL ---*---	83385	OBD
-72	200-0984-00			1		BEZEL:PLASTIC,5 BUTTON SWITCH	80009	200-0984-00
-73	-----			1		CKT BOARD ASSY:VERT MODE SW(SEE A19 EPL)		
-74	352-0174-00			5		LAMPHOLDER:(1) WIRE LEAD INCANDESCENT	80009	352-0174-00
-75	131-0787-00			17		CONTACT,ELEC:0.64 INCH LONG	22526	47359
-75	366-1109-01			1		PUSH BUTTON:LEFT	80009	366-1109-01
	366-1109-02			1		PUSH BUTTON:ALT	80009	366-1109-02
	366-1109-03			1		PUSH BUTTON:ADD	80009	366-1109-03
	366-1109-04			1		PUSH BUTTON:CHOP	80009	366-1109-04
	366-1109-05			1		PUSH BUTTON:RIGHT	80009	366-1109-05
-76	337-1157-00			1		SHIELD,ELEC:SHIELDING GASKET 5 BUT SW	80009	337-1157-00
-77	380-0147-00			1		HOUSING,PB: (ATTACHING PARTS)	80009	380-0147-00
-78	211-0125-00			3		SCREW,MACHINE:1-72 X 0.25 INCH,PNH STL (ATTACHING PARTS)	83385	OBD
-79	210-0599-00			2		NUT,SLEEVE:4-40 X 0.391 INCH LONG	80009	210-0599-00
-80	-----			1		CKT BOARD ASSY:A TRIG SOURCE SW(SEE A18 EPL)		
-81	131-0592-00			5		CONTACT,ELEC:0.885 INCH LONG	22526	47353

REV. C JULY 1978

Replaceable Mechanical Parts-R7704

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-131-0787-00				5	.					CONTACT,ELEC:0.64 INCH LONG	22526	47359
	380-0154-02			1	.					HOUSING,LIGHT:3 BUTTON (ATTACHING PARTS)	80009	380-0154-02
	213-0181-00			1	.					SCR,TPG,THD FOR:2-32 X 0.375 INCH,PNH STL ---*---	83385	OBD
										(ATTACHING PARTS FOR CKT BD)		
-82	211-0156-00			2	.					SCREW,MACHINE:1-72 X 0.25",82 DEG,FLH STL ---*---	93907	OBD
-83	-----			1	.					CKT BOARD ASSY:B TRIG SOURCE SW(SEE A17 EPL)		
-84	131-0592-00			5	.					CONTACT,ELEC:0.885 INCH LONG	22526	47353
	131-0787-00			5	.					CONTACT,ELEC:0.64 INCH LONG	22526	47359
	380-0154-02			1	.					HOUSING,LIGHT:3 BUTTON (ATTACHING PARTS)	80009	380-0154-02
	213-0181-00			1	.					SCR,TPG,THD FOR:2-32 X 0.375 INCH,PNH STL (ATTACHING PARTS)	83385	OBD
-85	211-0156-00			2	.					SCREW,MACHINE:1-72 X 0.25",82 DEG,FLH STL ---*---	93907	OBD
-86	-----			1	.					CKT BOARD ASSY:HORIZ MODE SW(SEE A20 EPL)		
	352-0174-00			4	.					LAMPHOLDER: (1) WIRE LEAD INCANDESCENT	80009	352-0174-00
-87	131-0592-00			8	.					CONTACT,ELEC:0.885 INCH LONG	22526	47353
	131-0787-00			8	.					CONTACT,ELEC:0.64 INCH LONG	22526	47359
-88	366-1109-02			1	.					PUSH BUTTON:ALT	80009	366-1109-02
	366-1109-04			1	.					PUSH BUTTON:CHOP	80009	366-1109-04
	366-1109-06			1	.					PUSH BUTTON:A	80009	366-1109-06
	366-1109-07			1	.					PUSH BUTTON:B	80009	366-1109-07
-89	337-1156-00			1	.					SHIELD,ELEC:SHIELDING GASKET 5 BUT SW	80009	337-1156-00
-90	380-0168-00			1	.					HOUSING,PB: (ATTACHING PARTS)	80009	380-0168-00
-91	211-0125-00			3	.					SCREW,MACHINE:1-72 X 0.25 INCH,PNH STL ---*---	83385	OBD
										(ATTACHING PARTS FOR CKT BD)		
-92	210-0599-00			2	.					NUT,SLEEVE:4-40 X 0.391 INCH LONG ---*---	80009	210-0599-00
-93	200-0983-00			1	.					BEZEL:PLASTIC,4 BUTTON SWITCH	80009	200-0983-00
-94	386-1890-00			1	.					SUBPANEL,FRONT:	80009	386-1890-00

REV. B JULY 1978

Replaceable Mechanical Parts-R7704

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-	119-0265-00			1		DELAY LINE,ELEC:118NS,100 OHM	80009	119-0265-00
-1	200-1165-00			1		. COVER,DLY LINE:TOP	80009	200-1165-00
-2	200-1166-00			1		. COVER,DLY LINE:BOTTOM (ATTACHING PARTS)	80009	200-1166-00
-3	211-0038-00			5		. SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-4	129-0080-00			4		. POST,ELEC-MECH:0.875 INCH LONG	80009	129-0080-00
-5	211-0097-00			3		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						---*---		
-6	129-0215-01			2		. SPACER,POST:0.875 LONG X 1.0 OD (ATTACHING PARTS)	80009	129-0215-01
-7	213-0229-00			1		. SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	93907	OBD
-8	213-0146-00			1		. SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
						---*---		
-9	352-0169-00			1		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
-10	131-0708-00			2		. CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
-11	131-0788-00			2		. CONN,RCPT,ELEC:FEEDTHRU,BRASS	98291	055-031-0000-220
-12	407-0862-00			1		. BRKT,DELAY LINE: (ATTACHING PARTS)	80009	407-0862-00
-13	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						---*---		
	211-0507-00			4		(ATTACHING PARTS FOR DELAY LINE ASSY) SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						---*---		
-14	348-0271-00			2		GROMMET,PLASTIC:BLACK,U-SHAPED,1.105 OD	80009	348-0271-00
-15	348-0056-00			2		GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-16	220-0603-00			1		NUT BAR:0.5 X 0.25 X 2.0 INCH (ATTACHING PARTS)	80009	220-0603-00
-17	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						---*---		
-18	337-1405-00			1		SHIELD,ELEC:TRANSISTOR,HV (ATTACHING PARTS)	80009	337-1405-00
-19	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						---*---		
-20	260-1196-00			1		SWITCH,TOGGLE: (SEE S800 EPL) (ATTACHING PARTS)		
-21	210-0473-00			1		NUT,PLAIN,DODEC:0.469-32 X 0.638 INCH,BRS	80009	210-0473-00
-22	407-0873-00			1		BRACKET,SWITCH:	80009	407-0873-00
-23	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-24	210-0229-00			1		TERMINAL,LUG:0.505 ID,PLAIN,BRS	80009	210-0229-00
						---*---		
-25	386-1936-00			1		SUPPORT,SHAFT: (ATTACHING PARTS)	80009	386-1936-00
-26	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						---*---		
	386-1900-00			1		SUPPORT,SHAFT: (ATTACHING PARTS)	80009	386-1900-00
	213-0068-00			1		SCR,TPG,THD CTG:4-40 X 0.50 INCH,PNL STL	83385	OBD
						---*---		
-27	407-0886-00			1		BRACKET,ACTR: (ATTACHING PARTS)	80009	407-0886-00
	210-0449-00			2		NUT,PLAIN,HEX. :5-40 X 0.250 INCH,BRS	73743	3030-402
	210-0006-00			1		WASHER,LOCK:INTL,O.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
						---*---		
-28	214-1524-00			1		ADAPTER,SW ACTR:POWER (ATTACHING PARTS)	80009	214-1524-00
-29	213-0088-00			2		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						---*---		
-30	351-0279-00			2		GUIDE,SHOE:5.18 X 0.375,NYLON	80009	351-0279-00
-31	351-0181-02			4		GUIDE,SLIDE:PLUG-IN UNIT,LWR,BLK NYLON (ATTACHING PARTS FOR EACH)	80009	351-0181-02
	213-0229-00			1		SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	93907	OBD
-32	213-0104-00			1		SCR,TPG,THD FOR:6-20 X 0.375 INCH,TRH STL	83385	OBD
-33	386-1892-00			1		SUPPORT,CHASSIS:	80009	386-1892-00

REV. F JULY 1978

Replaceable Mechanical Parts-R7704

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
2-34	-----			1		CKT BOARD ASSY:OUTPUT SIGNAL(SEE A10 EPL)		
-35	136-0220-00			19		SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-36	136-0263-03	B010100	B080944	33		SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B080945		33		SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-37	136-0237-00			1		SOCKET,PLUG-IN:8 CONTACT,ROUND	71785	133-98-12-062
-38	214-0579-00			14		TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-39	260-0723-00			2		SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
-40	260-0984-00			1		SWITCH,SLIDE:DP 3 POSN,0.5A,125VAC-DC	79727	G-128-S-0012
-41	211-0115-00			3		SCREW,MACHINE:2-56 X 0.50 INCH,OVH STL	83385	OBD
-42	361-0238-00			3		SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-43	-----			2		CKT BOARD ASSY:READOUT SYSTEM(SEE A21 EPL)		
-44	136-0220-00			11		SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-45	136-0235-00			1		SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-46	136-0237-00			4		SOCKET,PLUG-IN:S CONTACT,ROUND	71785	133-98-12-062
-47	136-0269-02			1		SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C95140
-48	136-0260-02			14		SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
-49	136-0263-03	B010100	B080944	46		SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B080945		46		SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-50	214-0579-00			18		TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-51	211-0155-00			2		SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-52	361-0238-00			2		SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-53	343-0013-00			1		CLAMP,LOOP:0.375 INCH DIA (ATTACHING PARTS)	95987	3-8-6B
-54	211-0510-00			1		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
-55	210-0863-00			1		WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
-56	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						---*---		
-57	343-0013-00			1		CLAMP,LOOP:0.375 INCH DIA (ATTACHING PARTS)	95987	3-8-6B
-58	212-0004-00			1		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-59	210-0863-00			1		WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
						---*---		
-60	131-0761-00			4		TERMINAL STUD:SCREW MTG,FLAT TAB (ATTACHING PARTS FOR EACH)	71279	572-4897-01-0516
-61	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						---*---		
-62	131-0761-00			2		TERMINAL STUD:SCREW MTG,FLAT TAB (ATTACHING PARTS FOR EACH)	71279	572-4897-01-0516
-63	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-64	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
						---*---		
-65	-----			1		RESISTOR,VAR:(SEE EPL) (ATTACHING PARTS)		
-66	210-0583-00			1		NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-67	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
						---*---		
-68	386-1901-00			1		SUPPORT,SHAFT: (ATTACHING PARTS)	80009	386-1901-00
-69	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						---*---		
-70	-----			1		TRANSFORMER: (SEE EPL) (ATTACHING PARTS)		
-71	210-0457-00			4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-72	210-0803-00			4		WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-73	210-0935-00			8		WASHER,NONMETAL:FIBER,0.14 IDX 0.375"OD	74921	OBD
-74	407-0867-00			1		BRACKET,XFMR:	80009	407-0867-00
-75	361-0364-00			2		SPACER,PLATE:0.05 X 2.5 X 0.35 INCH	80009	361-0364-00
						---*---		
-76	376-0050-00			1		CPLG,SHAFT,FLEX:FOR 0.081/0.125 INCH SHAFTS	80009	376-0050-00
	213-0022-00			4		SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
-77	210-0202-00			2		TERMINAL,LUG:SE #6 (ATTACHING PARTS)	78189	2104-06-00-2520N
-78	211-0507-00			1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-79	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						---*---		

Replaceable Mechanical Parts-R7704

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
2-80	131-0682-02			79	TERM,FEEDTHRU:0.82 L X 0.025 SQ EA END	80009	131-0682-02
-81	441-0975-00			1	CHASSIS,SCOPE:PLUG-IN HOUSING, TOP (ATTACHING PARTS)	80009	441-0975-00
-82	211-0507-00			5	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-83	210-0457-00			5	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					---*---		
-84	426-0713-00			1	FRAME,PL-IN HSG:REAR (ATTACHING PARTS)	80009	426-0713-00
-85	211-0538-00			4	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-86	210-0457-00			4	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					---*---		
-87	131-1018-00			4	CONTACT,ELEC:PLUG-IN GROUND (ATTACHING PARTS FOR EACH)	80009	131-1018-00
-88	213-0138-00			1	SCR,TPG,THD FOR:4-40 X 0.188 INCH,PNH STL	83385	OBD
					---*---		
-89	131-0930-00	B010100	B050269	6	CONTACT,ELEC:PLUG-IN GROUND	80009	131-0930-00
	131-0930-00		B050270	3	CONTACT,ELEC:PLUG-IN GROUND	80009	131-0930-00
	131-0799-00		B050270	3	CONTACT,ELEC:PLUG-IN GROUND (ATTACHING PARTS FOR EACH)	80009	131-0799-00
-90	211-0001-00			1	SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	83385	OBD
-91	210-0001-00			1	WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
-92	210-0405-00			1	NUT,PLAIN,HEX. :2-56 X 0.188 INCH,BRS	73743	2X12157-402
					---*---		
-93	-----			2	DIODE:(SEE EPL) (ATTACHING PARTS FOR EACH)		
-94	220-0410-00			1	NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
-95	210-0949-00			1	WASHER,FLAT:0.141 ID X 0.50 INCH OD,BRS	12327	OBD
-96	210-0909-00			1	WASHER,NONMETAL:0.196 ID X 0.625" OD,MICA	71400	OBD
-97	210-0813-00			1	WSHR,SHOULDERED:# 10 FIBER	74921	OBD
-98	210-0224-00			1	TERMINAL,LUG:0.20 ID X 0.344 OD,SE,BRS	86928	A373-148-1
					---*---		
-99	-----			1	CKT BOARD ASSY:VERT SW AND PWR(SEE A5 EPL)		
-100	136-0220-00			10	. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-101	136-0263-03	B010100	B080944	18	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04		B080945	18	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-102	214-0579-00			5	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-103	211-0155-00			3	.SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-104	361-0238-00			3	.SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-105	-----			1	CKT BOARD ASSY:HORIZ INTCON(SEE A7 EPL)		
-106	136-0263-03	B010100	B080944	8	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04		B080945	8	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-107	211-0155-00			2	. SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-108	361-0238-00			2	. SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-109	-----			1	CKT BOARD ASSY:LOGIC(SEE A2 EPL)		
-110	136-0220-00			7	. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-111	136-0241-00			4	. SOCKET,PLUG-IN:10 CONTACT,ROUND	71785	133-99-12-064
-112	136-0260-01			3	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-113	136-0263-03	B010100	B080944	44	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04		B080945	44	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-114	211-0155-00			3	.SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-115	361-0238-00			3	.SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-116	-----			1	CKT BOARD ASSY:MAIN INTERFACE(SEE A1 EPL)		
-117	388-1381-00	B010100	B059999X	1	. CKT BOARD ASSY:IPC OUTER	80009	388-1381-00
-118	388-1380-00	B010100	B059999X	1	. CKT BOARD ASSY:IPC INNER	80009	388-1380-00
-119	388-1401-01			1	. CKT BOARD ASSY:VERTICAL INTERCONNECT (ATTACHING PARTS)	80009	388-1401-01
-120	211-0065-00			2	. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	77250	OBD
	131-0767-00	BO10100	B069999	2	. CONNECTOR,RCPT, :76 CONTACT	80009	131-0767-00
	131-0767-07	B070000		2	. CONNECTOR,RCPT,:PLUG-IN CKT BD,70 CONTACT	80009	131-0767-07
					---*---		
-121	200-0950-00			2	. . COVER,ELEC CONN:PLASTIC	80009	200-0950-00 -
-122	204-0365-00			1	. . BODY,CONNECTOR:PLUG-IN CIRCUIT CARD	80009	204-0365-00
-123	131-0726-00			2	. CONTACT,ELEC:STRAIGHT	80009	131-0726-00

REV. D JULY 1978

Replaceable Mechanical Parts-R7704

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-124	131-0727-00		2		. CONTACT,ELEC:OFFSET (ATTACHING PARTS FOR EACH)	80009	131-0727-00
-125	213-0232-00		2		. SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	83385	OBD
	131-0767-02	B010100 B069999	2		. CONNECTOR,RCPT,:76 CONTACT	80009	131-0767-02
	131-0767-08	B070000	2		. CONNECTOR,RCPT,:PLUG-IN CKT BD,70 CONTACT	80009	131-0767-08
					---*---		
-126	200-0950-00		2		. . COVER,ELEC CONN:PLASTIC	80009	200-0950-00
-127	204-0365-00		1		. BODY,CONNECTOR:PLUG-IN CIRCUIT CARD	80009	204-0365-00
-128	131-0726-00		2		.CONTACT,ELEC:STRAIGHT	80009	131-0726-00
-129	131-0727-00		2		. . CONTACT,ELEC:OFFSET	80009	131-0727-00
-130	131-0899-00		4		. CONTACT,ELEC:0.048 X 0.006 INCH THK (ATTACHING PARTS FOR EACH)	80009	131-0899-00
-131	213-0232-00		2		. SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	83385	OBD
					---*---		
-132	136-0220-00		2		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
	131-0595-00		9		.CONTACT,ELEC:1.37 INCH LONG	22526	47355
-133	131-0608-00		66		.TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
	131-0590-00		45		.CONTACT,ELEC:0.71 INCH LONG	22526	47351
	131-0592-00		56		.CONTACT,ELEC:0.885 INCH LONG	22526	47353
	131-0665-00		19		.TERMINAL,PIN:0.88 L X 0.025 SQUARE	22526	47358
	131-0787-00		24		.CONTACT,ELEC:0.64 INCH LONG	22526	47359
-134	351-0155-00		68		. INSULATOR,STDF :CONNECTOR,DELTRIN	80009	351-0155-00
-135	351-0185-00		4		. GUIDE-POST,LOCK:0.65 INCH LONG	80009	351-0185-00
-136	351-0227-00		3		. GUIDE-POST,LOCK:0.84 INCH LONG	80009	351-0227-00
-137	351-0213-00		2		.GUIDE-POST,LOCK:0.285 INCH LONG	80009	351-0213-00
-138	351-0188-00		4		. GUIDE-POST,LOCK:0.65 INCH LONG	80009	351-0188-00
-139	351-0186-00		3		. GUIDE-POST,LOCK:0.84 INCH LONG	80009	351-0186-00
-140	352-0213-00		4		. HOLDER,CABLE:FOR 0.16 X 0.08"CABLE,PLASTIC	80009	352-0213-00
-141	386-1557-00		5		.SPACER,CKT CARD:PLASTIC	80009	386-1557-00
-142	352-0212-00		8		.HOLDER,COAX CA:GROUNDING,CKT BD MT (ATTACHING PARTS)	80009	352-0212-00
-143	213-0034-00		12		SCR,TPG,THD CTG:4-40 X 0.188 INCH,PNH STL	83385	OBD
					---*---		
-144	131-0804-00		2		LINK,TERM.CONNE :J-SHAPE (ATTACHING PARTS)	80009	131-0804-00
-145	220-0561-00		1		NUT,PLAIN,HEX. :10-32 X 0.25 INCH,BRS	80009	220-0561-00
					---*---		
-146	131-0805-00		1		LINK,TERM.CONNE:J-SHAPE,0.90X0.82 X 0.312" (ATTACHING PARTS)	80009	131-0805-00
-147	220-0561-00		1		NUT,PLAIN,HEX. :10-32 X 0.25 INCH,BRS	80009	220-0561-00
					---*---		
-148	337-1240-00		1		SHIELD,ELEC:VERTICAL INTERFACE	80009	337-1240-00
-149	-----		1		CKT BOARD ASSY:VERTICAL INTERFACE(SEE A4 EPL)		
-150	131-0589-00		2		.CONTACT,ELEC:0.46 INCH LONG	22526	47350
-151	136-0263-03	BO10100 B080944	16		.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B080945	16		.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-152	136-0350-00		12		. SOCKET,PLUG-IN:3 PIN,LOW PROFILE	80009	136-0350-00
-153	211-0155-00		2		.SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-154	361-0238-00		2		.SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-155	670-0625-00		1		CKT BOARD ASSY:TRIGGER SELECTOR (SEE A3 EPL)	80009	670-0625-00
	388-1156-00		1		.		
-156	136-0220-00		6		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-157	136-0260-02		2		.SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
-158	136-0263-03		19		.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
-159	214-0579-00		13		.TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-160	211-0155-00		2		.SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-161	361-0238-00		2		. SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-162	-----		1		CKT BOARD ASSY:HORIZ INTERFACE(SEE A8 EPL)		
-163	136-0220-00		2		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-164	136-0260-02		1		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
-165	136-0263-03	B010100 B080944	1		.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B080945	1		. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-166	214-0579-00		4		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00

REV. G JULY 1978

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
2-167	211-0155-00			2		. SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-168	361-0238-00			2		. SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-169	179-1604-00			1		. WIRING HARNESS:MAIN INTERFACE	80009	179-1604-00
-170	131-0512-02			112		.CONTACT,ELEC:0.315 INCH LONG	00779	61491-1
	131-0740-01			29		CONNECTOR,TERM:FOR 18-20 AWG WIRE	00779	61942-1
	131-0755-01			31		.CONTACT,ELEC:FOR 28-32 AWG WIRE	00779	61515-1
-171	131-0819-00			7		. CONNECTOR,TERM:FOR 20-24 AWG WIRE	80009	131-0819-00
-172	131-0707-00			43		CONNECTOR,TERM. :0.48" L,22-26AWG WIRE	22526	75691-005
	131-0708-00			1		CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
-173	131-0621-00			90		.CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	75694-006
-174	131-0818-00			3		. CONNECTOR,RCPT,:BNC,FEMALE	91836	KC19-153BNC
-175	352-0161-04			1		.CONN BODY,PL,EL:3 WIRE YELLOW	80009	352-0161-04
	352-0161-01			1		.CONN BODY,PL,EL:3 WIRE BROWN	80009	352-0161-01
-176	352-0162-05			1		.CONN BODY,PL,EL:4 WIRE GREEN	80009	352-0162-05
-177	352-0163-00			1		.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
	352-0163-02			1		.CONN BODY,PL,EL:5 WIRE RED	80009	352-0163-02
	352-0163-09			1		.CONN BODY,PL,EL:5 WIRE WHITE	80009	352-0163-09
-178	352-0164-06			1		.CONN BODY,PL,EL:6 WIRE BLUE	80009	352-0164-06
-179	352-0166-00			1		.CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00
	352-0166-03			1		.CONN BODY,PL,EL:8 WIRE ORANGE	80009	352-0166-03
-180	352-0167-07			1		.CONN BODY,PL,EL:9 WIRE VIOLET	80009	352-0167-07
-181	352-0198-00			1		.CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0198-00
-182	352-0201-00			5		.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-183	352-0204-00			7		.CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
-184	352-0206-00			3		. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0206-00
	195-0081-00			1		LEAD SET,CRT:	80009	195-0081-00
	131-0512-02			2		. CONTACT,ELEC:0.315 INCH LONG	00779	61491-1
	131-0865-00			6		. CONTACT,ELEC:0.450 INCH L	80009	131-0865-00
-185	351-0287-00			4		GUIDE,PL-IN UNI :FRONT,BLACK DELRIN (ATTACHING PARTS FOR EACH)	80009	351-0287-00
-186	213-0088-00			2		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL ---*---	83385	OBD
-187	351-0288-00			3		GUIDE,PL-IN UNI:REAR,BLACK DELRIN (ATTACHING PARTS FOR EACH)	80009	351-0288-00
	213-0088-00			2		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL ---*---	83385	OBD

REV. C JULY 1978

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

DISTRIBUTION:

Active Army:

HISA (Ft Monmouth) (21)
USAINSCOM (2)
COE (1)
TSG (1)
USAARENBD (1)
DARCOM (1)
TRADOC (2)
OS Maj Comd (4)
TECOM (2)
USACC (4)
MDW (1)
Armies (2)
Corps (2)
Svc Colleges (1)
USASIGS (5)
USAADS
USAFAS (2)
USAARMS (2)
USAIS (2)
USAES (2)

USAICS (3)
MAAG (1)
USARMIS (1)
USAERDAA (1)
USAERDAW (1)
Ft Gordon (10)
Ft Carson (5)
Army Dep (1) except
 SAAD (30)
 TOAD (14)
 SHAD (2)
Ft Gillem (10)
USA Dep (1)
Sig Sec USA Dep (1)
Ft Richardson (CERCOM Ofc) (2)
Units org under fol TOE:
 (2 copies each unit)
 29-207
 29-610

ARNG: None

USAR: None

For explanation of abbreviations used, see AR 310-50.

DEPARTMENT OF THE ARMY
US ARMY AG PUBLICATIONS CENTER
1655 WOODSON ROAD
ST. LOUIS, MISSOURI 63114

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314



Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
3-1	-----		1		CKT BOARD ASSY:HORIZ OUTPUT (SEE A9 EPL)		
-2	136-0183-00		4		•SOCKET, PLUG-IN:3 PIN, ROUND	80009	136-0183-00
-3	136-0220-00		10		•SOCKET, PLUG-IN:3 PIN, SQUARE	71785	133-23-11-034
-4	136-0263-03	B010100 B080944	12		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B080945	12		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-5	214-0579-00		7		•TERM., TEST PT:0.40 INCH LONG	80009	214-0579-00
-6	214-0668-00		2		HEAT SINK, ELEC:FOR TO-513103	2211B	
-7	211-0155-00		4		•SCREW, EXT, RLV B:4-40X 0.375	INCH, SST	80009 211-0155-
00							
-8	361-0238-00		4		•SPACER, SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-9	-----		1		•CKT BOARD ASSY:VERT OUTPUT(SEE A6 EPL)		
-10	136-0263-03	B010100 B080944	7		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B080945	7		•SOCKET, PIN TERM:FOR 0.025 INCH •SQUARE PIN	22526	48059
-11	136-0350-00		12		•SOCKET, PLUG-IN:3 PIN, LOW PROFILE	80009	136-0350-00
-12	214-0579-00		6		•TERM., TEST PT:0.40 INCH LONG	80009	214-0579-00
-13	200-0945-00		1		•COVER, HALF XSTR:FOR DUAL TO-18 CASE	80009	200-0945-00
-14	200-0945-01		1		•COVER, HALF XSTR:FOR DUAL TO-18 CS, 2-56 THD	80009	200-0945-01
-15	211-0001-00		1		•SCREW, MACHINE:2-56 X 0.25 INCH, PNH STL	83385	OBD
-16	211-0155-00		3		•SCREW, EXT, RLV B:4-40 X 0.375 INCH, SST	80009	211-0155-00
-17	361-0238-00		3		•SPACER, SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-18	441-0973-00		1		CHASSIS, SCOPE:VERTICAL AMPLIFIER (ATTACHING PARTS)	80009	441-0973-00
	211-0507-00		6		SCREW, MACHINE:6-32 X 0.312 INCH, PNH STL	83385	OBD
	210-0457-00		6		NUT, PLAIN, EXT W:6-32 X 0.312 INCH, STL	83385	OBD
	211-0504-00		2		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-19	131-0235-00		2		TERMINAL, STUD:0.213 DIA X 0.455 INCH L	88245	420977-9
	358-0136-00		2		INSULATOR, BSHG:	88245 420971	
-20	210-0202-00		1		TERMINAL, LUG:SE #6 (ATTACHING PARTS)	78189 2104-06-00-2520N	
-21	213-0088-00		1		SCR, TPG, THD CTG:4-24 X 0.25 INCH, PNH STL	83385	OBD
-22	407-0865-00		1		BRACKET, CMPNT: (ATTACHING PARTS)	80009 407-0865-00	
-23	213-0088-00		2		SCR, TPG, THD CTG:4-24 X 0.25 INCH, PNH STL	83385	OBD
-24	214-1138-00		2		HEAT SINK, ELEC:TRANSISTOR, 1 INCH OD, AL	80009	214-1138-00
-25	352-0062-00		2		HOLDER, HEAT SK:1.187 X 1.187 INCHES, PLSTC	80009	352-0062-00
-26	211-0008-00		4		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL	83385	OBD
-27	211-0012-00		4		SCREW, MACHINE:4-40 X 0.375 INCH, PNH STL	83385	OBD
-28	210-0406-00		8		NUT, PLAIN, HEX. :4-40 X 0.188 INCH, BRS	73743	2X12161-402
-29	343-0097-00		2		RTNR, TRANSISTOR:HEAT SINK	80009	343-0097-00
-30	210-0627-00		2		RIVET, SOLID:0.042 DIA X 0.25 INCH, RDH	80009	210-0627-00
-31	214-0368-00		2		SPRING, HLCP:0.24 DIA X 0.438 INCH LONG	80009	214-0368-00
-32	210-0599-00		4		NUT, SLEEVE:4-40 X 0.391 INCH LONG	80009	210-0599-00
-33	441-0976-00		1		CHASSIS, SCOPE:HORIZONTAL AMPLIFIER (ATTACHING PARTS)	80009	441-0976-00
-34	211-0504-00		4		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-35	348-0063-00		3		GROMMET, PLASTIC:0.50 INCH DIA	80009	348-0063-00
-36	131-0513-02		23		TERM, FEED THRU:0.83 L X 0.025 SQ EA END	00779	1-86074-4
-37	131-0513-03		7		TERM, FEED THRU:0.89 L X 0.025 SQ EA END	00779	1-86074-3
-38	337-1150-01		1		SHIELD, CRT:PAINTED	80009 337-1150-01	
-39	-----		1		COIL:(SEE EPL) (ATTACHING PARTS)		
-40	343-0217-00		1		CLAMP, COIL:Y-AXIS	80009 343-0217-00	
-41	213-0138-00		2		SCR, TPG, THD FOR:4-40 X 0.188 INCH, PNH STL	83385	OBD
-42	348-0216-00		1		SHLD GSKT, ELEK:MESH TYPE, RING, 5.25 ID	07700	30-9004V
-43	354-0347-00		1		RING, CRT CLAMP: (ATTACHING PARTS)	80009 354-0347-00	
-44	211-0170-00		2		SCREW, MACHINE:4-40 X 2.75	INCH, PNH STL	83385 OBD
-45	214-1333-00		2		SPRING, HLCP:0.213 OD X 0.375 INCH LONG	80009	214-1333-00

REV. B JULY 1978

Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
01	3-46	343-0205-01	1		RTNR, ELECTRON TU:3.0 DIA X 1.5 L, DELRIN		80009 343-0205-
					(ATTACHING PARTS)		
	-47	211-0507-00	4		SCREW, MACHINE:6-32 X 0.312 INCH, PNH STL		83385 OBD
	-48	210-0949-00	4		WASHER, FLAT:O.141 ID X 0.50 INCH OD, BRS		12327 OBD
00	-49	214-0291-00	1		CONTACT, SPRING:1.188 X 0.375 X 0.25 INCH		80009 214-0291-
					(ATTACHING PARTS)		
	-50	211-0008-00	1		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL		83385 OBD
	-51	210-0201-00	1		TERMINAL, LUG:SE #4 86928 OBD		
	-52	210-0586-00	1		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
	-53	407-0864-00	1		BRACKET, CRT : 80009	407-0864-00	
					(ATTACHING PARTS)		
	-54	211-0507-00	4		SCREW, MACHINE:6-32 X 0.312 INCH, PNH STL		83385 OBD
	-55	-----	1		CKT BOARD ASSY:HV/Z AXIS AMPL(SEE ALL EPL)		
	-56	136-0220-00	7		• SOCKET, PLUG-IN:3 PIN, SQUARE	71785	133-23-11-034
	-57	136-0183-00	4		• SOCKET, PLUG-IN:3 PIN, ROUND	80009	136-0183-00
	-58	214-0668-00	1		•HEAT SINK, ELEC:FOR TO-5 13103	2211B	
	-59	214-0579-00	11		•TERM., TEST PT:0.40 INCH LONG	80009	214-0579-00
	-60	136-0263-03	20	B010100 B080944	•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
		136-0263-04	20	B080945	•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
	-61	211-0155-00	4		•SCREW, EXT, RLV B:4-40 X 0.375 INCH, SST	80009	211-0155-00
00	-62	361-0238-00	4		•SPACER, SLEEVE:0.25 OD X 0.34 INCH LONG		80009 361-0238-
	-63	441-0974-00	1		CHASSIS, SCOPE:Z AXIS	80009 441-0974-00	
					(ATTACHING PARTS)		
	-64	211-0504-00	6		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL		83385 OBD
	-65	348-0056-00	2		GROMMET, PLASTIC:0.375 INCH DIA	80009	348-0056-00
	-66	-----	1		RESISTOR, VAR:(SEE EPL)		
					(ATTACHING PARTS)		
402	-67	210-0583-00	1		NUT, PLAIN, HEX. :0.25-32 X 0.312 INCH, BRS		73743 2X20224-
00-0541C-I	-68	210-0046-00	1		WASHER, LOCK:INTL, 0.26 ID X 0.40" OD, STL		78189 1214-05-
	-69	441-0972-00	1		CHASSIS, SCOPE:HIGH VOLTAGE	80009	441-0972-00
					(ATTACHING PARTS)		
	-70	211-0507-00	3		SCREW, MACHINE:6-32 X 0.312 INCH, PNH STL		83385 OBD
	-71	200-1169-00	1		COVER, HV: 80009	200-1169-00	
					(ATTACHING PARTS)		
	-72	211-0504-00	3		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL		83385 OBD
		621-0453-00	1		POWER SUPPLY:ASSEMBLY	80009	621-0453-00
	-73	200-0988-00	1		COVER, HV SUPPLY:PLASTIC	80009	200-0988-00
					(ATTACHING PARTS)		
	-74	211-0530-00	2		••SCREW, MACHINE:6-32 X 1.75 INCH, PNH STL		83385 OBD
	-75	211-0529-00	1		••SCREW, MACHINE:6-32 X 1.25 INCHES, PNH STL		83385 OBD
	-76	441-0879-00	1		••CHASSIS, HV BOX: 80009	441-0879-00	
	-77	124-0164-00	5		••STERMINAL BOARD:4 NOTCH, CERAMIC, STUD MTD	80009	124-0164-00
	-78	124-0176-00	2		••TERMINAL BOARD:4 NOTCH, CER, SW/O MTG STUD	80009	124-0176-00
	-79	124-0175-00	1		••TERMINAL BOARD:2 NOTCH, CER, SW/O MTG, STUD	80009	124-0175-00
	-80	124-0163-00	1		••TERMINAL BOARD:3 NOTCH CERAMIC, SSTUD MTG	80009	124-0163-00
00	-81	131-0403-00	1		••TERM, FEEDTHRU:BIFURCATED, TEFLON		80009 131-0403-
					SPRESS FIT		
	-82	136-0428-00	1		••SKT, PL-IN ELEK:ELECTRN TUBE, 11 SCONT, W/LEADS	80009	136-0428-00
	-83	131-0512-02	2		••CONTACT, ELEC:0.315 INCH LONG	00779	61491-1
	-84	343-0235-00	1		••SCLAMP, SOCKET: 80009	343-0235-00	
	-85	367-0117-00	1		••SPULL, SOCKET: 80009	367-0117-00	
	-86	337-1198-00	1		••SHLD, ELEC CONN:CRT SOCKET	80009	337-1198-00
	-87	200-0917-01	1		••SCOV, ELECTRON TU:2.052 OD X 0.291" THK, PLSTC	80009	200-0917-01
	-88	136-0304-02	1		••SOCKET, PLUG-IN:CRT, 14 PIN SOCKET, SW/PINS	80009	136-0304-02
	-89	346-0032-00	4		• STRAP, RETAINING:0.075 DIA X 4.0 L, MLD RBR		98159 2859-75-4
	-90	210-0966-00	8		•S WASHER, NONMETAL:0.312 ID X 0.875"	80009	210-0966-00

Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
3-91	210-1093-00		2		•WASHER, FLAT:0.188 ID X 0.312 OD X •S0.156 THK	83385	OBD
-92	119-0268-00		1		• MULTIPLIER, HV:5X, 21KVDC	80009	119-0268-00
-93	380-0166-00		1		S HSG, HV PWR SPLY: 80009 (ATTACHING PARTS)	380-0166-00	
-94	211-0008-00		3		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL	83385	OBD
-95	211-0507-00		3		SCREW, MACHINE:6-32 X 0.312 INCH, PNH STL	83385	OBD
-96	352-0217-00		1		HLD, ANODE CONN:U/W 0.5, HORIZ MT, BLACK PP (ATTACHING PARTS)	80009	352-0217-00
-97	210-0586-00		2		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-98	213-0088-00		1		SCR, TPG, THD CTG:4-24 X 0.25 INCH, PNH STL	83385	OBD
-99	----		2		TRANSISTOR:(SEE EPL) (ATTACHING PARTS FOR EACH)		
-100	213-0146-00		2		SCR, TPG, THD FOR:6-20 X 0.313 INCH, PNH STL	83385	OBD
-101	386-0978-00		2		INSULATOR, PLATE:0.002 INCH MICA, FOR TO-3	80009	386-0978-00
-102	136-0280-00		2		SOCKET, PLUG-IN:FOR TO-3 FOR TO-3 (ATTACHING PARTS FOR EACH)	97913	LST 2202-2
-103	211-0101-00		2		SCREW, MACHINE:4-40 X 0.25" 100 DEG, FLH STL	83385	OBD
-104	210-0586-00		2		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-105	210-0201-00		1		TERMINAL, LUG:SE #4 (ATTACHING PARTS)	86928 OBD	
-106	211-0008-00		1		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL	83385	OBD
-107	210-0586-00		1		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-108	131-0309-00 358-0241-00		4		TERMINAL, STUD:0.415 INCH LONG	88245	421572-02-9
-109	210-0201-00		4		INSULATOR, BSHG:0.05 ID X 0.125" OD, W/FLGE	88245	421565
			1		TERMINAL, LUG:SE #4 (ATTACHING PARTS)	86928 OBD	
-110	210-0586-00		1		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-111	348-0055-00		2		GROMMET, PLASTIC:0.25 INCH DIA	80009	348-0055-00

REV. C JULY 1978

Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
4-1	200-0981-01		1		COV, LINE V SEL:PLATED W/HARDWARE	80009	200-0981-01
-2	352-0102-00		2		•FUSEHOLDER:0.262"ID TUBE FOR CRTG FUSE 80009 (ATTACHING PARTS FOR EACH)		352-0102-00
-3	213-0088-00		2		•SCR, TPG, THD CTG:4-24 X 0.25 INCH, PNH STL 83385		OBD
-4	204-0373-01		1		BODY ASSY, LINE: 80009	204-0373-01	
-5	204-0374-01		1		BODY, FUSEHOLDER: 80009	204-0374-01	
-6	386-1561-00		1		PLATE, RING: 80009	386-1561-00	
					(ATTACHING PARTS)		
-7	211-0038-00		3		SCREW, MACHINE:4-40 X 0.312"100 DEG, 83385		OBD
					FLH STL		
-8	-----		1		THERMO CUTOUT: (SEE EPL) (ATTACHING PARTS)		
-9	211-0008-00		2		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL 83385		OBD
-10	210-0586-00		2		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL 78189		211-041800-00
-11	161-0046-00		1		CABLE ASSY, PWR, :MALE CONN, COILED 80009		161-0046-00
-12	358-0161-00		2		BSHG, STRAIN RLF:FOR 0.50 INCH HOLE, 28520		SR5P4
					PLASTIC		
-13	131-0775-00		2		CONTACT, ELEC:HEX, 0.25 INCH W/6-32 1 END 88245		1601-A
					(ATTACHING PARTS FOR EACH)		
-14	211-0503-00		1		SCREW, MACHINE:6-32 X 0.188 INCH, PNH STL 83385		OBD
-15	210-0202-00		1		TERMINAL, LUG:SE #6 78189	2104-06-00-2520N	
	119-0228-00		1		FILTER, LOW PASS:AC LINE 80009	119-0228-00	
-16	380-0171-00		1		•HSG, LINE FILTER: 80009	380-0171-00	
-17	131-0761-00		2		•TERMINAL STUD:SCREW MTG, FLAT TAB 71279		572-4897-01-0516
					(ATTACHING PARTS FOR EACH)		
-18	211-0504-00		1		•SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL 83385		OBD
-19	210-0006-00		1		•WASHER, LOCK:INTL, 0.146 IDX 0.288 OD, STL 78189		1206-00-00-0541C
-20	131-0761-00		1		•TERMINAL STUD:SCREW MTG, FLAT TAB 71279		572-4897-01-0516
					(ATTACHING PARTS)		
-21	211-0504-00		1		•SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL 83385		OBD
-22	210-0202-00		1		•TERMINAL, LUG:SE #6 78189	2104-06-00-2520N	
-23	346-0068-00		1		•BAND, RETAINING:1.78 X 0.25 X 0.125 80009		346-0068-00
					(ATTACHING PARTS)		
-24	211-0166-00	B010100 B029999	2		•SCREW, MACHINE:4-40 X 1.750, PNH, STL, 83385		OBD
					CD PL		
	211-0166-00	B030000	1		•SCREW, MACHINE:4-40 X 1.750, PNH, STL, 83385		OBD
					CD PL		
	211-0131-00	B030000	1		•SCREW, MACHINE:4-40 X 1.875 INCH, PNH 83385		OBD
-25	-----		1		•CAPACITOR: (SEE EPL) (ATTACHING PARTS)		
-26	213-0088-00		1		•SCR, TPG, THD CTG:4-24 X 0.25 INCH, PNH STL 83385		OBD
-27	-----		2		•CAPACITOR:(SEE EPL)		
-28	386-1902-00		1		PANEL, REAR: 80009	386-1902-00	
-29	200-1007-00		1		SHIELD, CAP:4.537 X 2.25, PLASTIC 80009		200-1007-00
-30	-----		2		CAPACITOR:(SEE EPL)		
-31	212-0518-00		4		SCREW, MACHINE:10-32 X 0.312 INCH, PNH STL 83385		OBD
-32	210-0228-00		5		TERMINAL, LUG:0.176 ID X 0.312"OD, SE 78189		2103-08-00-2520N
-33	386-1649-00		1		PLATE, BACKING: 80009	386-1649-00	
					(ATTACHING PARTS)		
-34	211-0016-00		1		SCREW, MACHINE:4-40 X 0.625 INCH, PNH STL 83385		OBD
-35	129-0230-00		1		SPACER, POST:1.375L, W/4-40THD EA END, 80009		129-0230-00
					BRAS		
-36	252-0571-00		FT		RUB.SPL SHAPED:CHANNEL, 2.0 FT LONG 77969		1353
-37	407-0651-00		1		BRACKET, CAP.: 80009	407-0651-00	
					(ATTACHING PARTS)		
-38	211-0619-00		2		SCREW, MACHINE:6-32 X 1.5 INCH, FLH STL 83385		OBD
-39	211-0553-00		4		SCREW, MACHINE:6-32 X 1.5 INCH, PNH STL 83385		OBD

REV. B JULY 1978

Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
4-40	337-1386-00		1		SHIELD, ELEC:POWER SWITCH (ATTACHING PARTS)	80009	337-1386-00
-41	211-0008-00		4		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL	83385	OBD
-42	129-0292-00		4		SPACER, POST:0.40 LONG X 0.25 INCH HEX	80009	129-0292-00
-43	210-0201-00		1		TERMINAL, LUG:SE #4 (ATTACHING PARTS)	86928 OBD	
-44	210-0586-00		1		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-45	-----		5		TRANSISTOR:(SEE EPL) (ATTACHING PARTS FOR EACH)		
-46	211-0537-00		1		SCREW, MACHINE:6-32 X 0.375 INCH, TRH STL	83385	OBD
-47	131-0739-00		1		TERMINAL, STUD:0.667 LONG X 0.312 HEX	80009	131-0739-00
-48	210-0935-00		2		WASHER, NONMETAL:FIBER, 0.14 IDX 0.375"OD	74921	OBD
-49	386-0978-00		1		INSULATOR, PLATE:0.002 INCH MICA, FOR TO-3	80009	386-0978-00
-50	210-0457-00		2		NUT, PLAIN, EXT W:6-32 X 0.312 INCH, STL	83385	OBD
-51	-----		2		TRANSISTOR:(SEE EPL) (ATTACHING PARTS FOR EACH)		
-52	211-0537-00		1		SCREW, MACHINE:6-32X 0.375 INCH, TRH STL	83385	OBD
-53	131-0739-00		1		TERMINAL, STUD:0.667 LONG X 0.312 HEX	80009	131-0739-00
-54	210-0935-00		2		WASHER, NONMETAL:FIBER, 0.14 IDX 0.375"OD	74921	OBD
-55	386-0143-00		1		INSULATOR, PLATE:0.002 INCH MICA, FOR TO-2	02735	DF31A
-56	210-0457-00		2		NUT, PLAIN, EXT W:6-32 X 0.312 INCH, STL	83385	OBD
-57	441-0977-00		1		CHASSIS, SCOPE:LOW VOLTAGE REG, REAR (ATTACHING PARTS)	80009	441-0977-00
-58	212-0004-00		4		SCREW, MACHINE:8-32 X 0.312 INCH, PNH STL	83385	OBD
-59	129-0291-00		4		SPACER, POST:5.78 LONG X 0.312 HEX	80009	129-0291-00
-60	343-0213-00		1		CLAMP, LOOP:PRESS MT, PLASTIC	80009	343-0213-00
-61	131-0737-00		26		TERM, FEEDTHRU:1.275 LONG X 0.188	OD 80009	131-0737-00
-62	131-0682-00		53		TERM, FEEDTHRU:1.384 LONG X 0.025 SQ EA END	80009	131-0682-00
-63	210-0202-00		1		TERMINAL, LUG:SE #6 (ATTACHING PARTS)	78189 2104-06-00-2520N	
-64	211-0504-00		1		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-65	-----		1		CKT BOARD ASSY:PWR CONN(SEE A16	EPL)	
-66	131-0608-00		18		TERMINAL, PIN:0.365 L X 0.25 PH, BRZ, GOLD PL	22526	47357
	131-0827-00		30		CONTACT, ELEC:0.55 INCH LONG	22526	47349
	131-0589-00		2		CONTACT, ELEC:0.46 INCH LONG (ATTACHING PARTS FOR CKT BD)	22526	47350
-67	213-0055-00		8		SCR, TPG, THD FOR:2-32 X 0.188 INCH, PNH STL	93907	OBD
-68	352-0076-00		1		FUSEHOLDER:W/HARDWARE (ATTACHING PARTS)	75915	342012-L
-69	210-0873-00		1		WASHER, NONMETAL:0.5 ID X 0.688 INCH OD , NPRN	70485	OBD
-70	-----		1		CKT BOARD ASSY:LV REGULATOR(SEE A15S	EPL)	
-71	136-0183-00		1		•SOCKET, PLUG-IN:3 PIN, ROUND	80009	136-0183-00
-72	136-0220-00		13		•SOCKET, PLUG-IN:3 PIN, SQUARE	71785	133-23-11-034
-73	136-0235-00		5		•SOCKET, PLUG-IN:6 CONTACT, ROUND	71785	133-96-12-062
-74	136-0263-03	B010100 B080944	39		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
	136-0263-04	B080945	39		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-75	214-0579-00		8		•TERM., TEST PT:0.40 INCH LONG	80009	214-0579-00
-76	136-0254-01		17		•SOCKET, PIN TERM:0.145 INCH LONG	00779	1-331892-8
-77	136-0338-01		4		•SOCKET, PIN TERM:	00779 1-332075-7	
-78	-----	B010100 B069999X	1		•METER, T TOLTZ:(SEE M941	EPL)	
					(ATTACHING PARTS)		
-79	166-0292-00	B010100 B069999X	2		•SPACER, SLEEVE:PLSTC, 0.155 DIA X 0.065"L	80009	166-0292-00
-80	136-0286-00		6		•SOCKET, PIN TERM:U/W 0.031 TO 0.062 PINS	00779	85488-2
-81	344-0154-00		8		•CLIP, ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00

REV. B JULY 1978

Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
4-82	211-0155-00		3		•SCREW, EXT, RLV B:4-40 X 0.375 INCH, SST	80009	211-0155-00
-83	361-0238-00		3		•SPACER, SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-84	380-0231-00		1		HSG, PWR SUPPLY: 80009 (ATTACHING PARTS)	380-0231-00	
-85	211-0507-00		6		SCREW, MACHINE:6-32 X 0.312 INCH, PNH STL	83385	OBD
-86	386-1907-00		1		COVER, PWR SPLY: 80009 (ATTACHING PARTS)	386-1907-00	
-87	211-0071-00		4		SCREW, MACHINE:4-40 X 0.375 1NCH, TRH, STL	83385	OBD
-88	-----		1		CKT BOARD ASSY:INVERTER(SEE A13 EPL)		
-89	214-0579-00		5		•TERM. , TEST PT:0.40 INCH LONG	80009	214-0579-00
-90	344-0189-00		1		•CLIP, CMPNT MTG:U/W 0.687 OD CMPNT, PLASTIC (ATTACHING PARTS)	80009	344-0189-00
-91	211-0008-00		1		•SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL	83385	OBD
-92	210-0586-00		1		•NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-93	337-1186-00		1		•SHIELD, ELEC:INVERTER 80009 (ATTACHING PARTS)	337-1186-00	
-94	211-0116-00		4		•SCR, ASSEM WSHR:4-40 X 0.312 INCH, PNH BRS	83385	OBD
-95	-----		2		•TRANSISTOR: (SEE EPL) (ATTACHING PARTS FOR EACH)		
-96	210-0406-00		2		•NUT, PLAIN, HEX.:4-40 X 0.188 INCH, BRS	73743	2X12161-402
-97	210-0004-00		2		•WASHER, LOCK:INTL, 0.12 ID X 0.26"OD, STL	78189	1204-00-00-0541C
-98	355-0518-02		2		•STUD, PRESSMOUNT:4-40 X 0.625 INCH, BRASS	80009 355-0518-02	
-99	136-0254-01		4		•SOCKET, PIN TERM:0.145 INCH LONG	00779	1-331892-8
-100	214-1194-00	B010100 B059999	1		•HEAT SINK, XSTR: (2) TO-3 PORCELAIN	80009	214-1194-00
	214-1581-00	B060000	1		•HEAT SINK, XSTR:TO-3 ALUMINA	80009	214-1581-00
	211-0540-00	B060000	4		•SCREW, MACHINE:6-32 X 0.50 INCH, TRH STL	83385	OBD
	407-0957-00	B060000	1		•BRACKET, HEAT SK: 80009 (ATTACHING PARTS FOR CKT BD)	407-0957-00	
-101	211-0512-00	B010100 B059999	5		SCREW, MACHINE:6-32 X 0.50" 100 DEG, FLH STL	83385	OBD
	211-0504-00	B060000	5		SCREW, MACHINE: :6-32 X 0.25 INCH, STL	83385	OBD
-102	210-0457-00	B010100 B059999X	5		NUT, PLAIN, EXT W:6-32 X 0.312 INCH, STL	83385	OBD
-103	211-0116-00		2		SCR, ASSEM WSHR:4-40 X 0.312 INCH, PNH BRS	83385	OBD
-104	-----		1		CKT BOARD ASSY:RECTIFIER(SEE A14 EPL)		OBD
-105	136-0183-00		1		•SOCKET, PLUG-IN:3 PIN, ROUND	80009	136-0183-00
-106	136-0220-00		8		•SOCKET, PLUG-IN:3 PIN, SQUARE	71785	133-23-11-034
-107	214-0579-00		5		•TERM., TEST PT:0.40 INCH LONG	80009	214-0579-00
-108	136-0263-00	B010100 B080944	12		•SOCKET, PIN TERM:U/W 0.025	SQ PIN	00779 85861-3
	136-0263-04	B080945	12		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-109	214-0269-00		1		•HEAT SINK, XSTR:0.312 DIA X 0.75 L	98978	TXD-032-75
-110	-----		2		DIODE:(SEE EPL) (ATTACHING PARTS FOR EACH)		
-111	210-0410-00		1		•NUT, PLAIN, HEX. :10-32 X 0.312 INCH, BRS	73743	2X20003-402
-112	210-0010-00		1		•WASHER, LOCK:INT, 0.20 ID X0.376" OD, STL	78189	1210-00-00-0541C
-113	210-0805-00		1		•WASHER, FLAT:0.204 ID X 0.438 INCH OD, STL	12327	OBD
-114	-----		1		•TRANSISTOR: (SEE EPL) (ATTACHING PARTS)		
-115	210-0586-00		2		•NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-116	355-0146-00		2		•STUD, PRESSMOUNT:4-40 X 0.35 INCH, BRS	80009	355-0146-00
-117	136-0338-01		2		•SOCKET, PIN TERM: 00779	1-332075-7	
-118	136-0286-00		34		•SOCKET, PIN TERM:U/W 0.031	TO 0.062	PINS 00779
85448-2							
-119	211-0155-00		3		•SCREW, EXT, RLV B:4-40 X 0.375 INCH, SST	80009	211-0155-00
-120	361-0238-00		3		•SPACER, SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-121	-----		1		CKT BOARD ASSY:LINE INPUT(SEE A12 EPL)		
-122	136-0286-00		3		•SOCKET, PIN TERM:U/W 0.031 TO 0.062 PINS	00779	85861-3
-123	136-0263-03	B010100 B080944	2		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2

REV. C JULY 1978

Replaceable Mechanical Parts-R7704

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-	136-0263-04	B080945	2		•SOCKET, PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-124	343-0043-00		1		•CLAMP, LOOP:#20, NEON BULBS	80009	343-0043-00
-125	211-0155-00		2		•SCREW, EXT, RLV B:4-40 X 0.375 INCH, SST	80009	211-0155-00
-126	361-0238-00		2		•SPACER, SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-127	214-1525-00		1		HEAT SINK, DIODE:0.188 DIA HOLE (ATTACHING PARTS)	80009	214-1525-00
-128	210-0586-00		3		NUT, PLAIN, EXT W:4-40 X 0.25 INCH, STL	78189	211-041800-00
-129	441-0893-00		1		CHASSIS, SCOPE:POWER SUPPLY (ATTACHING PARTS)	80009	441-0893-00
-130	211-0504-00		2		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-131	386-1556-00		4		SPACER, CKT CARD:0.215 BD HT, PLASTIC	80009	386-1556-00
-132	210-0202-00		1		TERMINAL, LUG:SE #6 (ATTACHING PARTS)	78189 2104-06-00-2520N	
-133	211-0504-00		1		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-134	210-0457-00		1		NUT, PLAIN, EXT W:6-32 X 0.312 INCH, STL	83385	OBD
-135	119-0229-00		1		POWER SUPPLY:	80009 119-0229-00	
-136	-----		1		•CAPACITOR:(SEE EPL) (ATTACHING PARTS)		
-137	344-0118-00 211-0504-00 211-0511-00 210-0457-00	XB081288 B010100 B081287 B081288 XB081288	1 2 1 1		•CLIP, SPG TENS:CAPACITOR MTG •SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL •SCREW, MACHINE:6-32 X 0.50 INCH, PNH STL •NUT, PLAIN, EXT W:6-32X 0.312 INCH, STL (ATTACHING PARTS)	80033 83385 83385 83385	E50008-044 OBD OBD OBD
-138	213-0144-00		8		SCREW, TPG, TF:8-18 X 0.5 INCH, TRH, STL	83385	OBD
-139	179-1605-00		1		WIRING HARNESS :POWER	80009 179-1605-00	
-140	131-0512-02 131-0740-01 131-0755-01		49 10 1		•CONTACT, ELEC:0.315 INCH LONG •CONNECTOR, TERM:FOR 18-20 AWG WIRE •CONTACT, ELEC:FOR 28-32 AWG WIRE	00779 00779 00779	61491-1 61942-1 61615-1
-141	131-0819-00 31-0707-00 131-0708-00		25 21 1		•CONNECTOR, TERM:FOR 2-24AWG WIRE •CONNECTOR, TERM. :0.48" L, 22-26AWG WIRE •CONTACT, ELEC:0.48"L, 28-32 AWG WIRE	80009 22526 22526	131-0819-00 75691-005 47437
-142	352-0169-01		1		•CONN BODY, PL, EL:2 WIRE BROWN	80009	352-0169-0
-143	352-0161-05 352-0161-00 352-0161-09		1 1 1		•CONN BODY, PL, EL:3 WIRE GREEN •CONN BODY, PL, EL:3 WIRE BLACK •CONN BODY, PL, EL:3WIRE WHITE	80009 80009 80009	352-0161-05 352-0161-00 352-0161-09
-144	352-0162-03 352-0162-07		1 1		•CONN BODY, PL, EL:4 WIRE ORANGE •CONN BODY, PL, EL:4 WIRE VIOLET	80009 80009	352-0162-03 352-0162-07
-145	352-0164-06 179-1606-00 131-0707-00 352-0169-04		1 1 5 1		•CONN BODY, PL, EL:6 WIRE BLUE WIRING HARNESS :POWER •CONNECTOR, TERM. :0.48" L, 22-26AWG WIRE •CONN BODY, PL, EL:2 WIRE YELLOW	80009 179-1606-00 22526 80009	352-0164-06 179-1606-00 75691-005 352-0169-04
-146	352-0163-02 131-0512-02		1 6		•CONN BODY, PL, EL:5 WIRE RED CONTACT, ELEC:0.315 INCH LONG	80009 00779	352-0163-02 61491-1
-147	131-0738-00 179-1469-00		1 1		CONNECTOR, TERM:FOR 18-20 AWG WIRE WIRING HARNESS:AC POWER	00779 80009	61616-2 179-1469-00
-148	343-0150-00		1		CLAMP, TIE DOWN: (ATTACHING PARTS)	95987 OBD	
-149	211-0504-00		1		SCREW, MACHINE:6-32X 0.25INCH, PNH STL	83385	OBD
-150	-----		2		DIODE:(SEE EPL) (ATTACHING PARTS FOR EACH)		
-151	220-0410-00		1		NUT, EXTENDED WA:10-32 X 0.375 INCH, STL	83385	OBD
-152	210-0224-00		1		TERMINAL, LUG:0.20 ID X 0.344 OD, SE, BRS	86928	A373-148-1
-153	210-0909-00		1		WASHER, NONMETAL:0.196 ID X 0.625" OD, MICA	71400	OBD
-154	210-0813-00		1		WSHR, SHOULDERED:# 10 FIBER	74921	OBD

REV. D JULY 1978

Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
5-1	200-1168-00		1		COVER, VERT AMP: 80009 (ATTACHING PARTS)	200-1168-00	
-2	211-0504-00		9		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-3	351-0007-00		1		SLIDE SECT, DWR:TILT-LOCK, PAIR (ATTACHING PARTS)	98376	TKLA-20
-4	212-0004-00	B010100 B050269	12		SCREW, MACHINE:8-32 X 0.312 INCH, PNH STL	83385	OBD
	212-0004-00	B050270	6		SCREW, MACHINE:8-32 X 0.312 INCH, PNH STL	83385	OBD
	212-0070-00	B050270	6		SCREW, MACHINE:8-32 X 0.312"100 DEG, FLH STL	83385	OBD
-5	210-0458-00		12		NUT, PLAIN, EXT W:8-32 X 0.344 INCH, STL	83385	OBD
-6	260-1195-00		1		SWITCH, SLIDE:DP3T, 0.5A, 125VAC (ATTACHING PARTS)	82389	XW-3029
-7	211-0008-00		2		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL	83385	OBD
-8	210-0406-00		2		NUT, PLAIN, HEX. :4-40 X 0.188 INCH, BRS	73743	2X12161-402
-9	390-0180-00		1		COVER, SCOPE:LEFT SIDE (ATTACHING PARTS)	80009 390-0180-00	
-10	212-0040-00		3		SCREW, MACHINE:8-32 X 0.375 100 DEG, FLH STL	83385	OBD
-11	210-0458-00		3		NUT, PLAIN, EXT W:8-32 X 0.344 INCH, STL	83385	OBD
-12	200-1179-00		1		COVER, SCOPE:TOP (ATTACHING PARTS)	80009 200-1179-00	
-13	211-0504-00		12		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-14	200-1180-00		1		COVER, SCOPE:BOTTOM (ATTACHING PARTS)	80009 200-1180-00	
-15	211-0504-00		12		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-16	390-0178-00		1		COVER, SCOPE:RIGHT SIDE (ATTACHING PARTS)	80009 390-0178-00	
-17	212-0045-00		2		SCREW, MACHINE:8-32 X 0.500 INCH, TRH, STL	83385	OBD
-18	210-0458-00		2		NUT, PLAIN, EXT W:8-32 X 0.344 INCH, STL	83385	OBD
_ =	212-0040-00		2		SCREW, MACHINE:8-32X 0.375 100 DEG, FLH STL	83385	OBD
-19	386-1889-00		1		PANEL, REAR: 80009	386-1889-00	
-20	136-0089-00		1		CONNECTOR, RCPT, :9 PIN CHASSIS MOUNT (ATTACHING PARTS)	02660	165-16
-21	211-0008-00		4		SCREW, MACHINE:4-40 X 0.25 INCH, PNH STL	83385	OBD
-22	131-0761-00		1		TERMINAL STUD:SCREW MTG, FLAT TAB (ATTACHING PARTS)	71279, 572-4897-01-0516	
-23	211-0504-00		1		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-24	210-0204-00		1		TERMINAL, LUG:0.146 INCH DIA DE, 45 DEG BEND	78189	2157-06-01-2520N
-25	131-0761-00		1		TERMINAL STUD:SCREW MTG, FLAT TAB (ATTACHING PARTS)	71279	572-4897-01-0516
-26	211-0504-00		1		SCREW, MACHINE:6-32 X 0.25 INCH, PNH STL	83385	OBD
-27	131-0955-00		2		CONNECTOR, RCPT, :BNC, FEMALE, W/HARDWARE	05091	31-279
-28	200-0678-00		1		COVER, ELEC CONN:BNC, SHORTING	91836	KC89-58TR5
	200-0991-00		1		COV, ELEC CONN:BNC, W/CTR GND	77820	2096-5
	346-0045-00		2		STRAP, CONN COV:PLASTIC	80009	346-0045-00
	129-0035-00		1		POST, BDG, ELEC: 80009	129-0035-00	
-29	200-0103-00		1		•NUT, PLAIN, KNURL:0.25-28 X 0.375" OD, BRASS		80009 200-0103-
00	-30	355-0507-00	1		•STUD, SHOULDERED:BINDING POST	80009	355-0507-00
		210-0046-00	1		•WASHER, LOCK:INTL, 0.26 ID X 0.40" OD, STL	78189	1214-05-00-0541C
		210-0455-00	1		•NUT, PLAIN, HEX. :0.25-28 X 0.375 INCH, BRASS		73743 3089-402
	-31	131-0771-00	1		CONNECTOR, RCPT, :4 CONT, QUICK DISCONNECT (ATTACHING PARTS)	0000A	ROA-304NYL
	-32	220-0551-00	1		NUT, PLAIN, HEX. :9 MM X 0.437 INCH	73743	OBD
	-33	134-0026-00	8		BUTTON, PLUG:FOR 0.375" HOLE	80112	1711-M

REV. D JULY 1978

Replaceable Mechanical Parts-R7704

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF DSCONT	QTY	1 2 3 4 5	NAME & DESCRIPTION	MFR. CODE	MFR PART NUMBER
5-34	380-0230-00		1		HSG, AXIAL FAN: 80009 (ATTACHING PARTS)	380-0230-00	
-35	211-0504-00		7		SCREW, MACHINE:6-32CX 0.25 INCH, PNH STL	83385	OBD
-36	378-0040-01		1		FILTER, ELEM, AIR:4.5 X 4.812 X 0.5 FOAM	80009	378-0040-01
-37	378-0788-00		1		GRILLE, FAN:5.714 X 5.36 X 0.063 INCH	80009	378-0788-00
-38	176-0276-00		FT		BRAID, WIRE 80009	176-0276-00	
-39	220-0603-00		1		NUT BAR:0.5 X 0.25 X 2.0 INCH (ATTACHING PARTS)	80009	220-0603-00
-40	211-0507-00		2		SCREW, MACHINE:6-32 X 0.312 INCH, PNH STL	83385	OBD
-41	-----		1		FAN, VENTILATING:(SEE B801 EPL) (ATTACHING PARTS)		
-42	211-0511-00		4		SCREW, MACHINE:6-32 X 0.50 INCH, PNH STL	83385	OBD
	210-0457-00		4		NUT, PLAIN, EXT W:6-32 X 0.312 INCH, STL	83385	OBD

REV. D JULY 1978

FIGURE 4 LV POWER SUPPLY (cont)

Ckt No.	Tektronix Part No.	Eff	Serial/Model No. Dscont	Q T Y						Description
					1	2	3	4	5	
4 -117	136-0338-01			2						SOCKET, terminal pin
-118	136-0286-00			34						SOCKET, terminal pin
-119	211-0155-00			3						SCREW, relieved shank, 4-40x0.375 inch
-120	361-0238-00			3						SPACER, sleeve
-121	670-0813-01	B010100	B029999	1						CIRCUIT BOARD ASSEMBLY-LINE INPUT A12
	670-0813-03	B030000	B039999	1						CIRCUIT BOARD ASSEMBLY-LINE INPUT A12
	670-0813-02	B040000		1						CIRCUIT BOARD ASSEMBLY-LINE INPUT A12
	-----	-								circuit board assembly includes:
	388-1404-00	B010100	B039999	1						CIRCUIT BOARD
	388-1404-02	B040000		1						CIRCUIT BOARD
-122	136-0286-00			3						SOCKET, terminal pin
-123	136-0263-03			2						SOCKET, pin terminal
-124	343-0043-00			1						CLAMP, neon
-125	211-0155-00			2						SCREW, relieved shank, 4-40x0.375 inch
-126	361-0238-00			2						SPACER, sleeve
-127	214-1525-00			1						HEAT SINK, diode
	-----	-		-						mounting hardware: (not included w/heat sink)
-128	210-0586-00			3						NUT, keps, 4-40 x 0.25 inch
-129	441-0893-00			1						CHASSIS, LV power supply
	-----	-		-						mounting hardware: (not included w/chassis)
-130	211-0504-00			2						SCREW, 6-32 x 0.25 inch, PHS
-131	386-1556-00			4						SUPPORT, circuit board
-132	210-0202-00			1						LUG, solder, SE #6
	-----	-		-						mounting hardware: (not included w/lug)
-133	211-0504-00			1						SCREW, 6-32 x 0.25 inch, PHS
-134	210-0457-00			1						NUT, keps, 6-32x0.312 inch
-135	119-0229-00			1						POWER SUPPLY
	-----	-		-						power supply includes
-136	-----	-		1						CAPACITOR
	-----	-		-						mounting hardware: (not included w/capacitor)
-137	211-0504-00			2						SCREW, 6-32x0.25 inch, PHS
	-----	-		-						mounting hardware: (not included w/power supply)
-138	213-0144-00			8						SCREW, sheet metal, #8 x 0.25 inch, THS
-139	179-1605-00			1						WIRING HARNESS-POWER
				-						wiring harness includes:
-140	131-0512-02			49						CONNECTOR, terminal, for 22 to 26 AWG
	131-0740-01			10						CONNECTOR, terminal, for 18 to 20 AWG
	131-0755-01			1						CONNECTOR, terminal, for 28 to 32 AWG
-141	131-0819-00			25						CONNECTOR, terminal, for 22 to 24 AWG
	131-0707-00			21						CONNECTOR, terminal, for 22 to 26 AWG
	131-0708-00			1						CONNECTOR, terminal, for 28 to 32 AWG

FIGURE 4 LV POWER SUPPLY (cont)

Ckt No.	Tektronix Part No.	Eff	Serial/Model No. Dscont	Q					Description	
				T	Y	1	2	3		4
4 -142	352-0169-01			1						HOLDER, terminal connector, 2 wire (brown)
-143	352-0161-05			1						HOLDER, terminal connector, 3 wire (green)
	352-0161-00			1						HOLDER, terminal connector, 3 wire (black)
	352-0161-09			1						HOLDER, terminal connector, 3 wire (white)
-144	352-0162-03			1						HOLDER, terminal connector, 4 wire (orange)
	352-0162-07			1						HOLDER, terminal connector, 4 wire (violet)
-145	352-0164-06			1						HOLDER, terminal connector, 6 wire (blue)
	179-1606-00			1						WIRING HARNESS-LINE VOLTAGE
	-----			-						wiring harness includes:
	131-0707-00			5						CONNECTOR, terminal, for 22 to 26 AWG
	352-0169-04			1						HOLDER, terminal connector, 2 wire (yellow)
-146	352-0163-02			1						HOLDER, terminal connector, 5 wire (red)
	131-0512-02			6						CONNECTOR, terminal, for 22 to 26 AWG
-147	131-0738-00			1						CONNECTOR, terminal, for 18 to 20 AWG
	179-1469-00			1						WIRING HARNESSAC
-148	343-0150-00			1						HOLD-DOWN, clamp, plastic
	-----			-						mounting hardware: (not included w/clamp)
-149	211-0504-00			1						SCREW, 6-32 x 0.25 inch, PHS
-150	-----			2						DIODE
	-----			-						mounting hardware for each: (not included w/diode)
-151	220-0410-00			1						NUT, keps, 10-32x0.375 inch
-152	210-0224-00			1						LUG, solder, SE #10, 0.865 inch long
-153	210-0909-00			1						WASHER, mica, 0.196 IDx0.625 inch OD
-154	210-0813-00			1						WASHER, fiber, #10

FIGURE 5

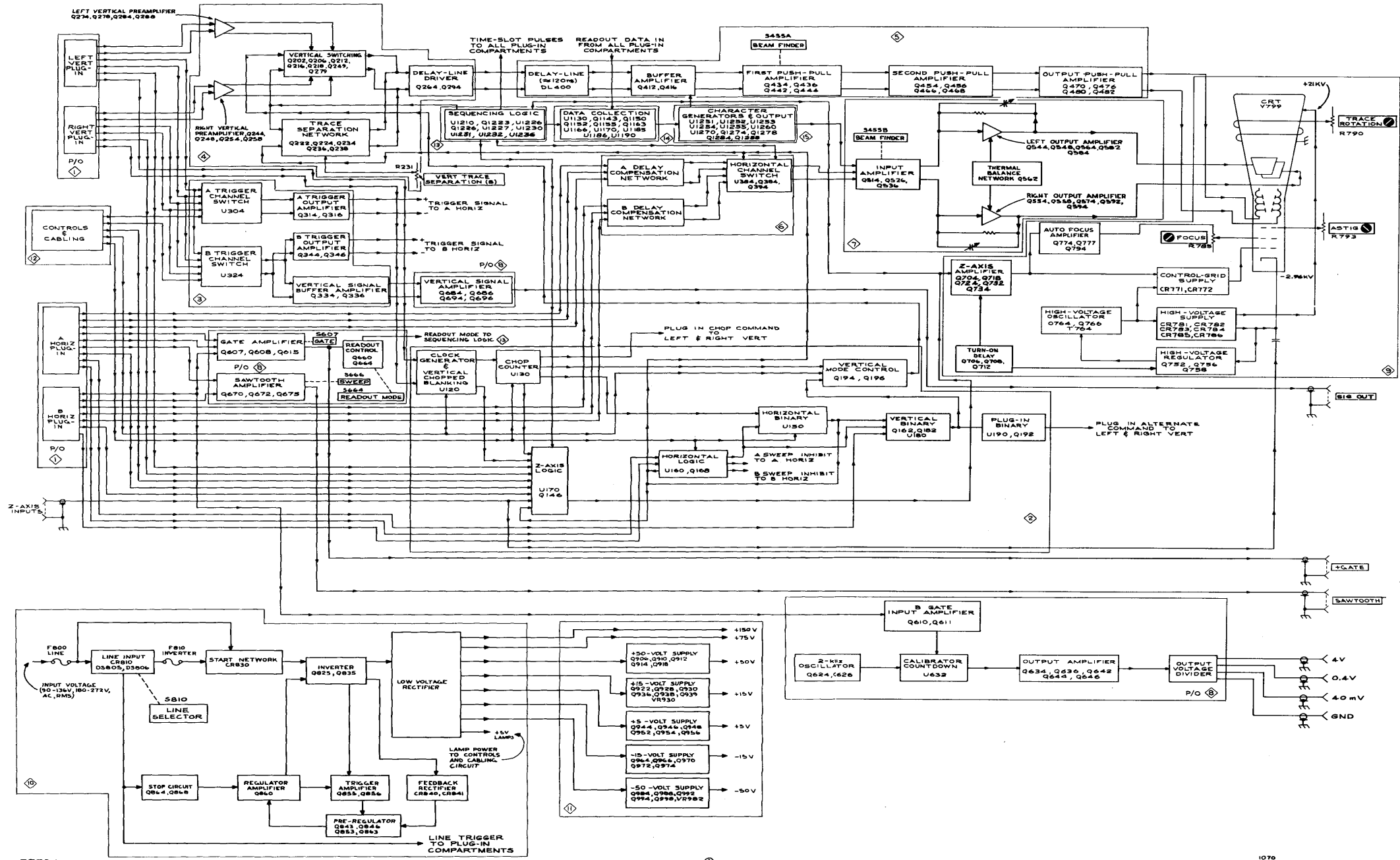
FIGURE 5 CABINET & REAR

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscnt	Q					Description	
				T	Y	1	2	3		4
5 -1	200-1168-00			1						COVER, vertical amplifier
	-----			-						mounting hardware: (not included w/cover)
-2	211-0504-00			9						SCREW, 6-32 x 0.25 inch, PHS
-3	351-0007-00			1						TRACK, slide out, chassis
	-----			-						mounting hardware: (not included w/track)
-4	212-0004-00	B010100	B050269	12						SCREW, 8-32 x 0.312 inch, PHS
	212-0004-00	B050270		6						SCREW, 8-32 x 0.312 inch, PHS
	212-0070-00	B050270		6						SCREW, 8-32 x 0.312 inch, 100° csk, FHS
-5	210-0458-00			12						NUT, keps, 8-32 x 0.344 inch
-6	260-1195-00			1						SWITCH, slide
				-						mounting hardware: (not included w/switch)
-7	211-0008-00			2						SCREW, 4-40 x 0.25 inch, PHS
-8	210-0406-00			2						NUT, hex., 4-40x0.188 inch
-9	390-0180-00			1						CABINET SIDE, left
	-----			-						mounting hardware: (not included w/cabinet side)
-10	212-0040-00			3						SCREW, 8-32x0.375 inch, 100° csk, FHS
-11	210-0458-00			3						NUT, keps, 8-32x0.344 inch
-12	200-1179-00			1						COVER, top
	-----			-						mounting hardware: (not included w/cover)
-13	211-0504-00			12						SCREW, 6-32 x 0.25 inch, PHS
-14	200-1180-00			1						COVER, bottom
	-----			-						mounting hardware: (not included w/cover)
-15	211-0504-00			12						SCREW, 6-32x0.25 inch, PHS
-16	390-0178-00			1						CABINET SIDE, right
	-----			-						mounting hardware: (not included w/cabinet side)
-17	212-0045-00			2						SCREW, 8-32 x 0.50 inch, THS
-18	210-0458-00			2						NUT, keps, 8-32 x 0.344 inch
	212-0040-00			2						SCREW, 8-32x0.375 inch, 100° csk, FHS
-19	386-1889-00			1						PANEL, rear
-20	136-0089-00			1						SOCKET, 9 pin chassis mount
	-----			-						mounting hardware: (not included w/socket)
-21	211-0008-00			4						SCREW, 4-40 x 0.25 inch, PHS
-22	131-0761-00			1						TERMINAL POST
	-----			-						mounting hardware: (not included w/terminal post)
-23	211-0504-00			1						SCREW, 6-32 x 0.25 inch, PHS
-24	210-0204-00			1						LUG, solder, DE #6

FIGURE 5

FIGURE 5 CABINET & REAR

Ckt No.	Tektronix Part No.	Serial/Model No.	Eff	Dscnt	Q	T	Y	1	2	3	4	5	Description
5-25	131-0761-00				1								TERMINAL POST
-													mounting hardware: (not included w/terminal post)
-26	211-0504-00				1								SCREW, 6-32 x 0.25 inch, PHS
-27	131-0955-00				2								CONNECTOR, receptacle, female BNC, w/hardware
-28	200-0678-00				1								COVER, BNC, non shorting
200-0991-00					1								COVER, BNC, shorting
346-0045-00					2								STRAP, plastic, BNC cover
129-0035-00					1								BINDING POST ASSEMBLY
----													binding post assembly includes:
-29	200-0103-00				1								CAP, binding post
-30	355-0507-00				1								STEM, binding post
210-0046-00					1								WASHER, lock, internal, 0.261 ID x 0.40 inch OD (not shown)
210-0455-00					1								NUT, hex., 0.25-28x0.375 inch (not shown)
-31	131-0771-00				1								CONNECTOR, receptacle, 4-contact
----													mounting hardware: (not included w/connector)
-32	220-0551-00				1								NUT, hex., 0.437 inch
-33	134-0026-00				8								PLUG
34	380-0230-00				1								HOUSING, fan, 5.04 x 5.38 inches
----													mounting hardware: (not included w/housing)
35	211-0504-00				7								SCREW, 6-32 x 0.25 inch, PHS
-36	378-0040-01				1								FILTER, air
-37	378-0788-00				1								SCREEN, fan, 5 x 5.34 inches
38	176-0276-00				ft								SHIELDING GASKET, braided, 3 feet long
39	220-0603-00				1								NUT BAR, 0.50 x 2 inches
----													mounting hardware: (not included w/nut bar)
-40	211-0507-00				2								SCREW, 6-32 x 0.312 inch, PHS
-41	119-0147-01				1								FAN ASSEMBLY
----													mounting hardware: (not included w/fan assembly)
-42	211-0511-00				4								SCREW, 6-32 x)0.50 inch, PHS
210-0457-00					4								NUT, keps, 6-32 x 0.312 inch (not shown)



R7704

1070
BLOCK DIAGRAM

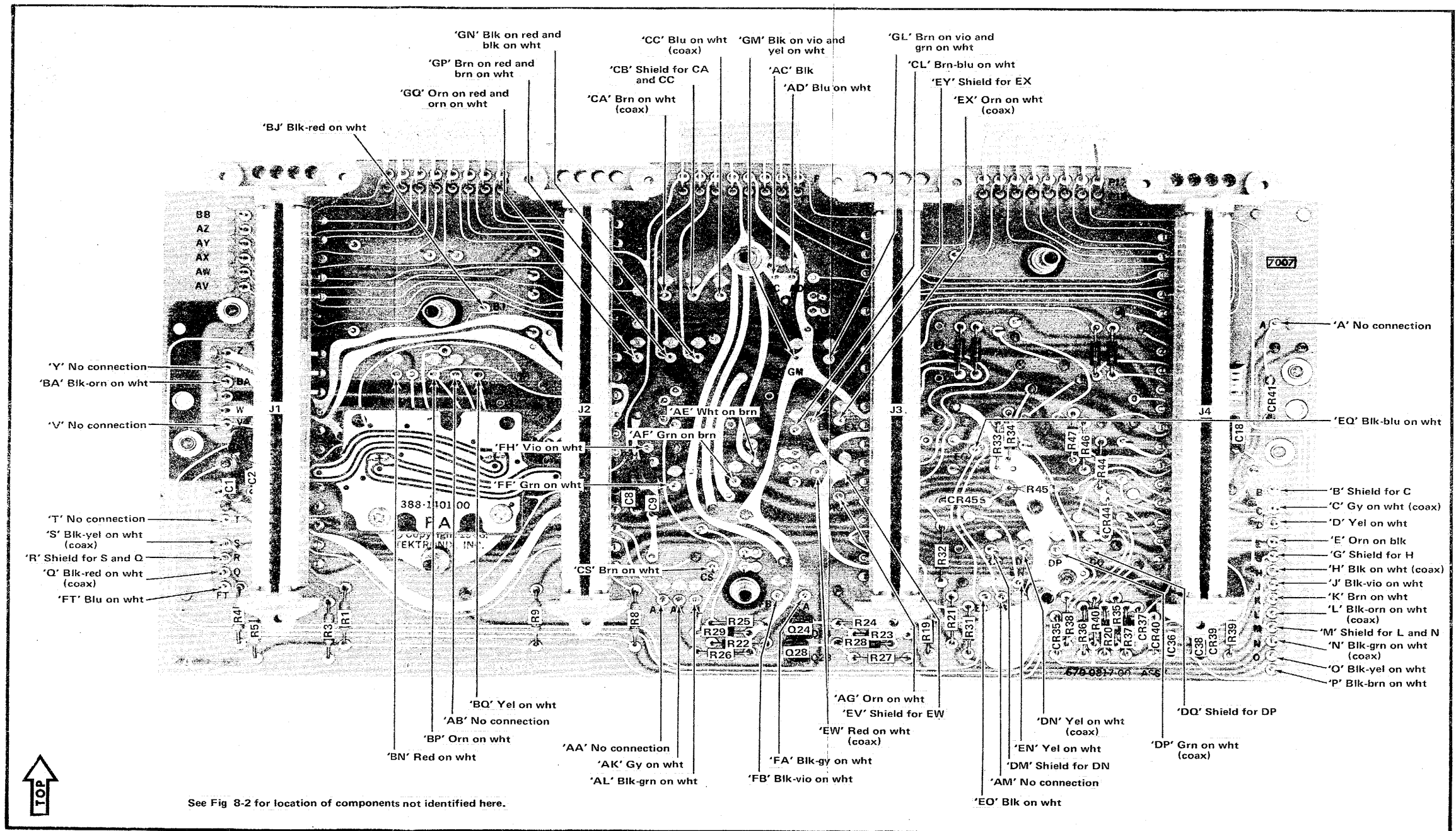
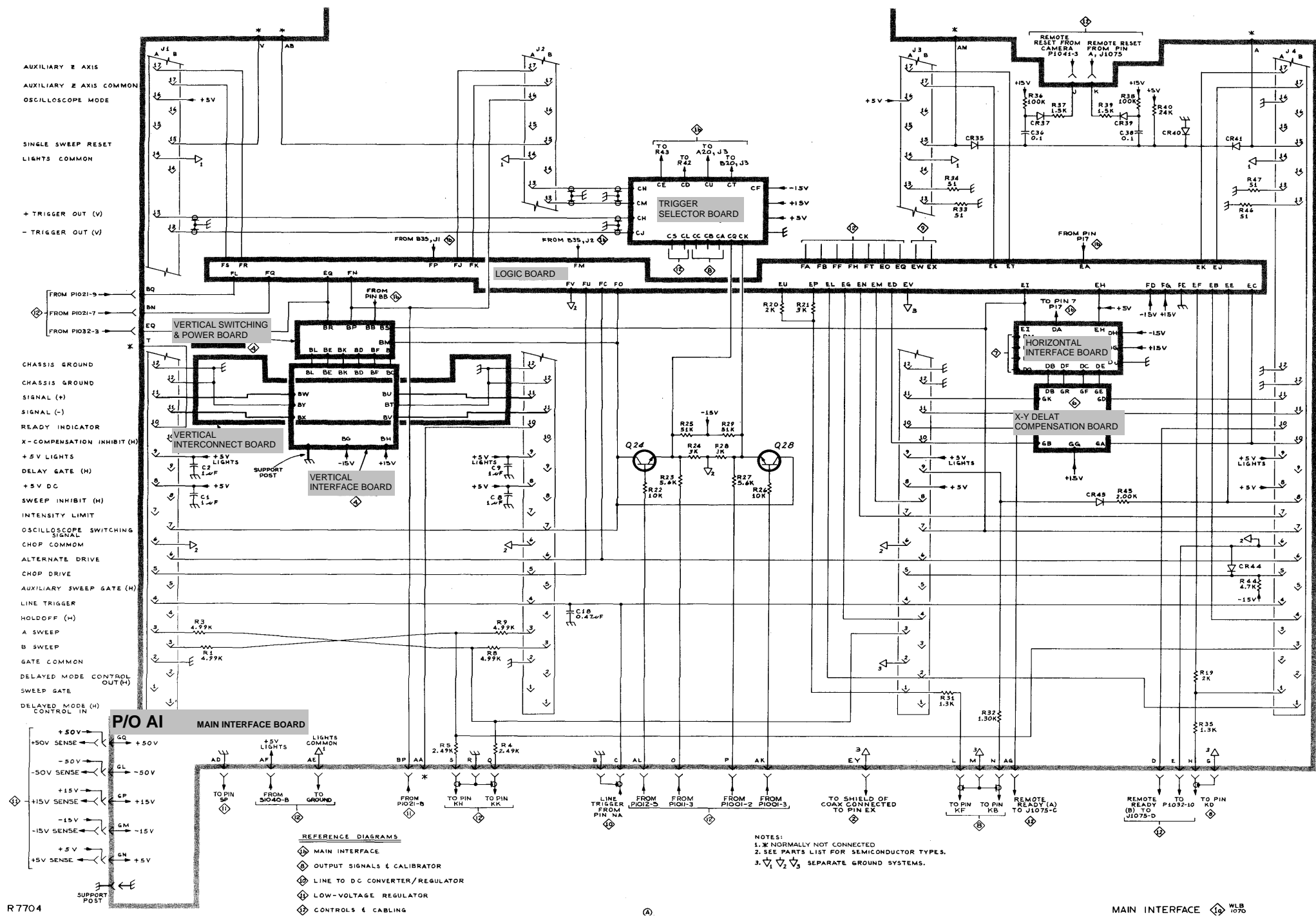
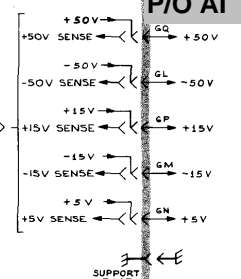


Fig. 8-1. P/O A1-Partial Main Interface circuit board.;



- AUXILIARY E AXIS
- AUXILIARY Z AXIS COMMON
- OSCILLOSCOPE MODE
- SINGLE SWEEP RESET
- LIGHTS COMMON
- + TRIGGER OUT (V)
- TRIGGER OUT (V)
- FROM P1021-5
- FROM P1021-7
- FROM P1032-3
- CHASSIS GROUND
- CHASSIS GROUND
- SIGNAL (+)
- SIGNAL (-)
- READY INDICATOR
- X-COMPENSATION INHIBIT (H)
- +5V LIGHTS
- DELAY GATE (H)
- +5V DC
- SWEEP INHIBIT (H)
- INTENSITY LIMIT
- OSCILLOSCOPE SWITCHING SIGNAL
- CHOP COMMON
- ALTERNATE DRIVE
- CHOP DRIVE
- AUXILIARY SWEEP GATE (H)
- LINE TRIGGER
- HOLDOFF (H)
- A SWEEP
- B SWEEP
- GATE COMMON
- DELAYED MODE CONTROL OUT (H)
- SWEEP GATE
- DELAYED MODE (H) CONTROL IN

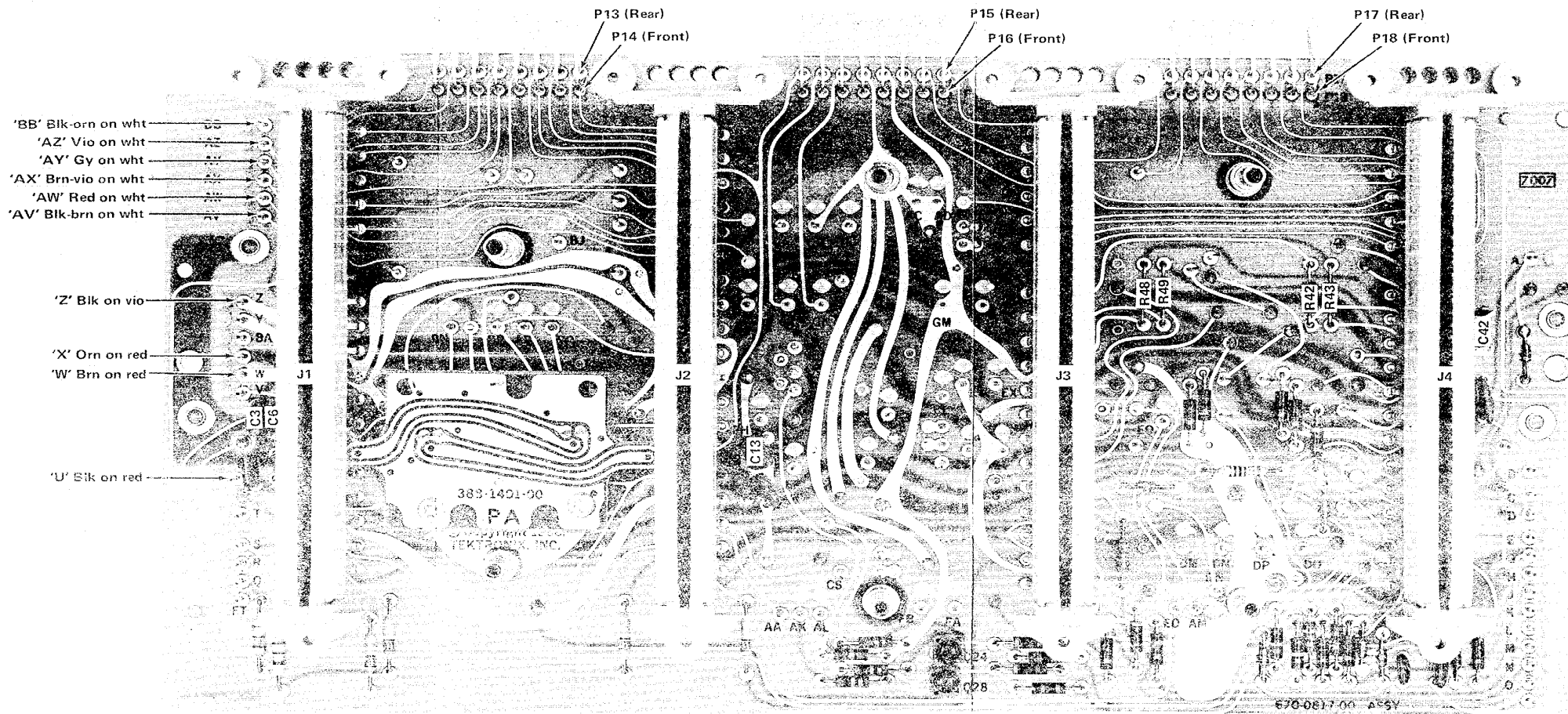


- REFERENCE DIAGRAMS
- ⊠ MAIN INTERFACE
 - ⊡ OUTPUT SIGNALS & CALIBRATOR
 - ⊢ LINE TO DC CONVERTER/REGULATOR
 - ⊣ LOW-VOLTAGE REGULATOR
 - ⊤ CONTROLS & CABLING

- NOTES:
1. * NORMALLY NOT CONNECTED
 2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
 3. ∇₁ ∇₂ ∇₃ SEPARATE GROUND SYSTEMS.

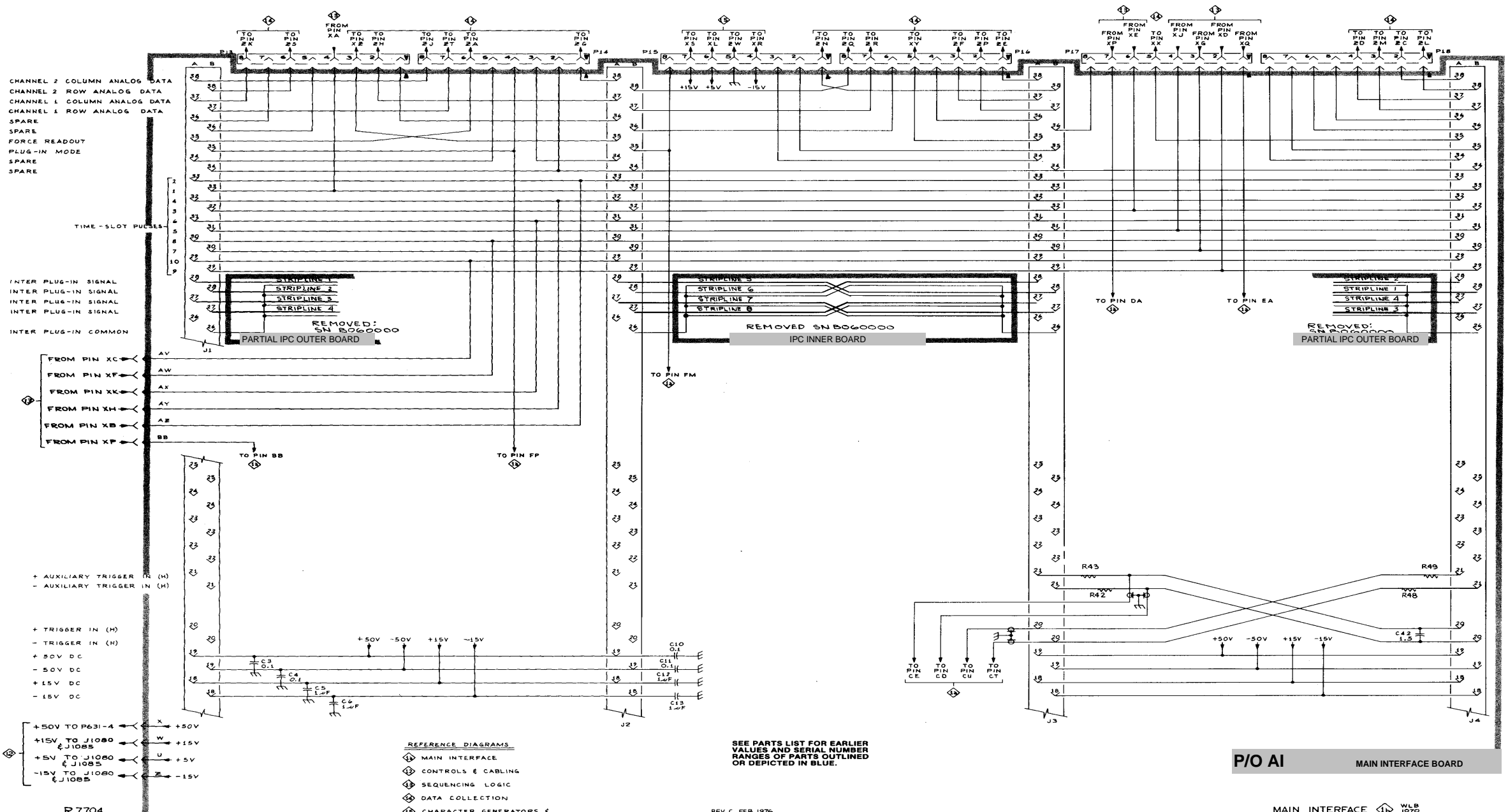
R7704

MAIN INTERFACE WLB 1076



See Fig. 8-1 for location of components not identified here.

Fig. 8-2. P/O A1-Partial Main Interface circuit board.



CHANNEL 2 COLUMN ANALOG DATA
 CHANNEL 2 ROW ANALOG DATA
 CHANNEL 1 COLUMN ANALOG DATA
 CHANNEL 1 ROW ANALOG DATA
 SPARE
 FORCE READOUT
 PLUG-IN MODE
 SPARE
 SPARE

TIME-SLOT PULSES
 2
 4
 3
 4
 5
 8
 7
 10
 9

INTER PLUG-IN SIGNAL
 INTER PLUG-IN SIGNAL
 INTER PLUG-IN SIGNAL
 INTER PLUG-IN SIGNAL
 INTER PLUG-IN COMMON

FROM PIN XC
 FROM PIN XF
 FROM PIN XK
 FROM PIN XH
 FROM PIN XB
 FROM PIN XP

+ AUXILIARY TRIGGER IN (H)
 - AUXILIARY TRIGGER IN (H)
 + TRIGGER IN (H)
 - TRIGGER IN (H)
 + 50V DC
 - 50V DC
 + 15V DC
 - 15V DC

+50V TO P631-4
 +15V TO J1080 & J1085
 +5V TO J1080 & J1085
 -15V TO J1080 & J1085

REFERENCE DIAGRAMS

- ① MAIN INTERFACE
- ② CONTROLS & CABLING
- ③ SEQUENCING LOGIC
- ④ DATA COLLECTION
- ⑤ CHARACTER GENERATORS & OUTPUT

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

REV. C, FEB. 1976

P/O AI MAIN INTERFACE BOARD

MAIN INTERFACE WLB 1070

R7704

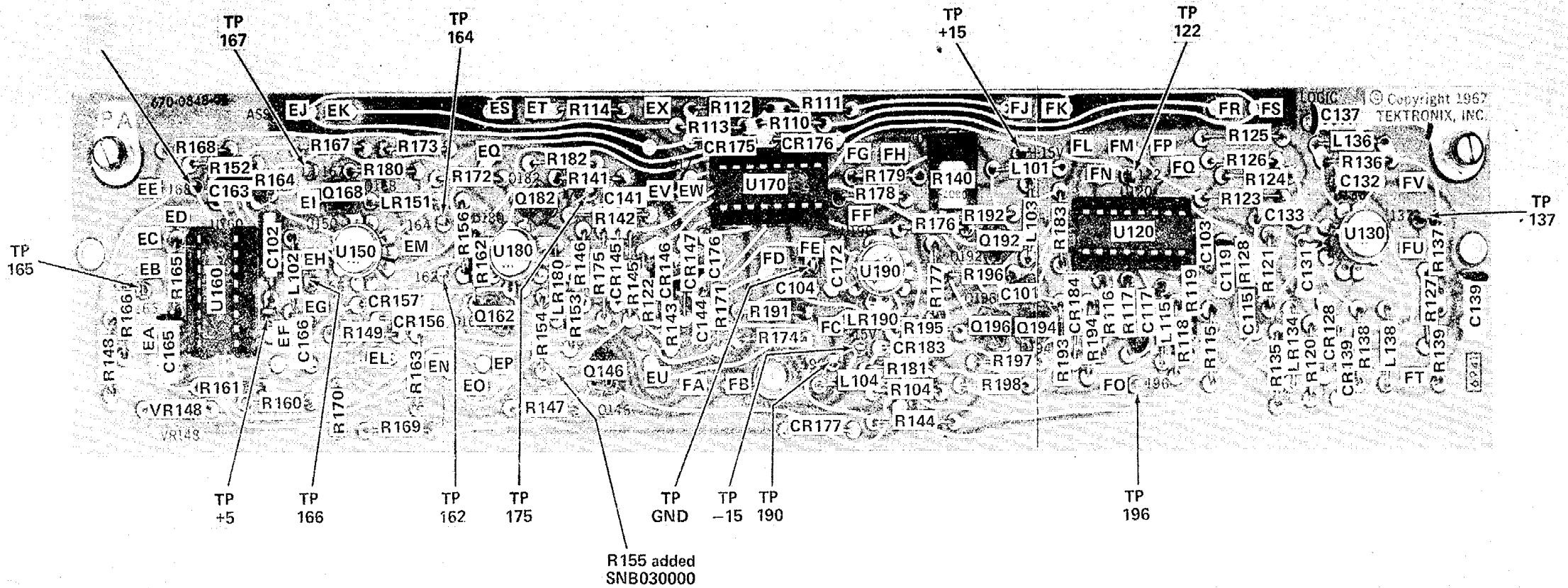
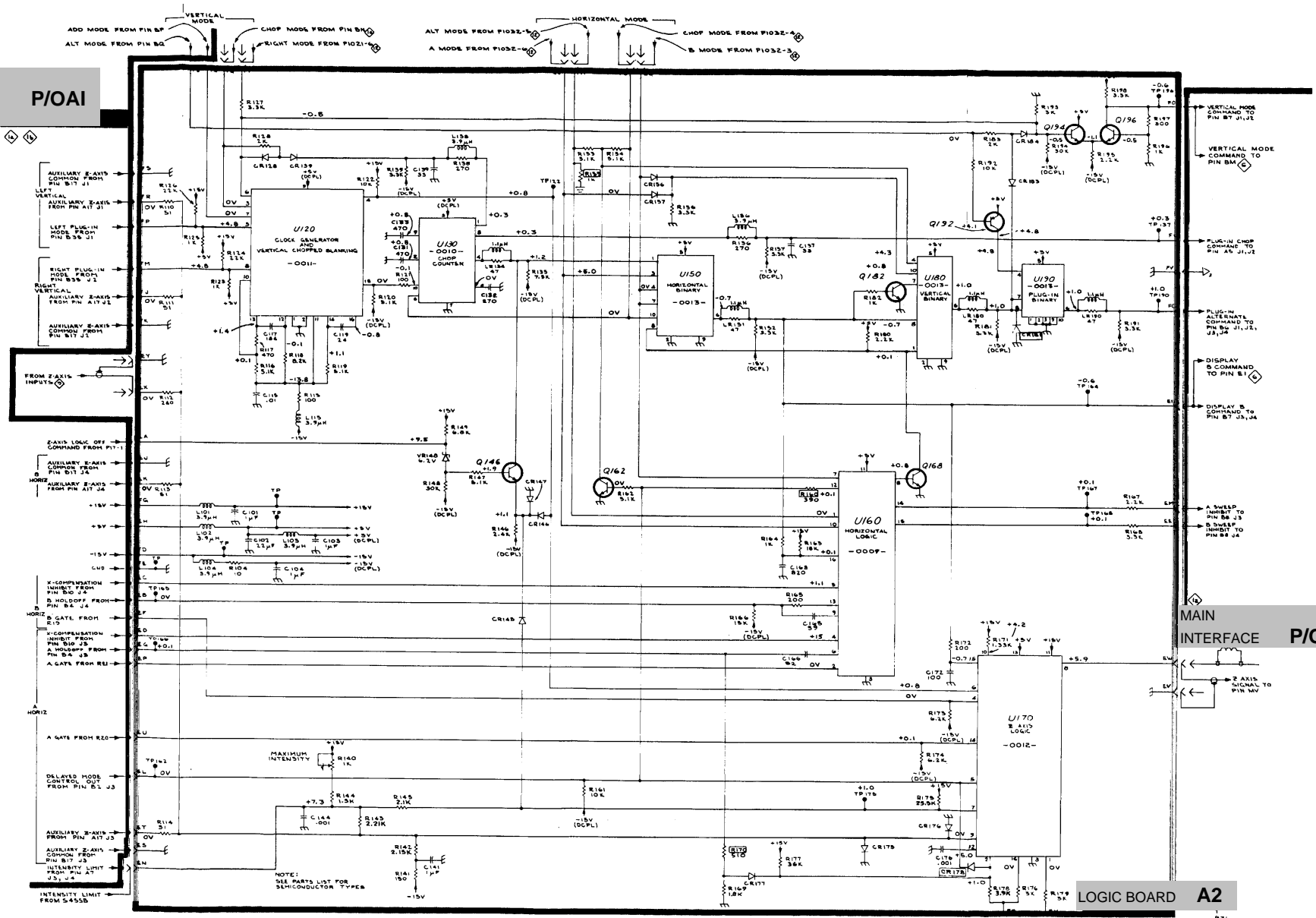


Fig. 8-3. A2-Logic circuit board.

MAIN INTERFACE P/OAI



MAIN INTERFACE P/O AI

LOGIC BOARD A2

R7704

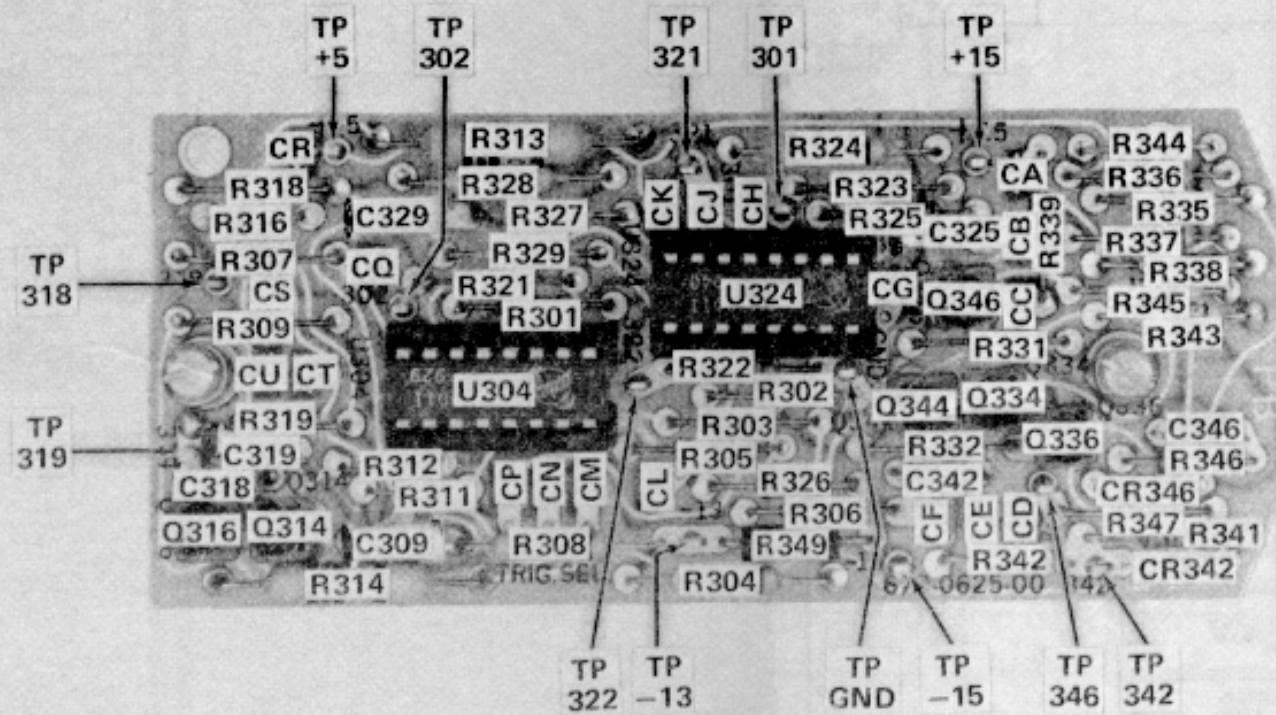
REV. D, AUG. 1977

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

VOLTAGES obtained under conditions given on page B.2.

LOGIC CIRCUIT

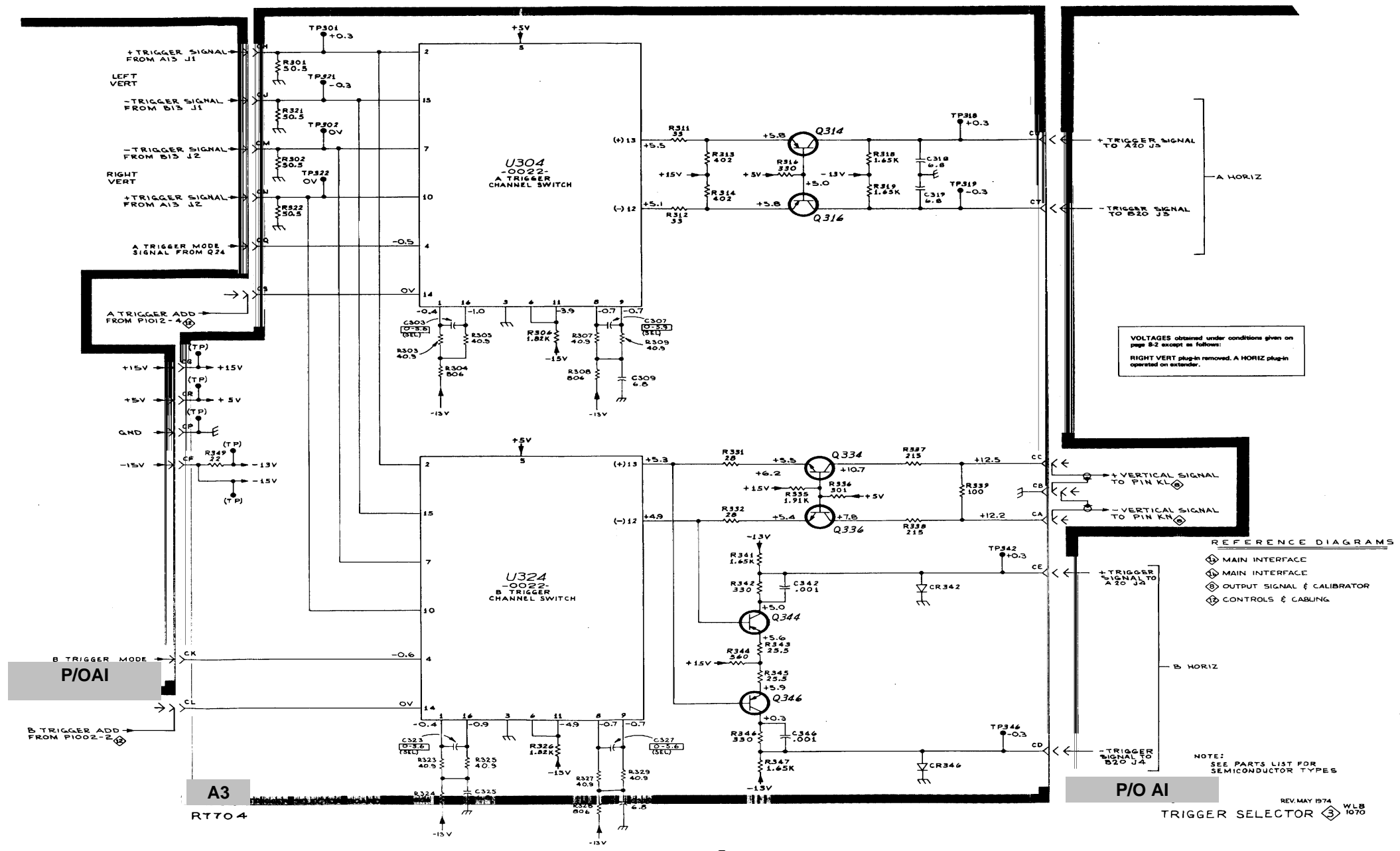
971



NOTE: R313 moved to rear of board SN B020000



Fig. 8-4. A3 - Trigger Selector circuit board.



VOLTAGES obtained under conditions given on page B-2 except as follows:
 RIGHT VERT plug-in removed. A HORIZ plug-in operated on extender.

REFERENCE DIAGRAMS

- ⊕ MAIN INTERFACE
- ⊕ MAIN INTERFACE
- ⊕ OUTPUT SIGNAL & CALIBRATOR
- ⊕ CONTROLS & CABLING

NOTE: SEE PARTS LIST FOR SEMICONDUCTOR TYPES

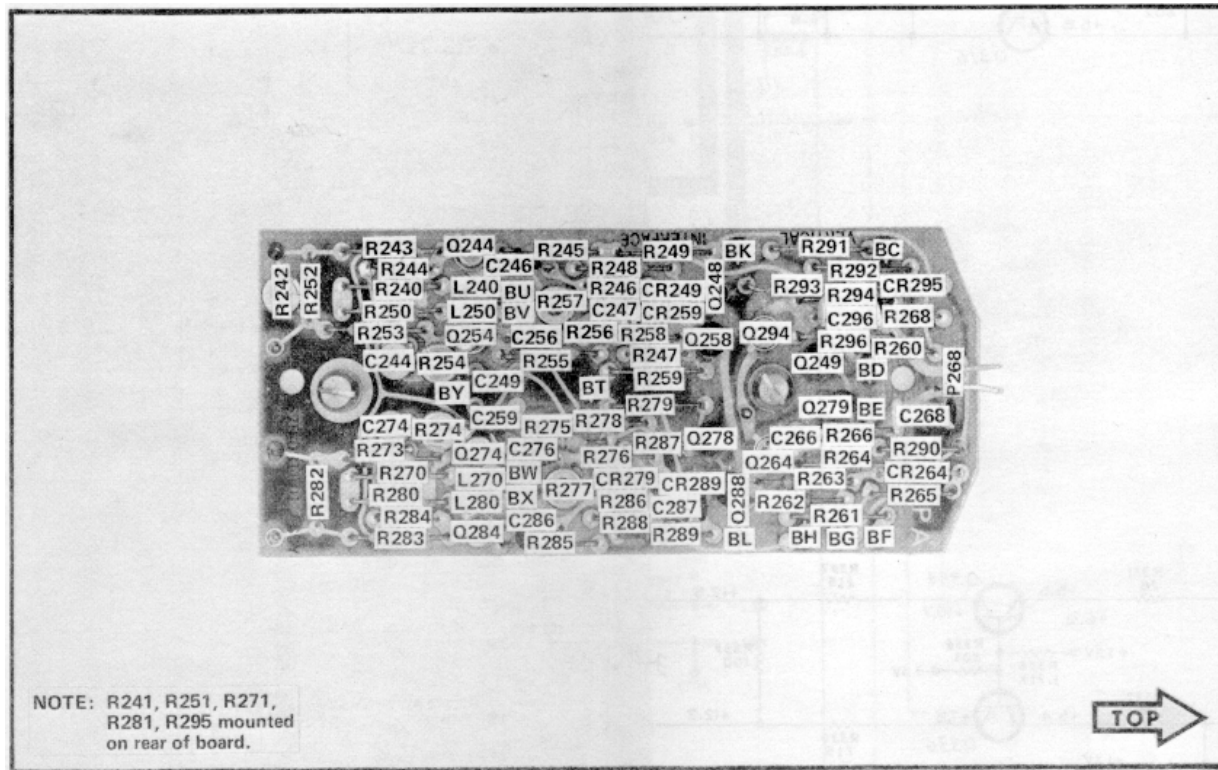


Fig. 8-5. A4 - Vertical Interface circuit board.

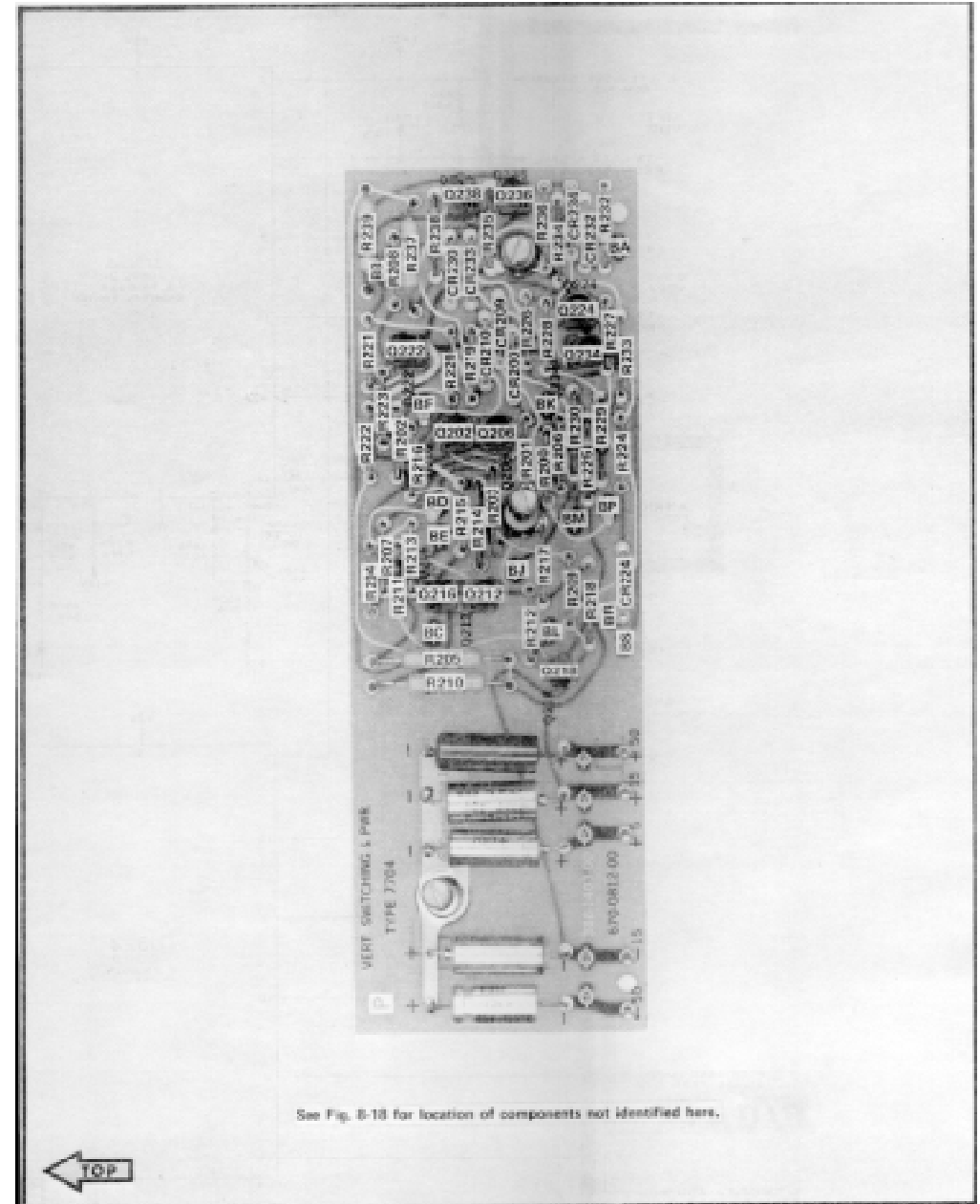
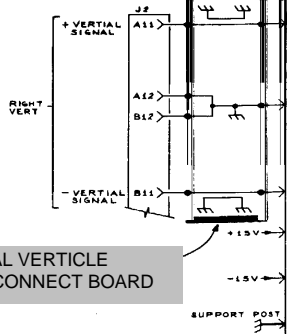
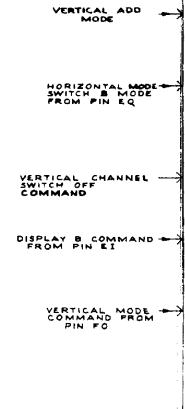


Fig. 8-6. P/O A5 - Partial Vertical Switching and Power circuit board.

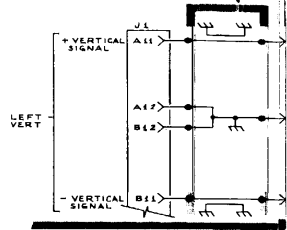
P/O A1



PARTIAL VERTICLE INTERCONNECT BOARD

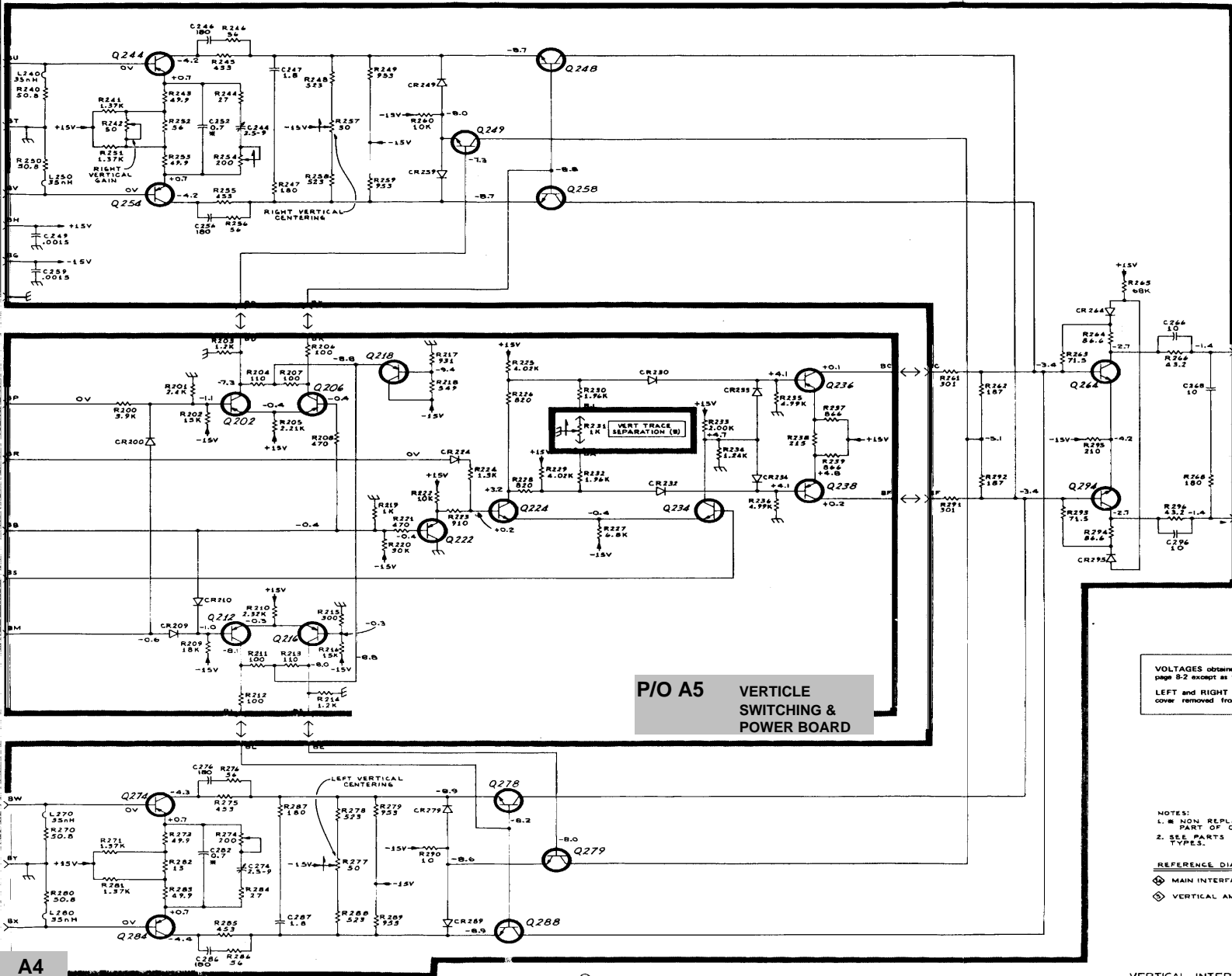


PARTIAL VERTICLE INTERCONNECT BOARD



A4

P/O A5 VERTICLE SWITCHING & POWER BOARD



VOLTAGES obtained under conditions given on page 8-2 except as follows:
LEFT and RIGHT VERT units removed. Plastic cover removed from Vertical Interface board.

NOTES:
1. M NON REPLACEABLE PART, INTEGRAL PART OF CIRCUIT BOARD.
2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

REFERENCE DIAGRAMS

- ◇ MAIN INTERFACE
- ◇ VERTICAL AMPLIFIER

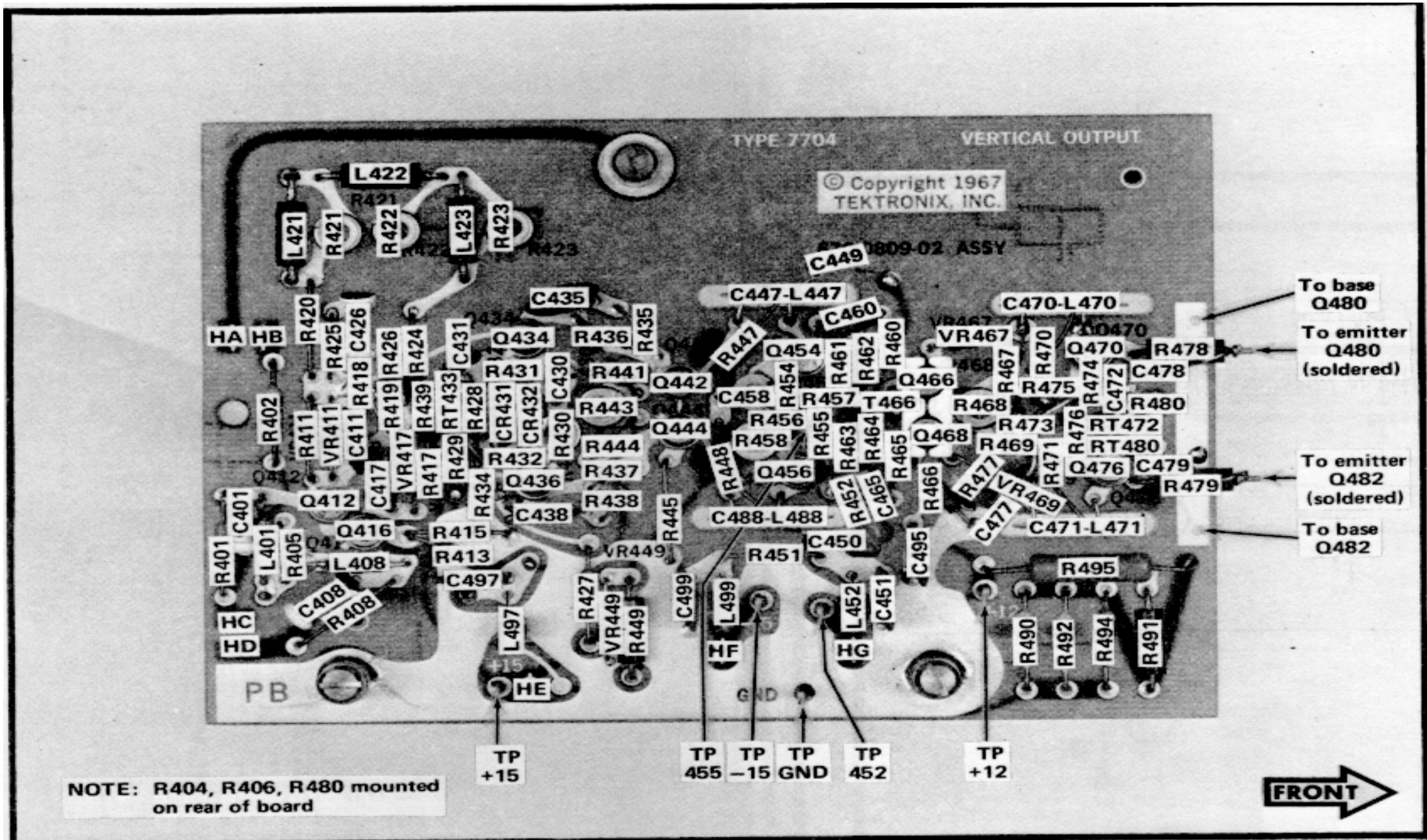
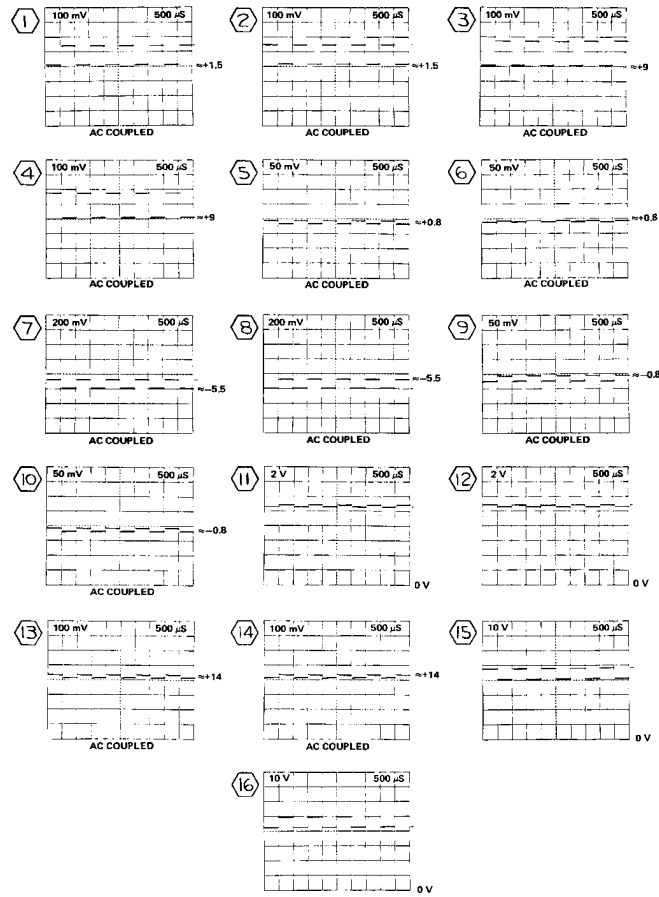


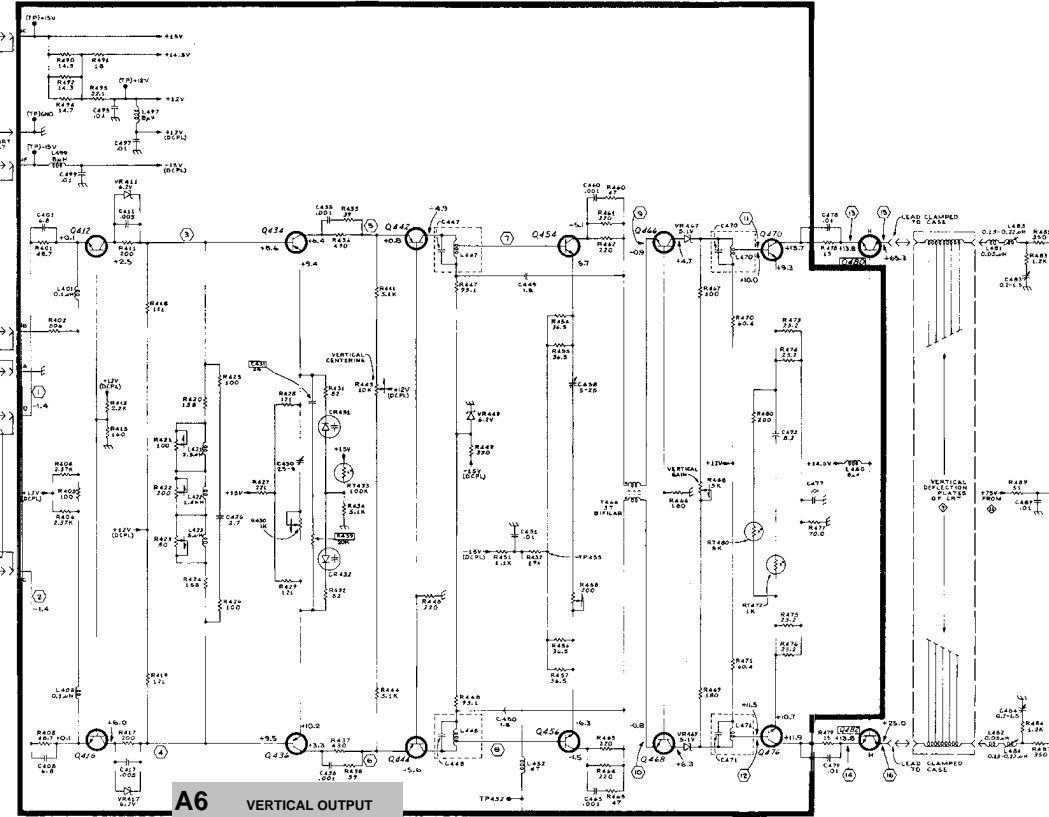
Fig. 8-7. A6 - Vertical Output circuit board.



← WAVEFORMS

REFERENCE DIAGRAM:
 ○ VERTICAL INTERFACE
 ○ HORIZONTAL AMPLIFIER
 ○ KEY CIRCUIT
 ○ LOW-VOLTAGE REGULATOR
 ○ CAPACITOR GENERATOR CIRCUIT

NOTE:
 SEE PARTS LIST FOR SEMICONDUCTOR TYPES



A6 VERTICAL OUTPUT

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

VOLTAGES and WAVEFORMS obtained under conditions given on page B2 except as follows:
 Plastic cover removed from Vertical Output board.

REV. C, AUG 1977

R7704

VERTICAL AMPLIFIER

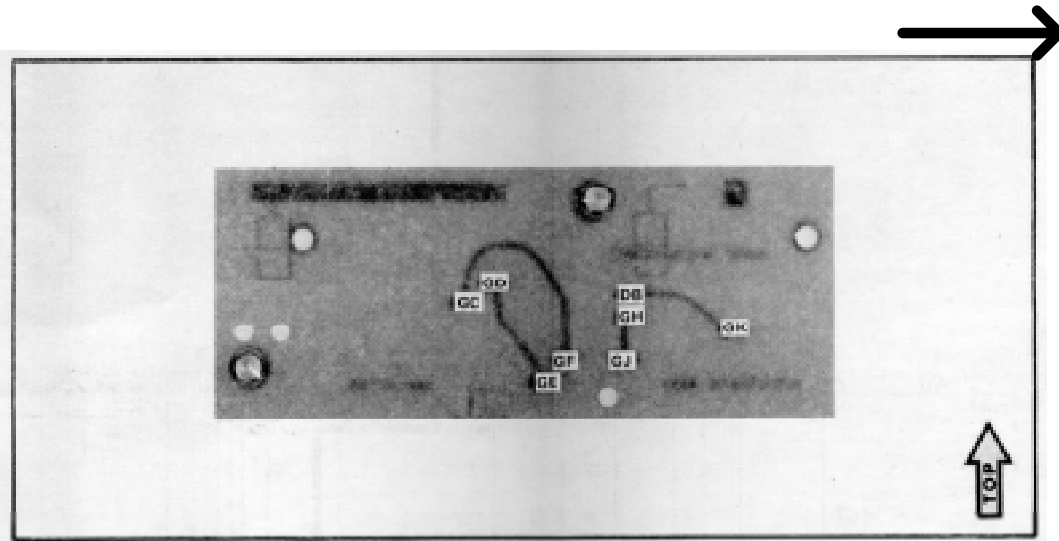


Fig. 8-8. A7-Horizontal Interconnect circuit board.

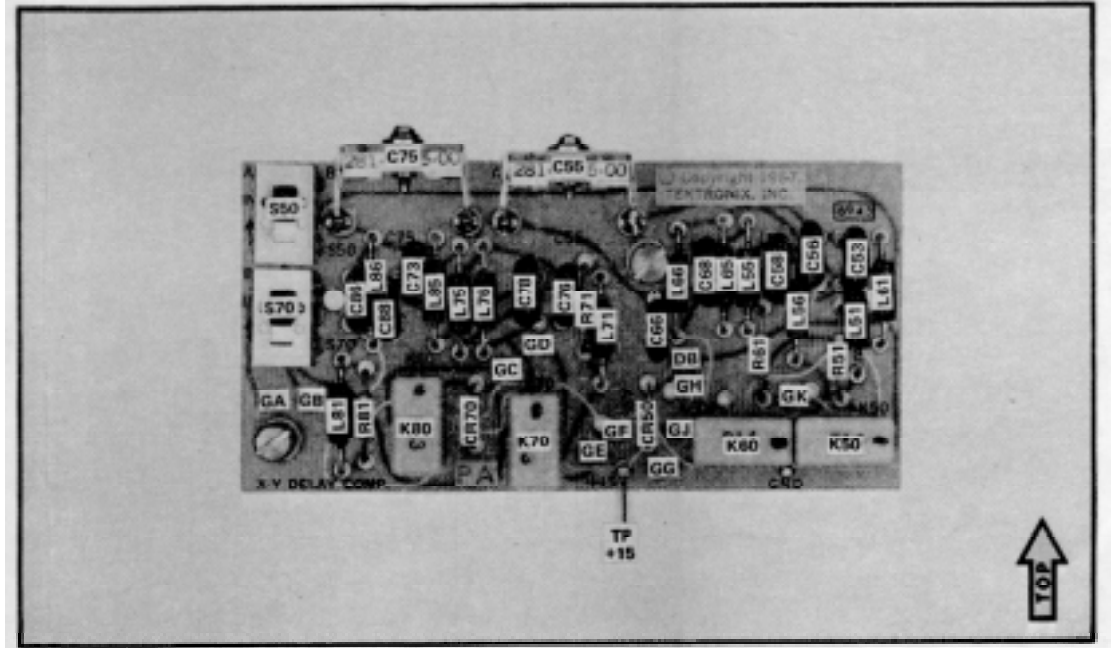


Fig. 8-10. A23-x-y Delay Compensation circuit board (optional).

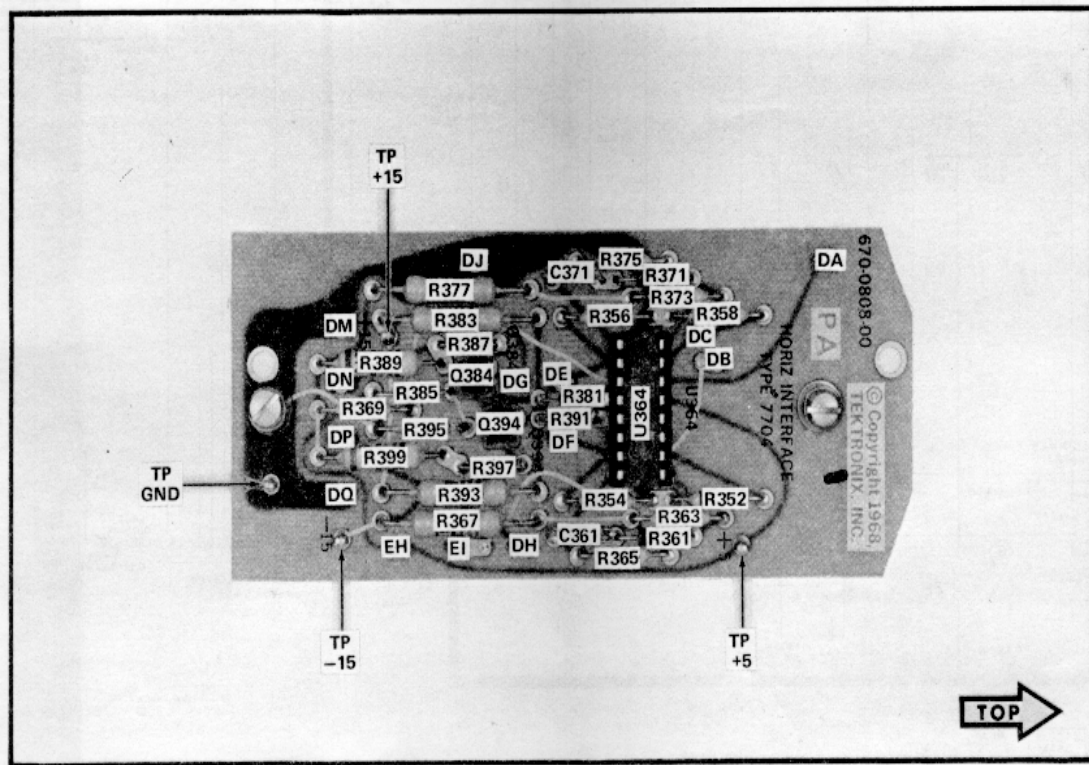
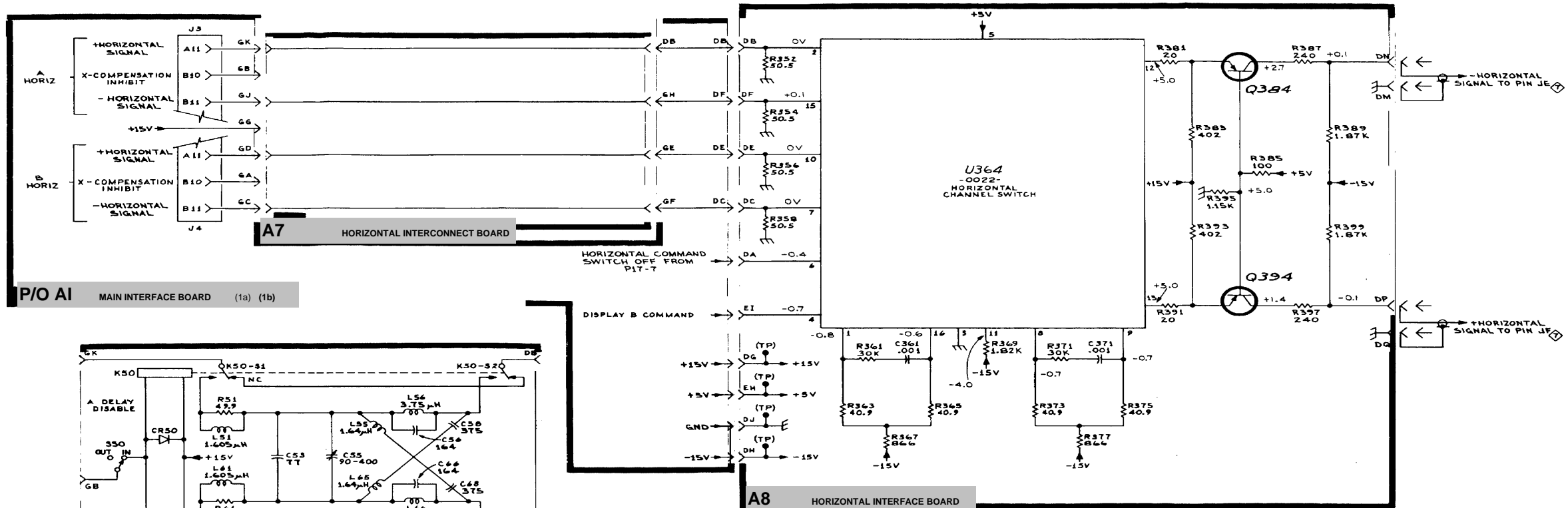
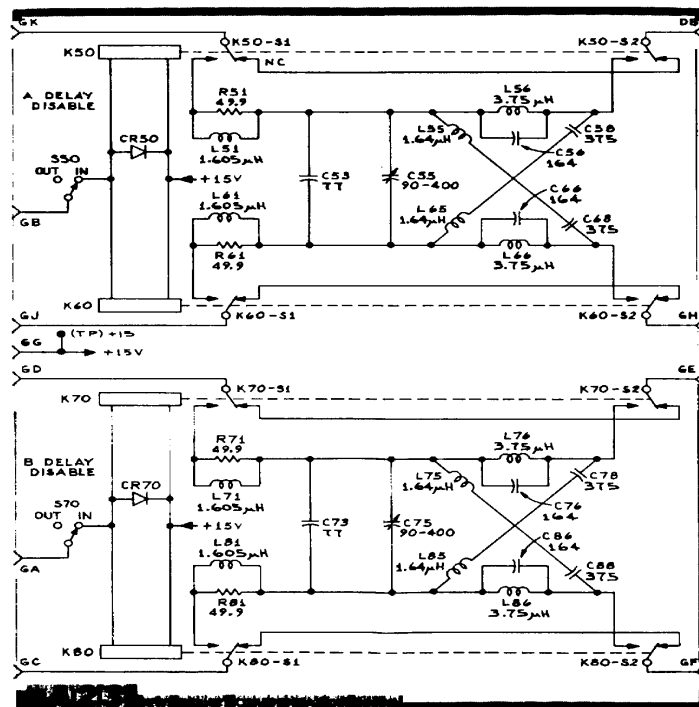


Fig. 8-9. A8-Horizontal interface circuit board.



P/O AI MAIN INTERFACE BOARD (1a) (1b)



RT704

VOLTAGES obtained under conditions given on page B-2 except as follows:
B HORIZ plugin removed.

REFERENCE DIAGRAMS
 ◆ MAIN INTERFACE
 ◆ HORIZONTAL AMPLIFIER

NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

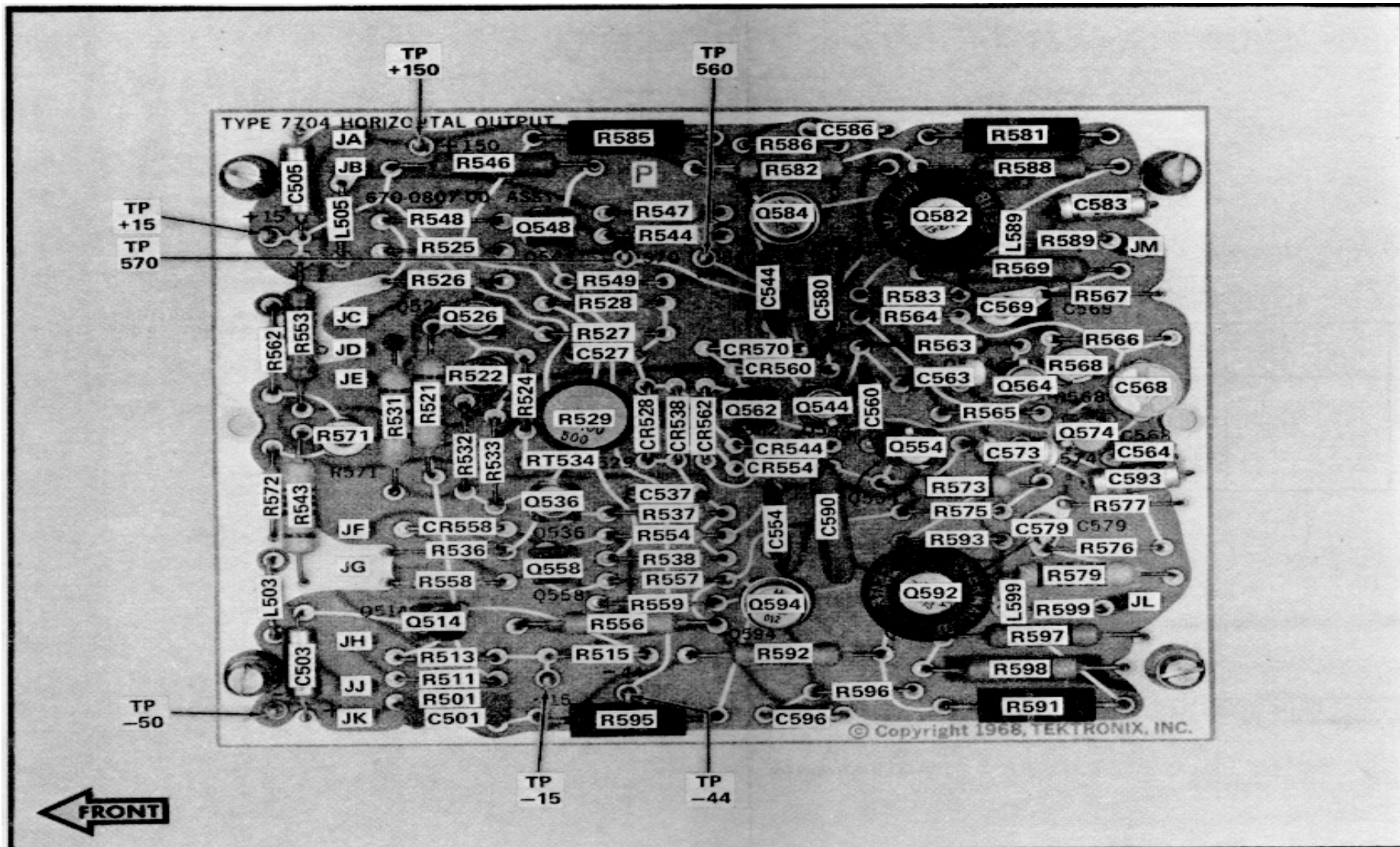
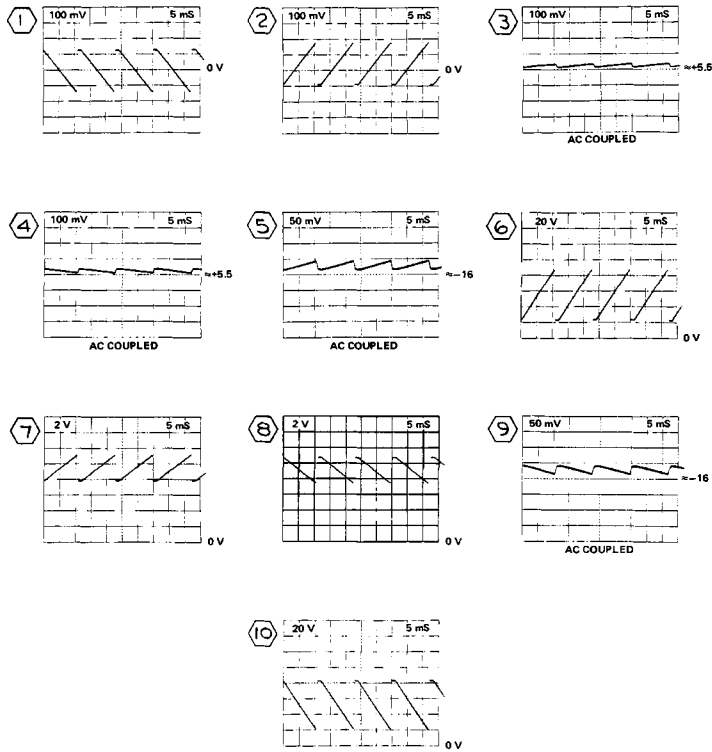


Fig. 8-11. A8-Horizontal Output circuit board



← WAVEFORMS

NOTE: PIN 10 CONNECTED TO PIN 10 (R540) ONLY. RESISTOR R540 IS NOT INSTALLED.

X READOUT SIGNAL FROM PIN 20

+ HORIZONTAL SIGNAL FROM PIN 20

INTENSITY LIMIT TO EU

+ HORIZONTAL SIGNAL FROM PIN 20

SUPPORT POST

+150V TO PIN 1A

FROM

+150V

+15V

+15V

+15V

+15V

+15V

+15V

+15V

+15V

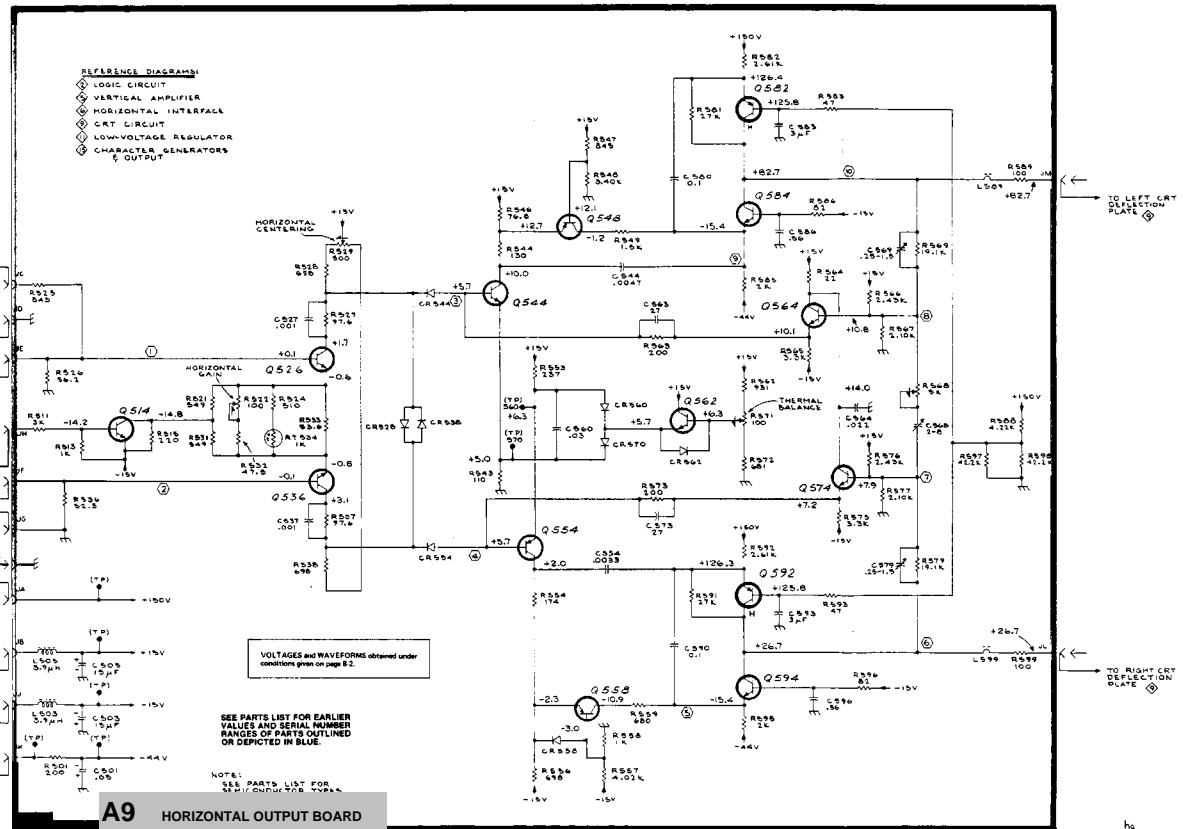
+15V

+15V

+15V

+15V

+15V



A9 HORIZONTAL OUTPUT BOARD

R7704

REV B, AUG. 1977

HORIZONTAL AMPLIFIER

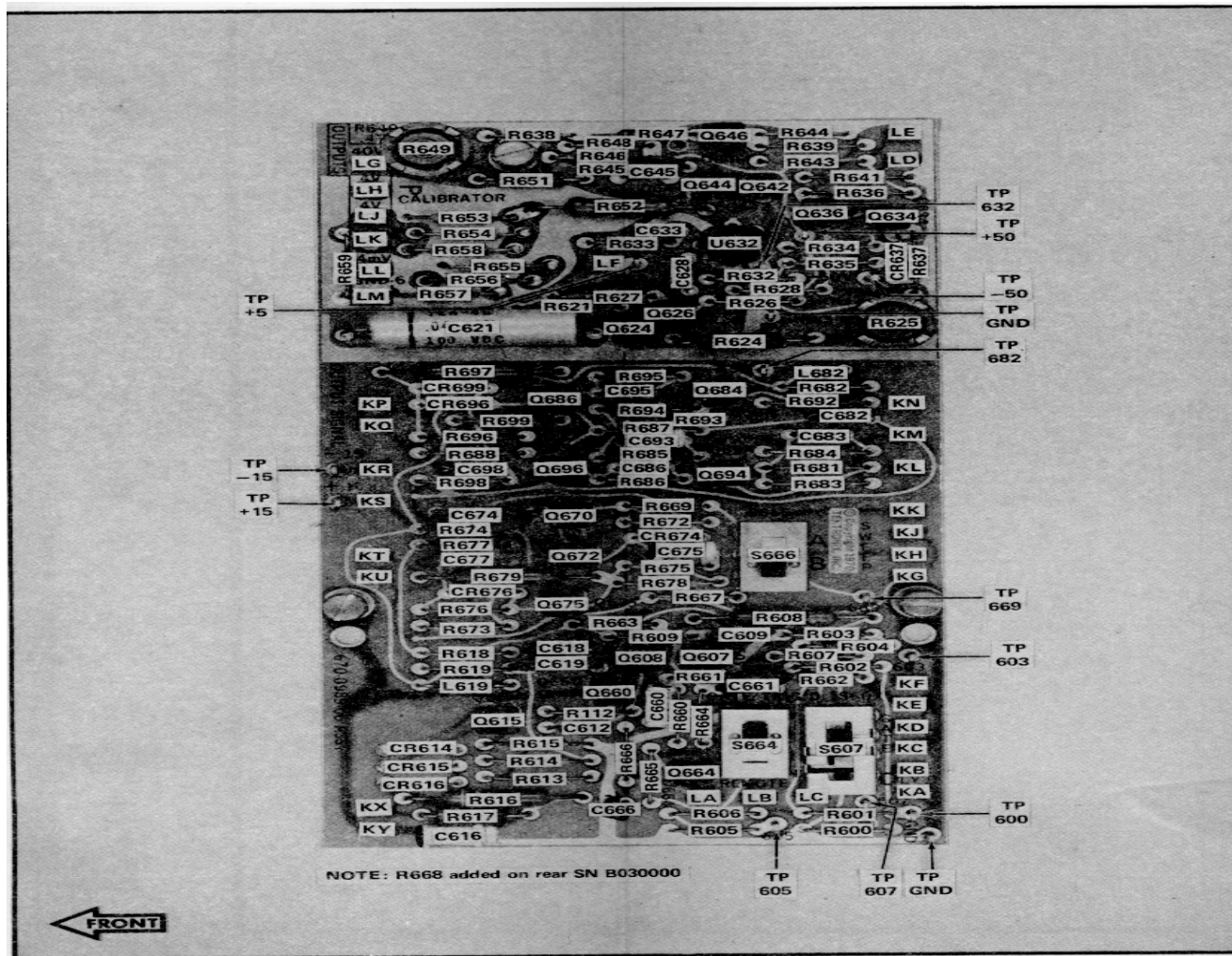


Fig. 8-12. A10-Output Signal circuit board.

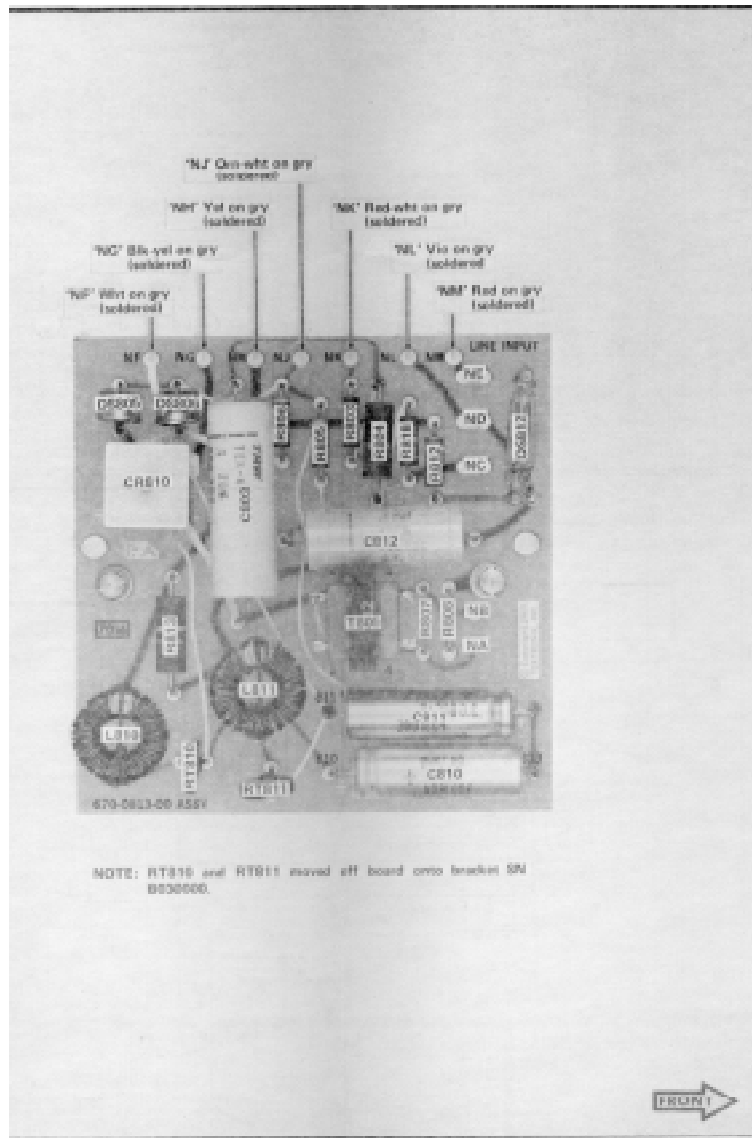


Fig 8-14. A12 - Line Input circuit board.

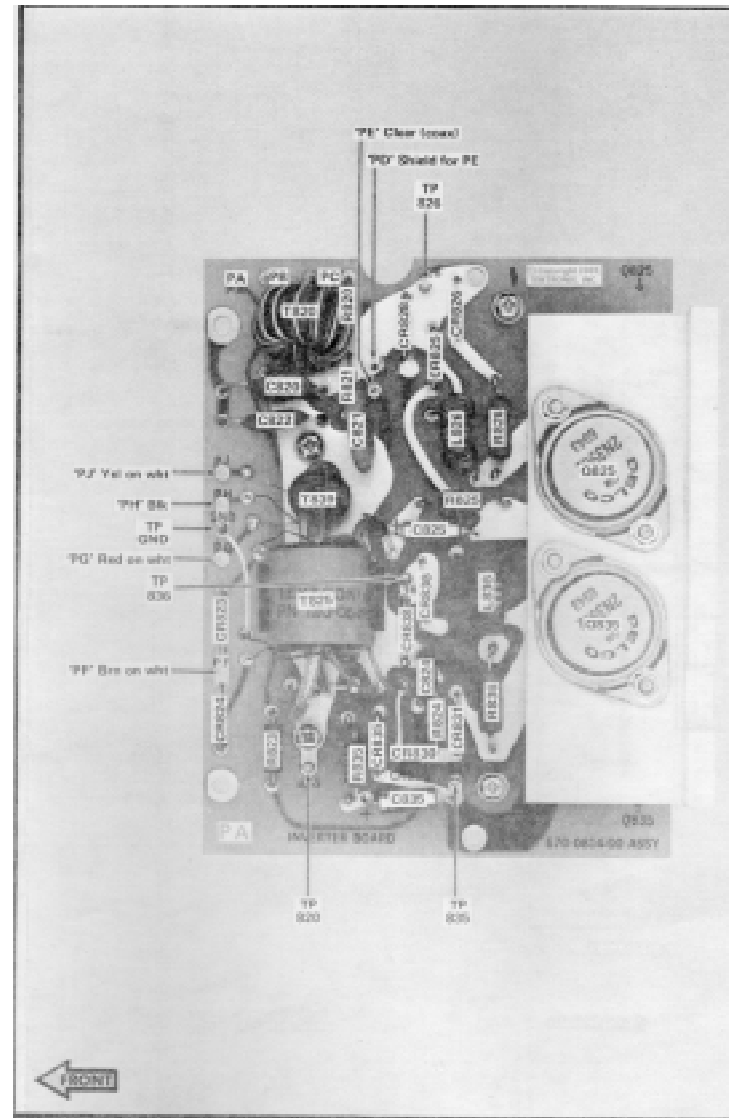


Fig. 8-15. A13 - Inverter circuit board.

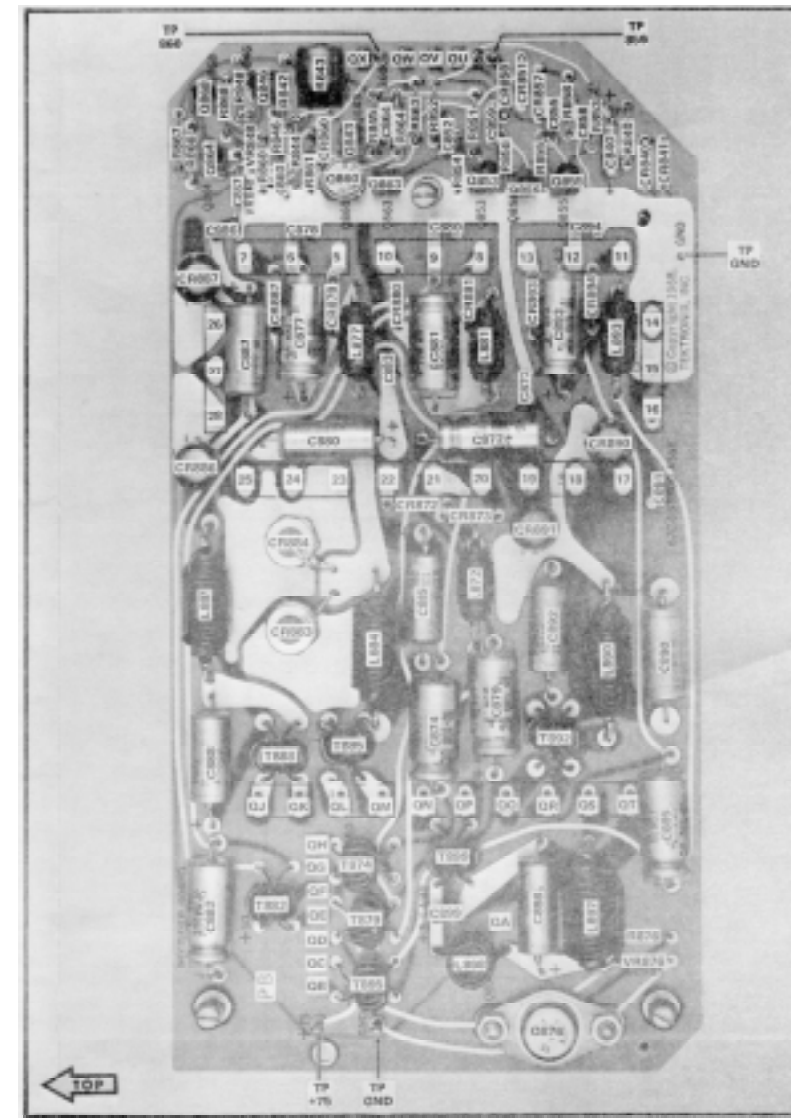
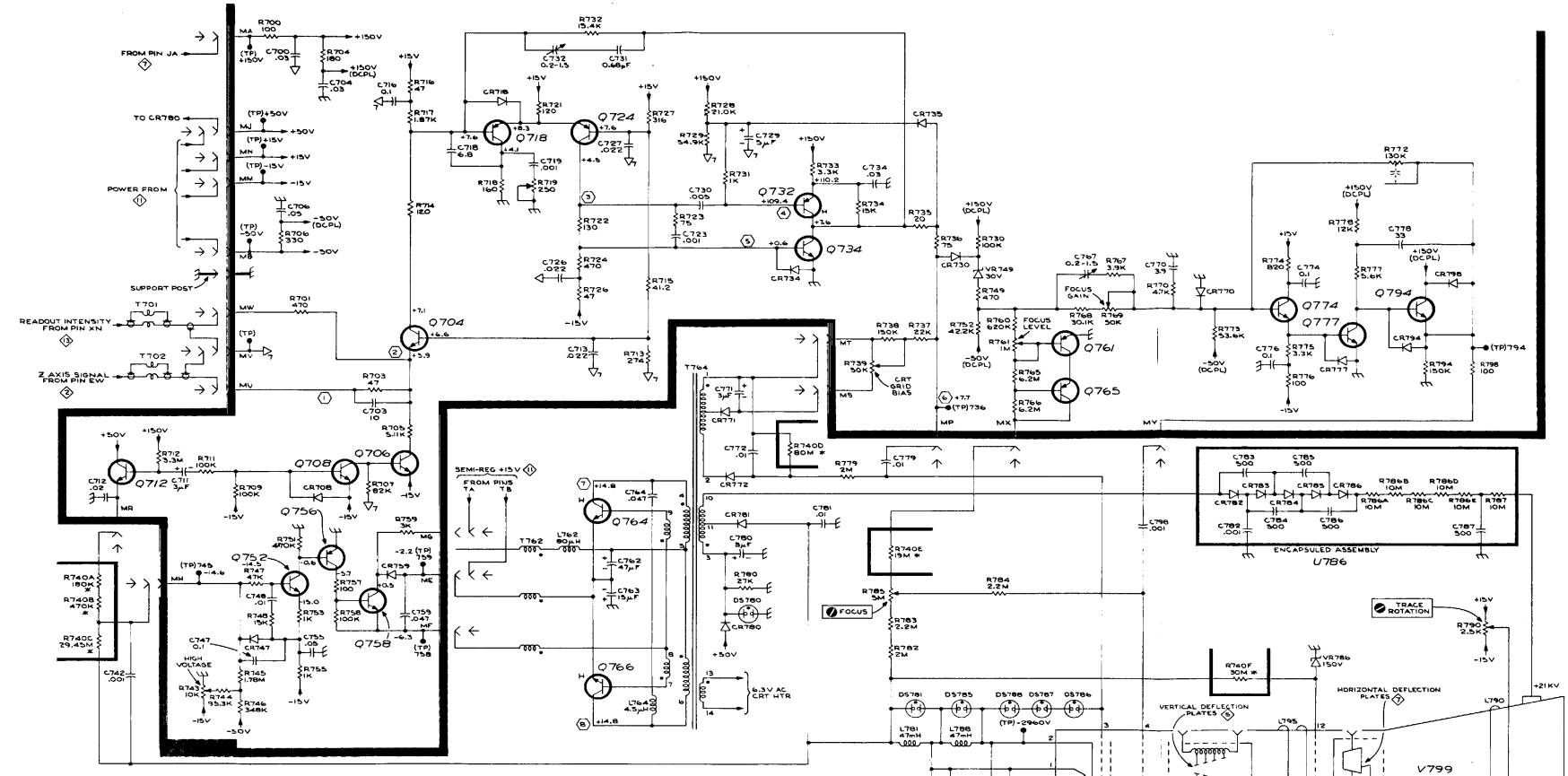
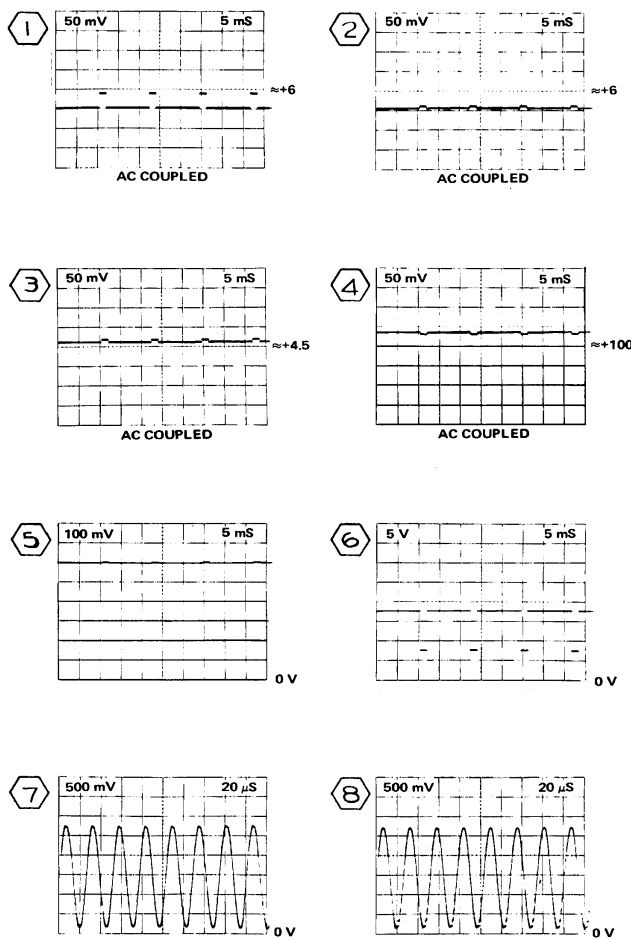


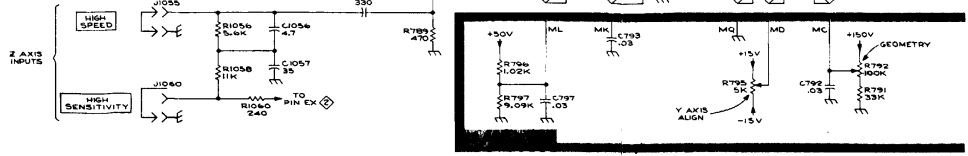
Fig. 8-16. A14 - Rectifier circuit board.



- NOTES:
1. THICK FILM RESISTOR
 2. SEPARATE GROUND SYSTEM
 3. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
- REFERENCE DIAGRAMS
- ◇ LOGIC CIRCUIT
 - ◇ VERTICAL AMPLIFIER
 - ◇ HORIZONTAL AMPLIFIER
 - ◇ LOW-VOLTAGE REGULATOR
 - ◇ SEQUENCING LOGIC

← WAVEFORMS

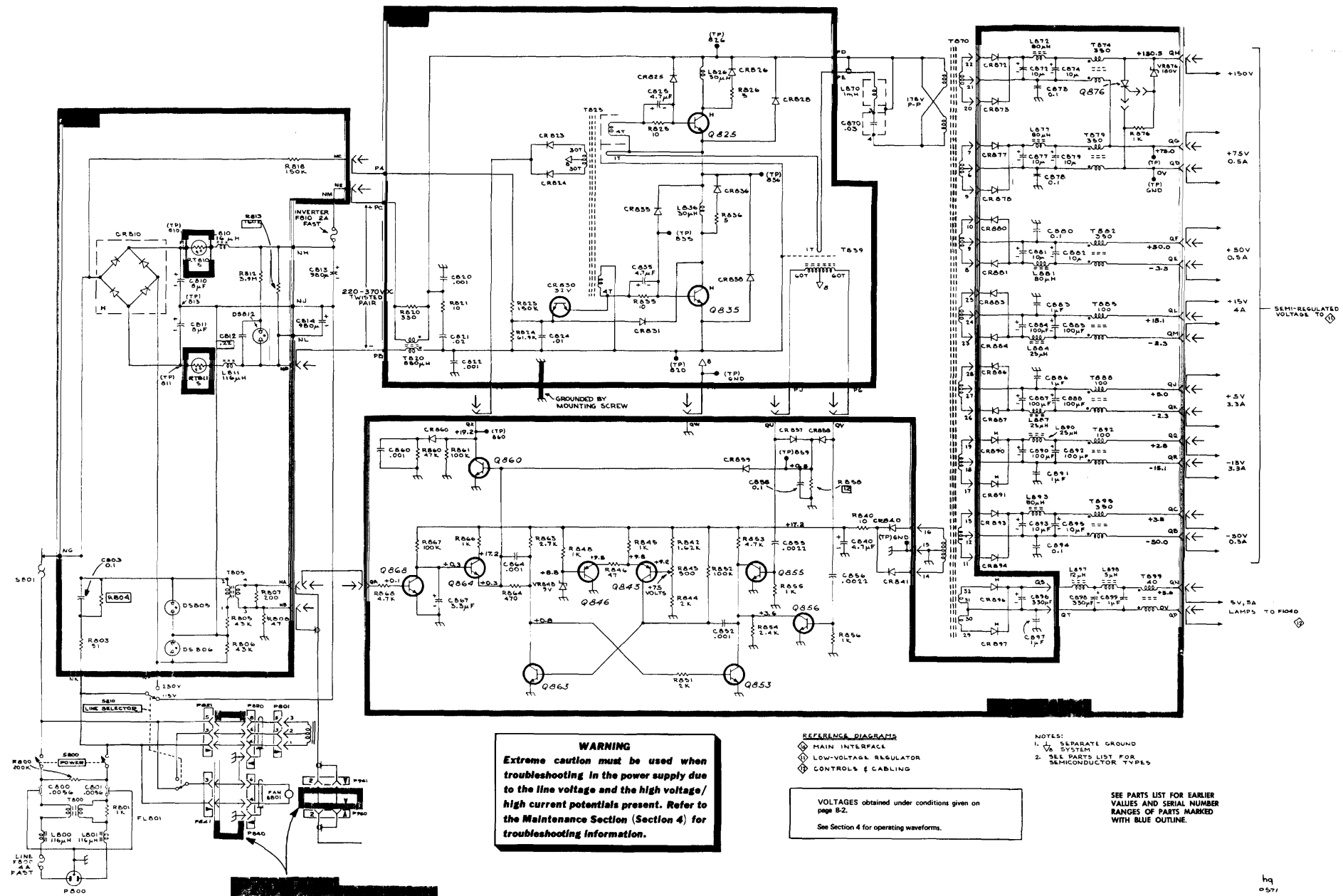
VOLTAGES and WAVEFORMS obtained under conditions given on page 52.



R7704

REV. B, FEB. 1976

685 1070 CRT CIRCUIT



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 (Section 4) for troubleshooting information.

REFERENCE DIAGRAMS
 1. MAIN INTERFAC
 2. LOW-VOLTAGE REGULATOR
 3. CONTROLS & CABLING

VOLTAGES obtained under conditions given on page B-2.
 See Section 4 for operating waveforms.

NOTES:
 1. SEPARATE GROUND FOR SYSTEM.
 2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

R7704

LINE TO DC CONVERTER/REGULATOR
 REV. MAY 1974

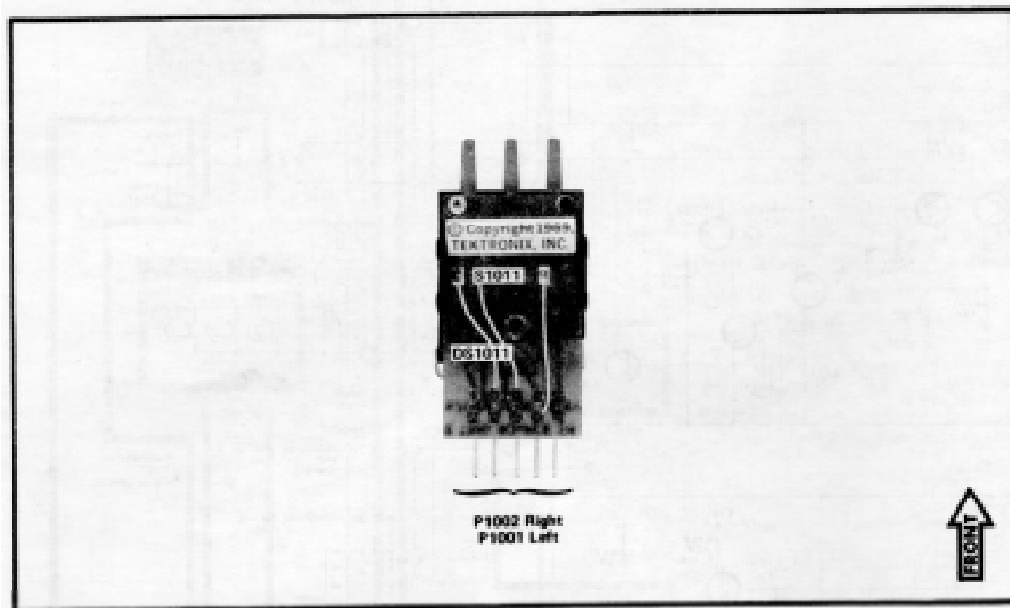


Fig. 8-21. A17 - B Trigger Source Switch circuit board.

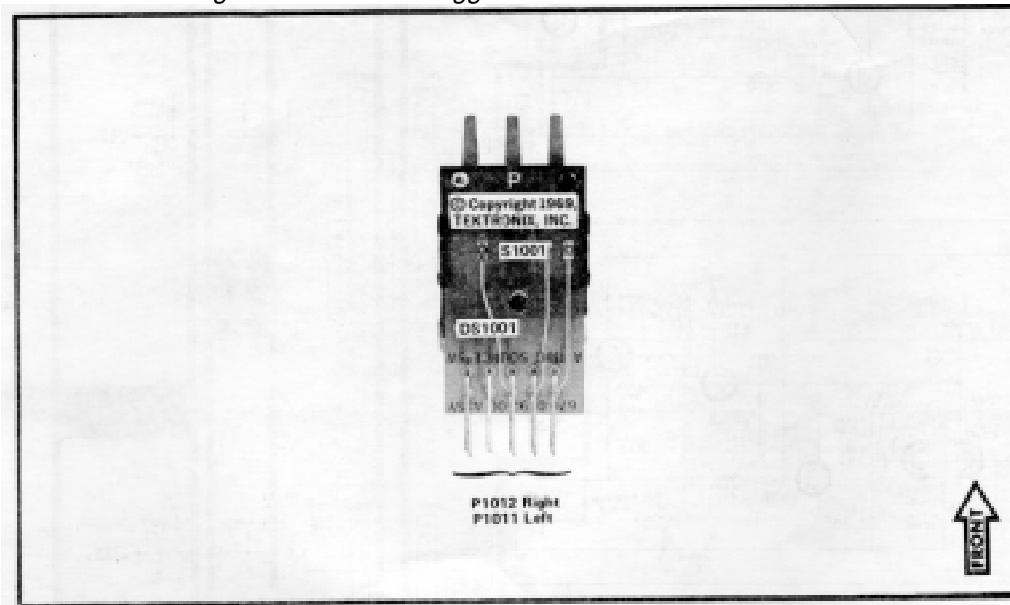


Fig. 8-22. A18 - A Trigger Source Switch circuit board.

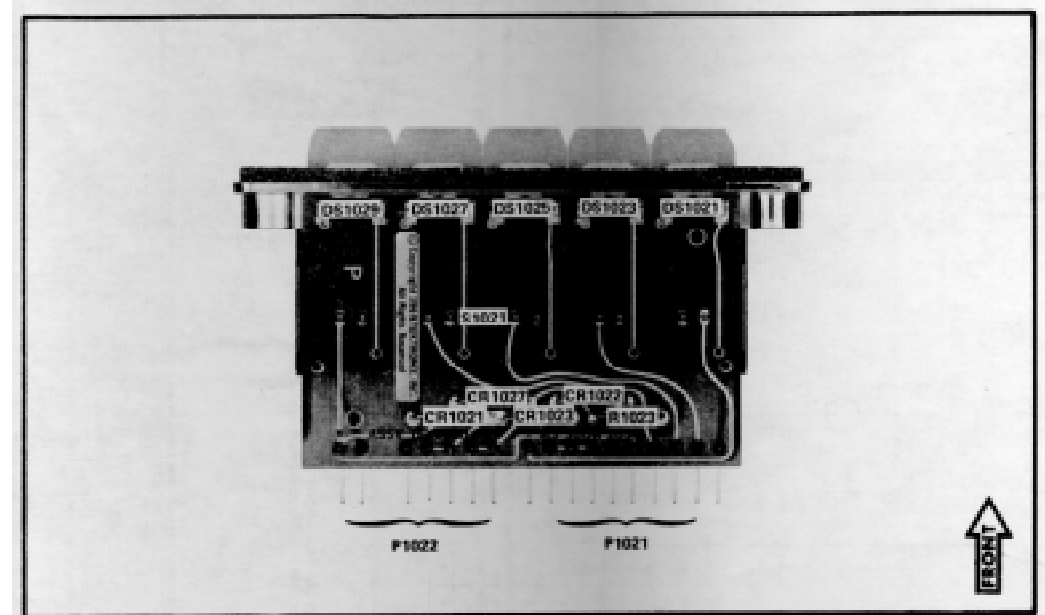


Fig. 8-23. A19 - Vertical Mode Switch circuit board.

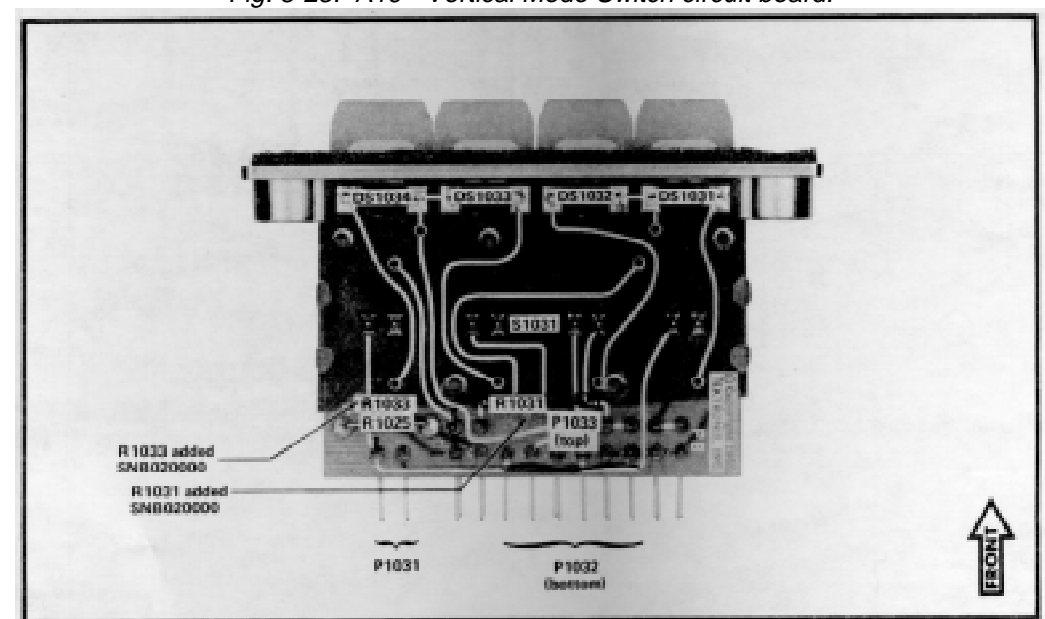
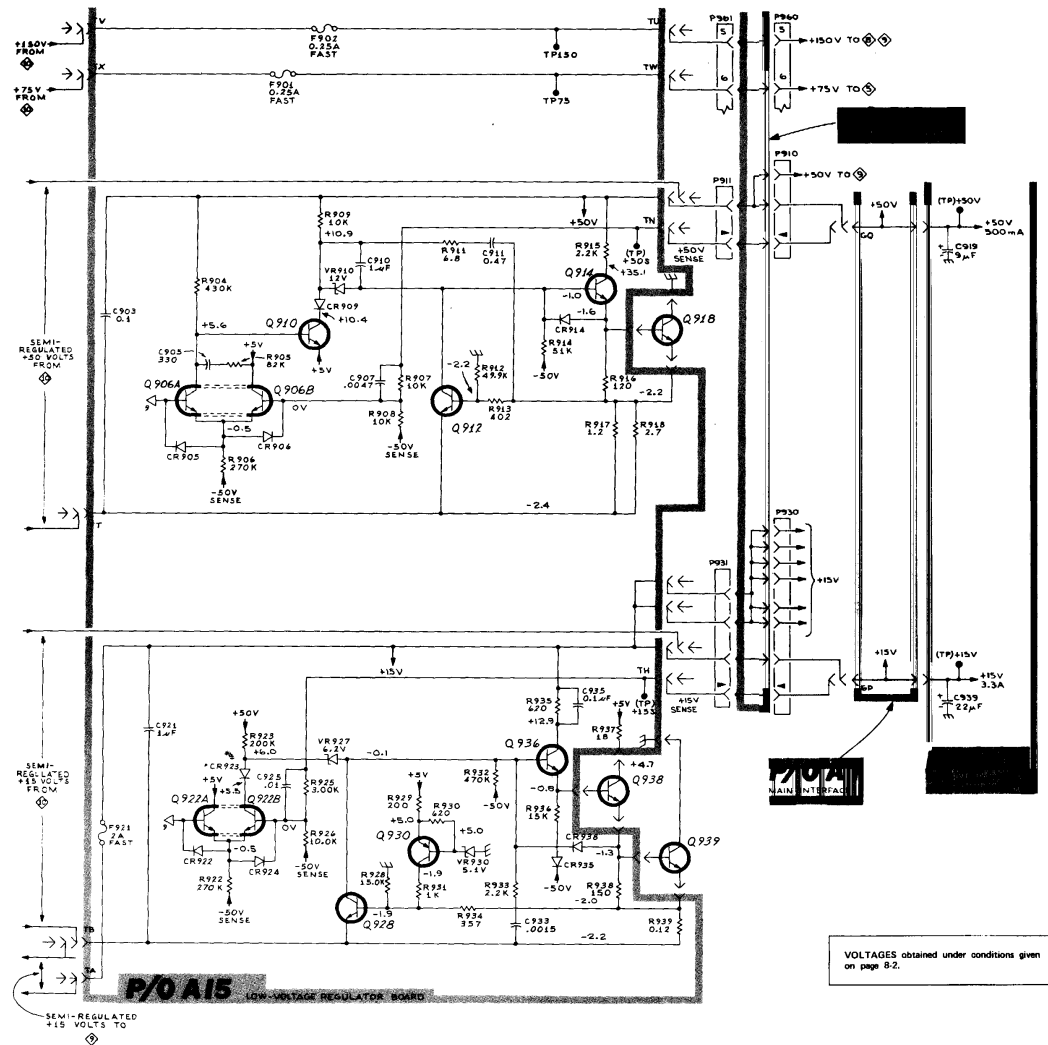


Fig. 8-24. A20 - Horizontal Mode Switch circuit board.



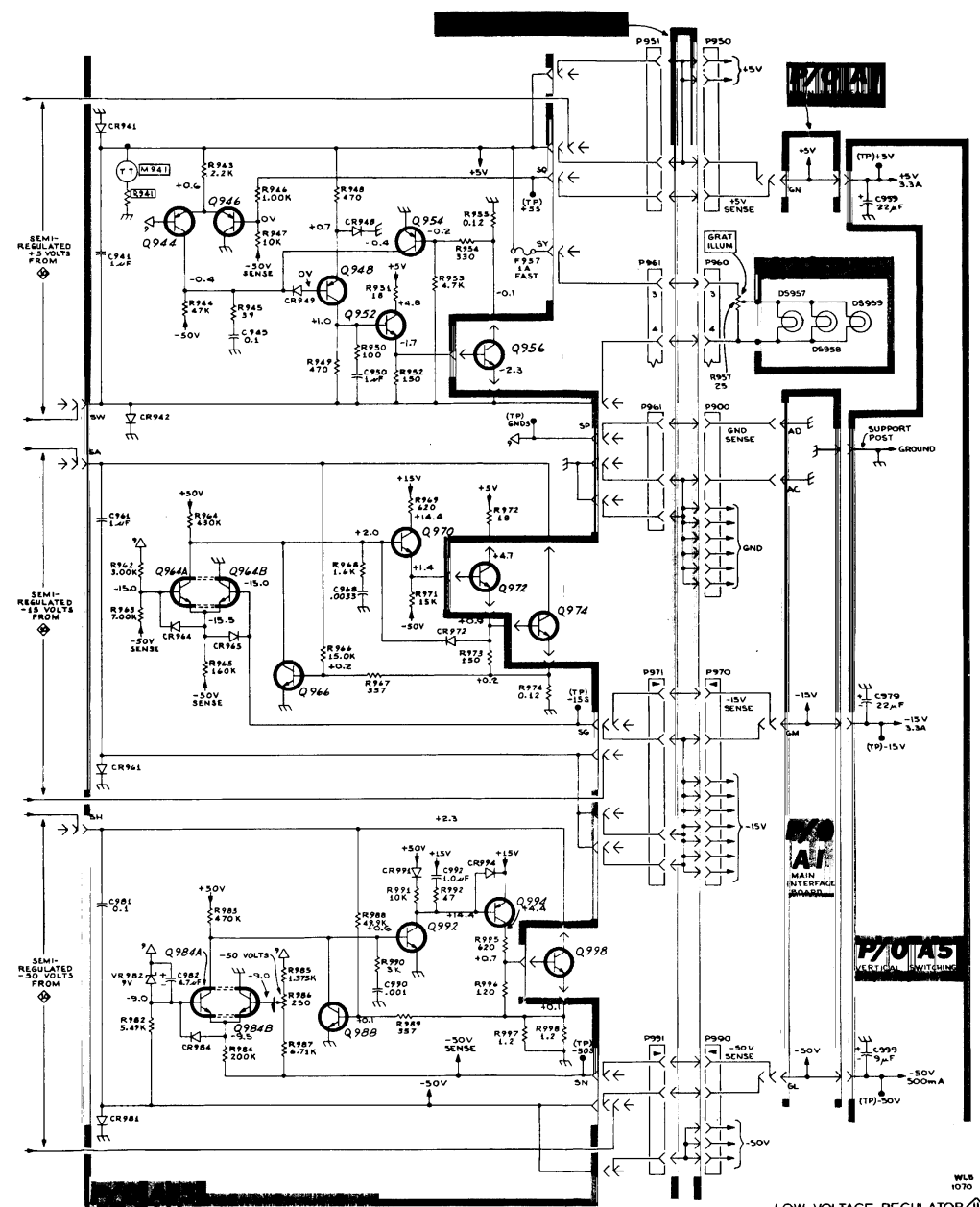
P/O A15
LOW-VOLTAGE REGULATOR BOARD

- REFERENCE DIAGRAMS
 ⊕ VERTICAL AMPLIFIER
 ⊕ OUTPUT SIGNALS & CALBRATOR
 ⊕ CRT CIRCUIT
 ⊕ LINE TO DC CONVERTER/REGULATOR

- NOTES:
 1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
 2. SEPARATE GROUND SYSTEM.

VOLTAGES obtained under conditions given on page 8-2.

R7704



LOW-VOLTAGE REGULATOR

REV. MAY 1974

WLS 1070

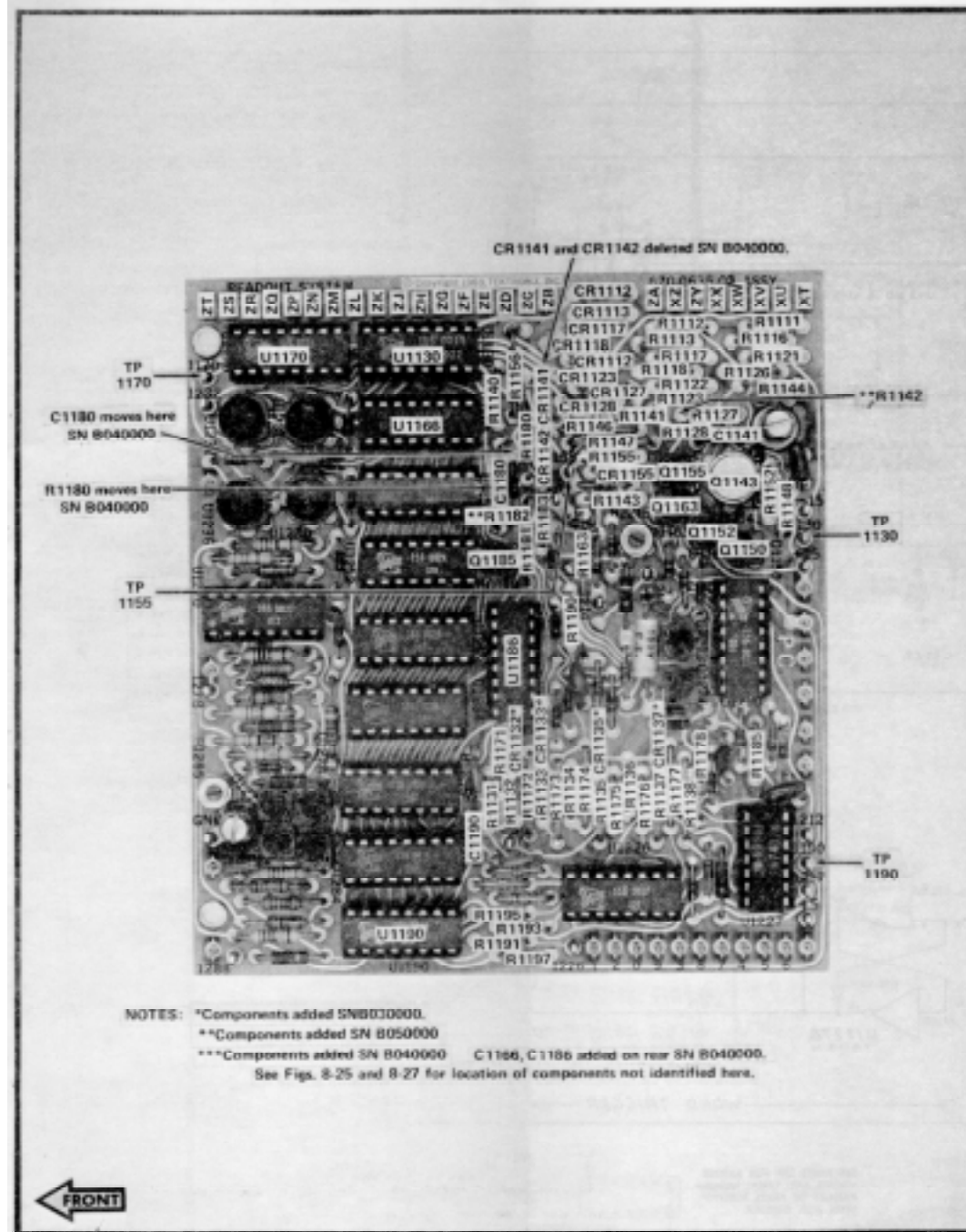
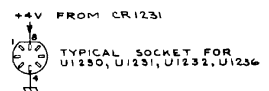
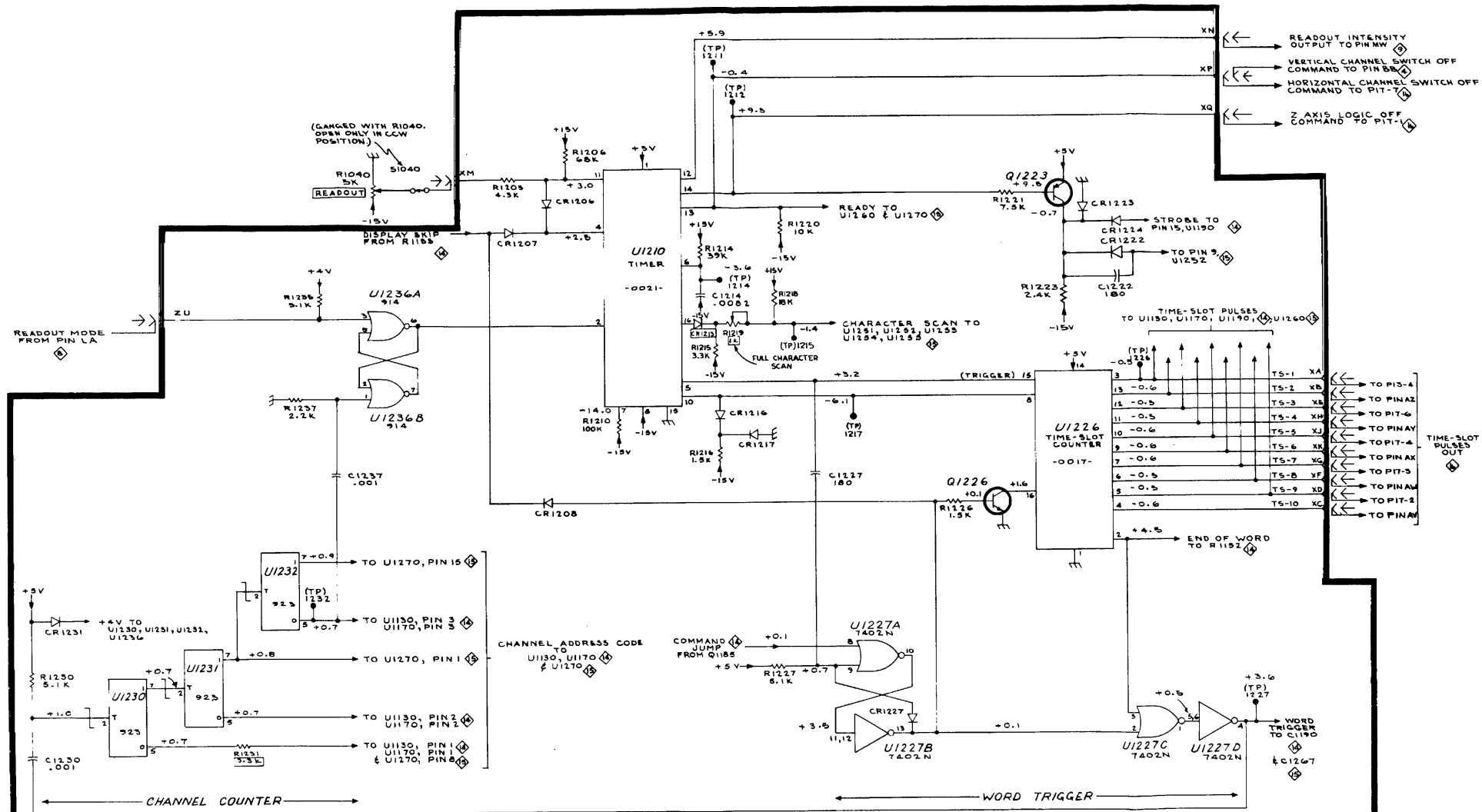


Fig. 8-26. P/O A21 - Partial Readout System circuit board.

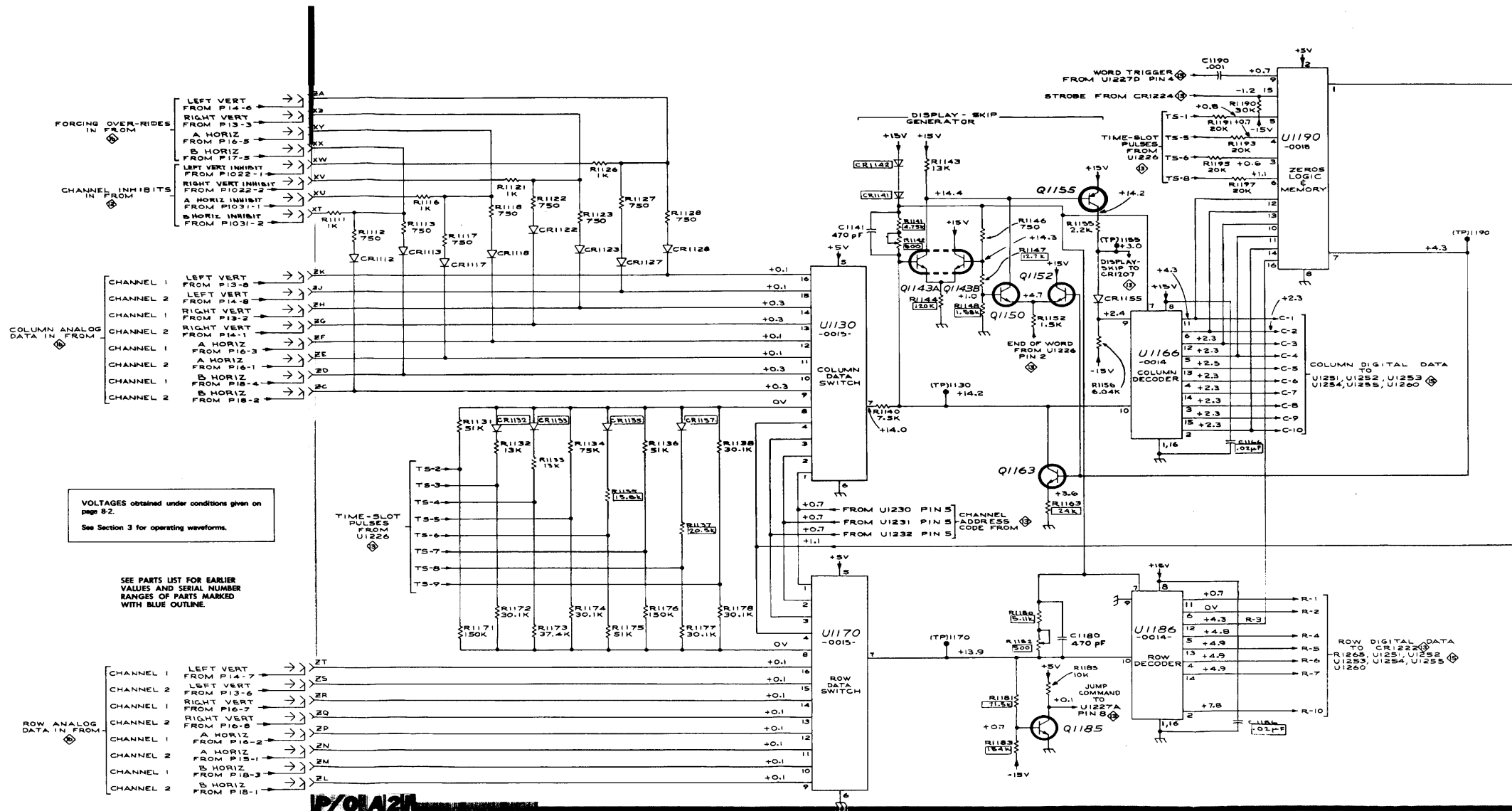


VOLTAGES obtained under conditions given on page B2. See Section 3 for operating waveforms.

- REFERENCE DIAGRAMS**
- ⊕ MAIN INTERFACE
 - ⊕ LOGIC CIRCUIT
 - ⊕ VERTICAL INTERFACE
 - ⊕ HORIZONTAL INTERFACE
 - ⊕ OUTPUT SIGNALS
 - ⊕ CRT CIRCUIT
 - ⊕ CONTROLS & CABLING
 - ⊕ DATA COLLECTION
 - ⊕ CHARACTER GENERATORS & OUTPUT

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

NOTE: SEE PARTS LIST FOR SEMICONDUCTOR TYPES



VOLTAGES obtained under conditions given on page 62.
See Section 3 for operating waveforms.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

- NOTES:
1. C=COLUMN DIGITAL DATA
 2. R=ROW DIGITAL DATA
 3. TS=TIME SLOT PULSE
 4. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS

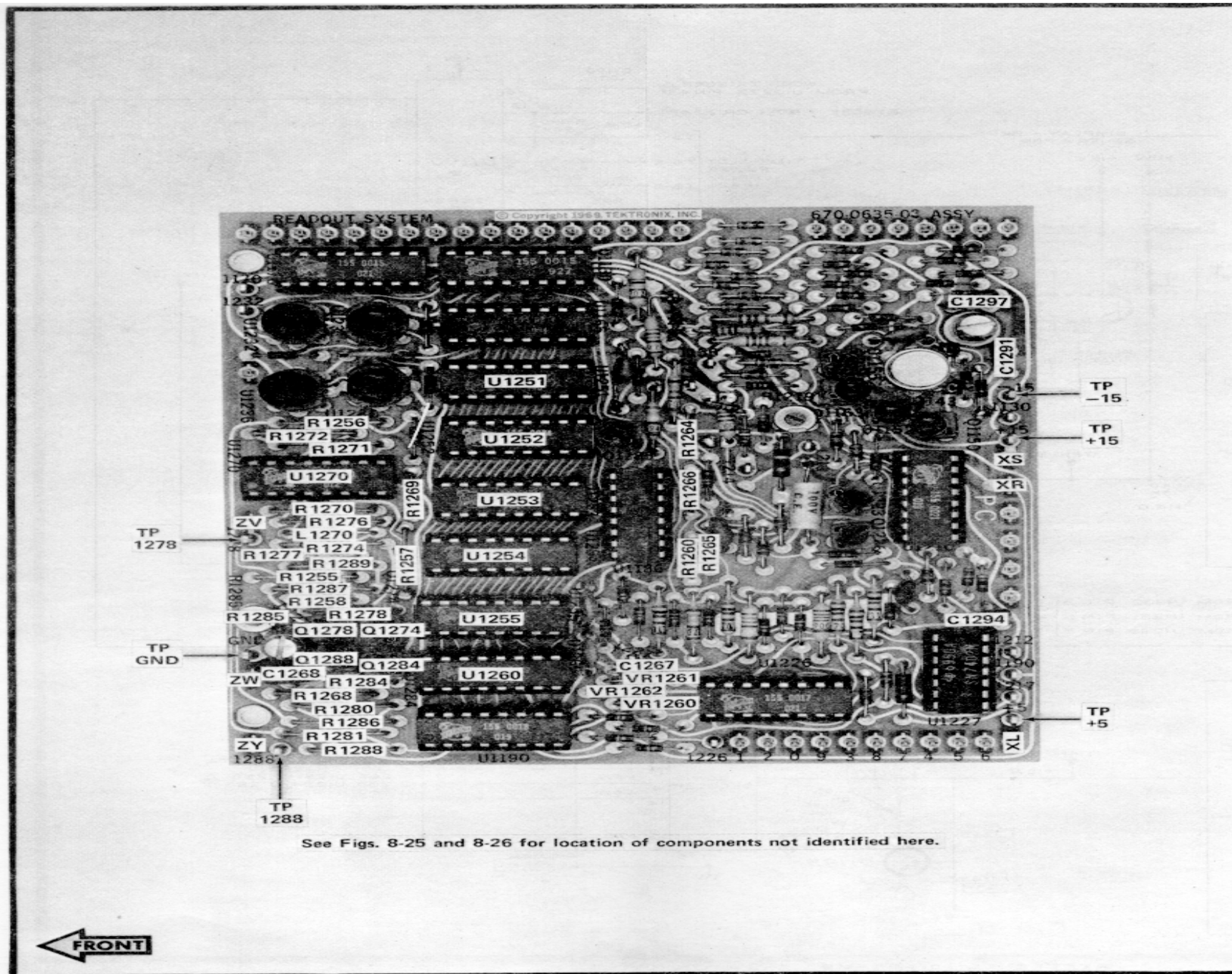
- ⊕ MAIN INTERFACE
- ⊕ CONTROLS & CABLING
- ⊕ SEQUENCING LOGIC
- ⊕ CHARACTER GENERATORS & OUTPUT

R7704

©

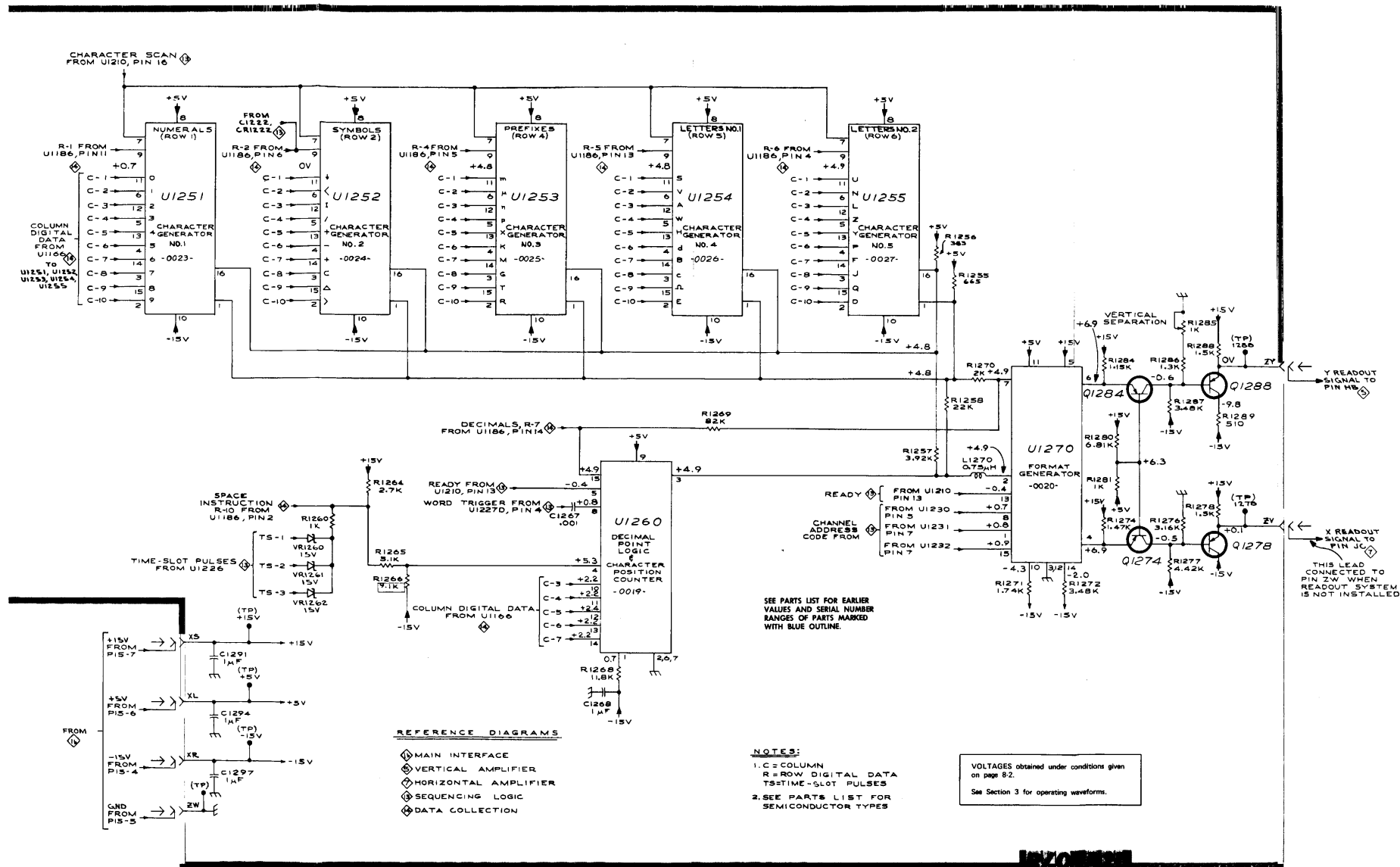
87/ VRS

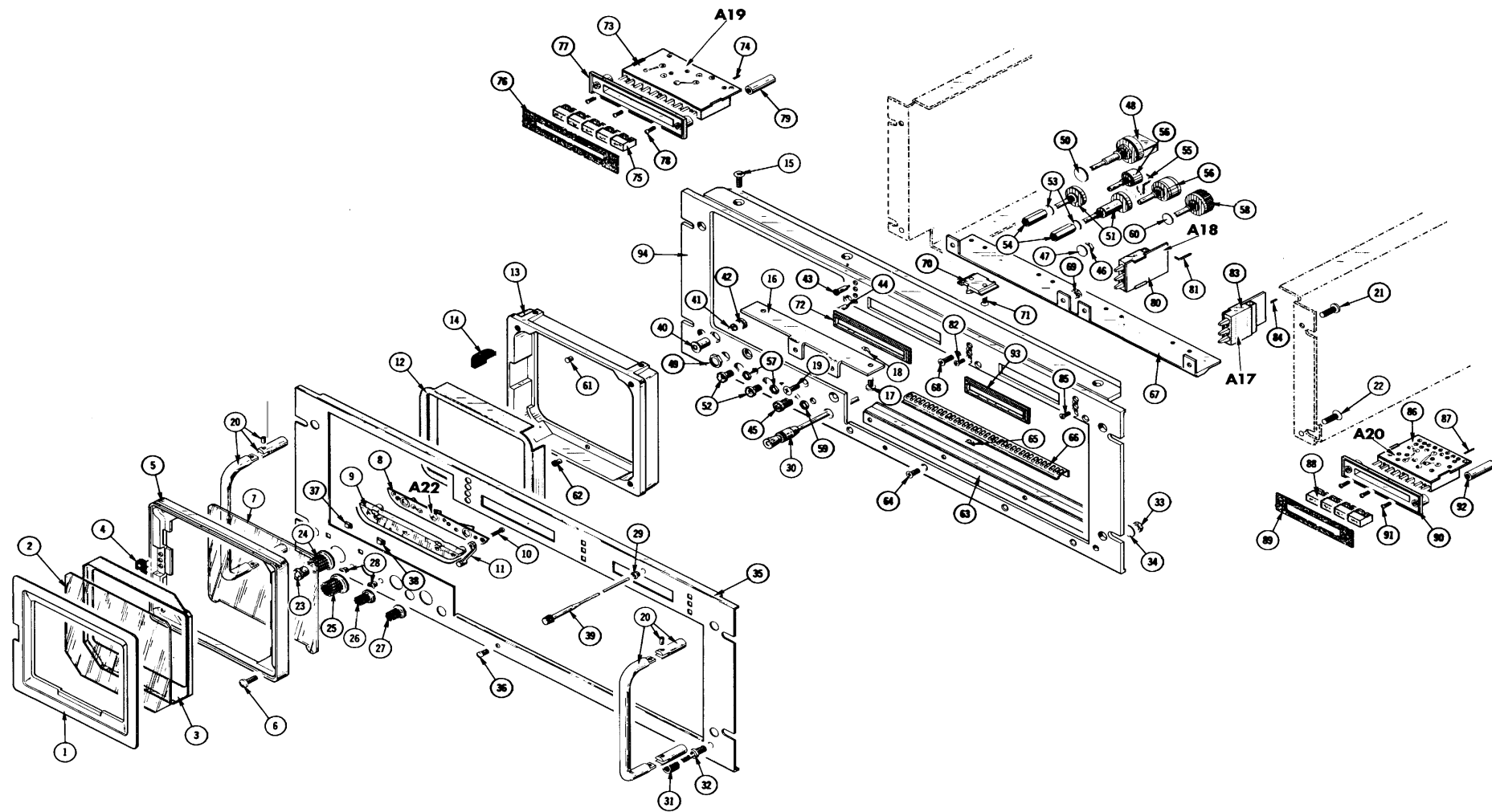
DATA COLLECTION

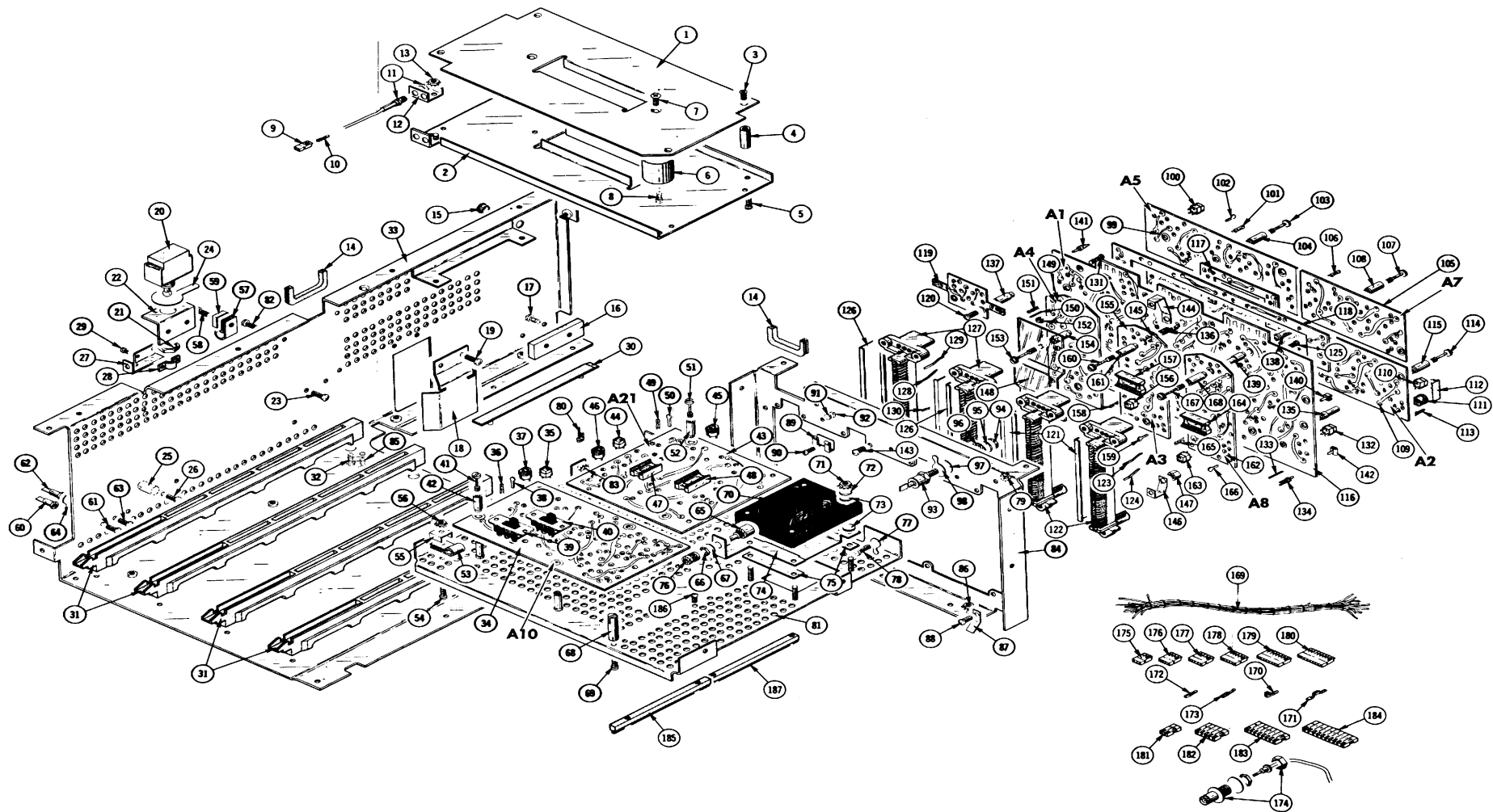


See Figs. 8-25 and 8-26 for location of components not identified here.

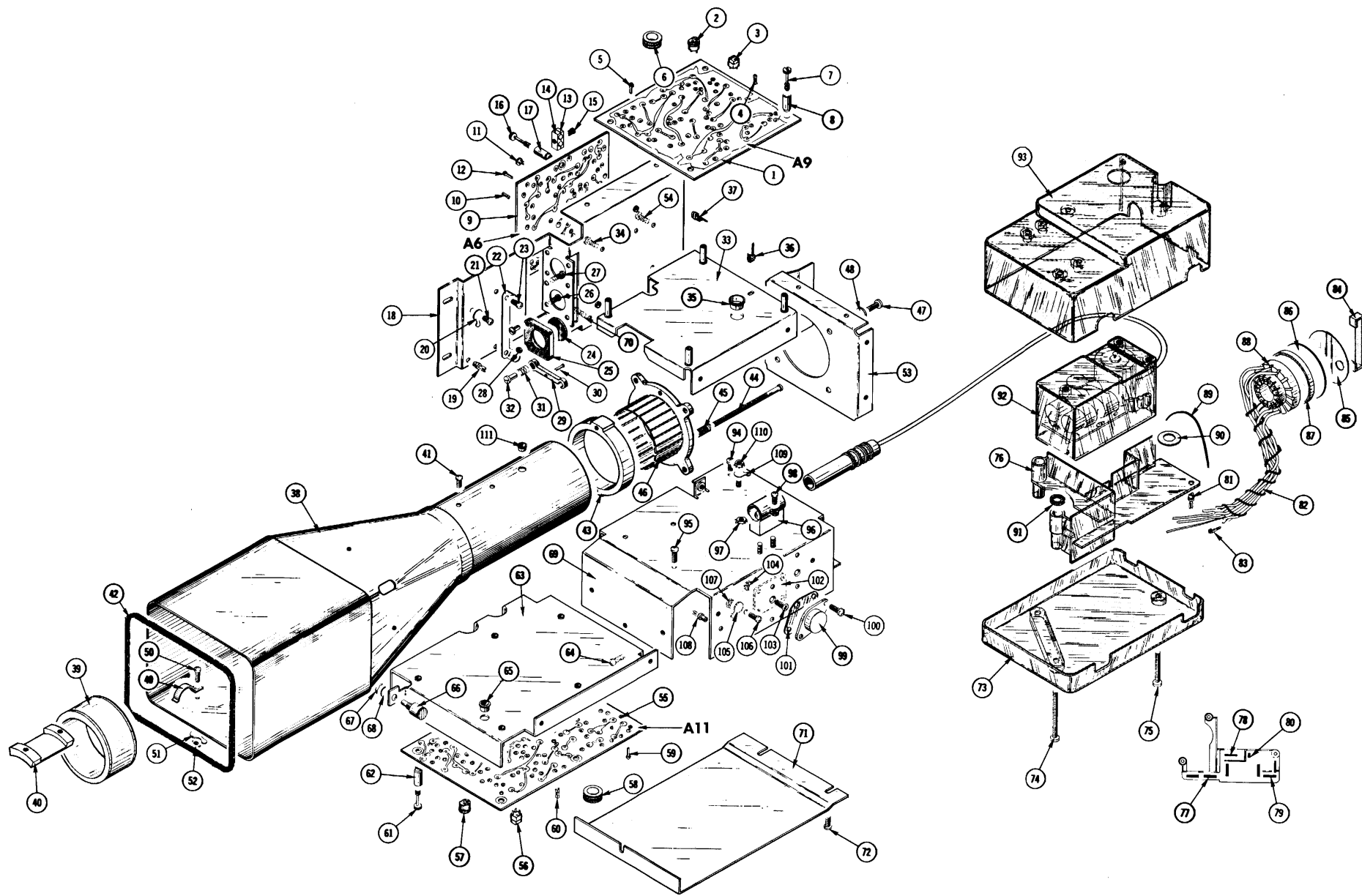
Fig. 8-27. P/O A21 - partial Readout system circuit board.



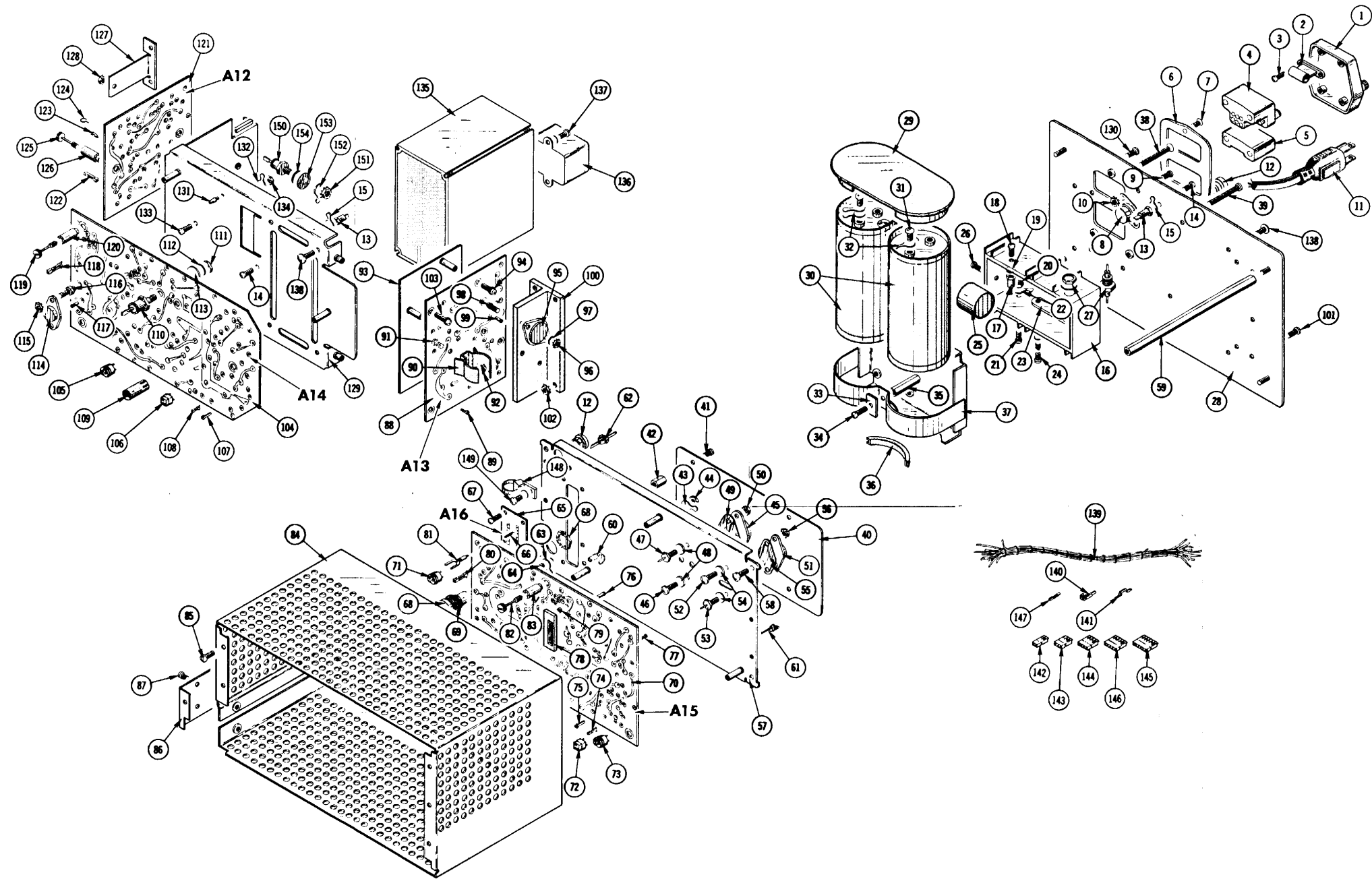




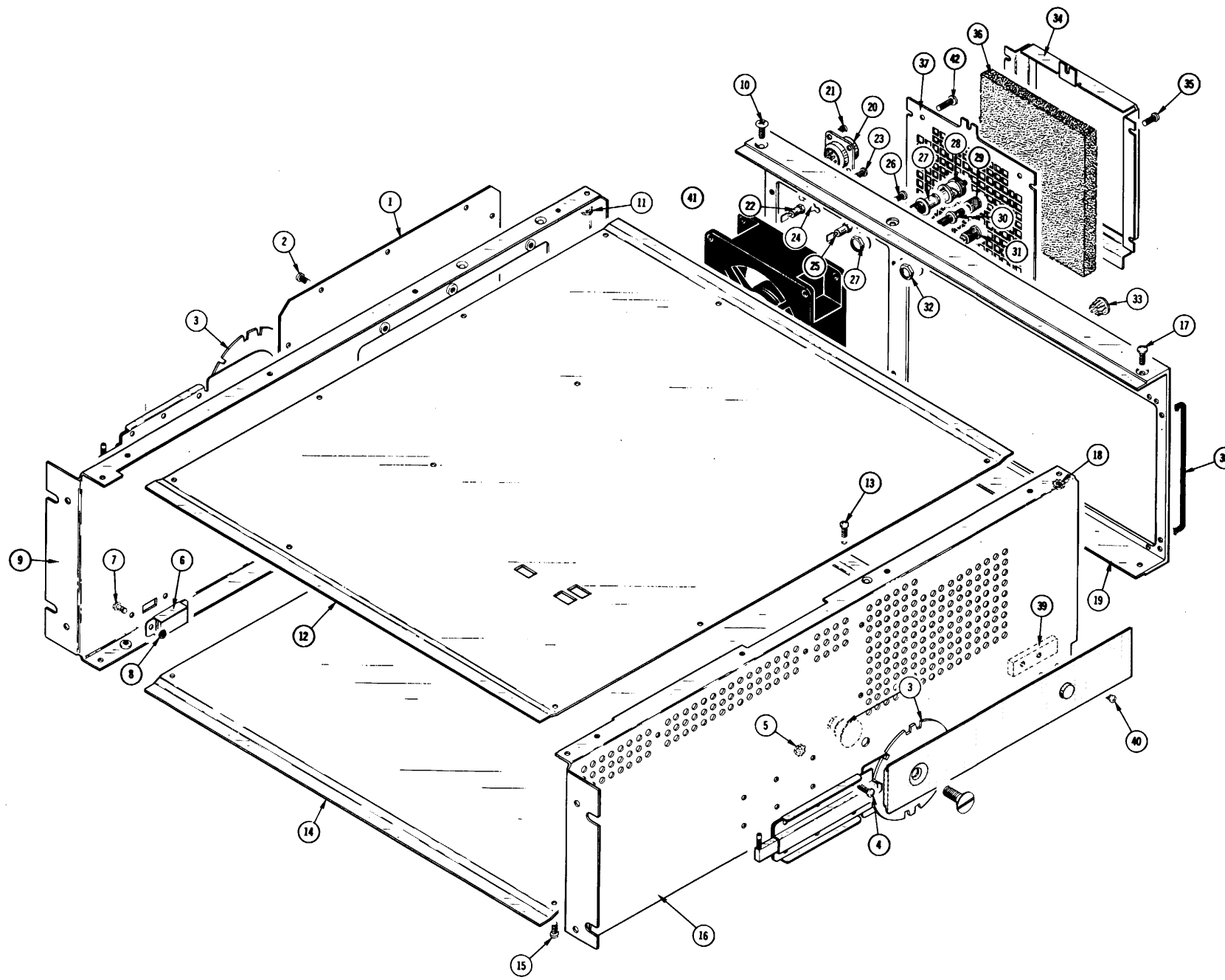
R7704 OSCILLOSCOPE



R7704 OSCILLOSCOPE



R7704 OSCILLOSCOPE



07704 0001 000005

R7704 OSCILLOSCOPE

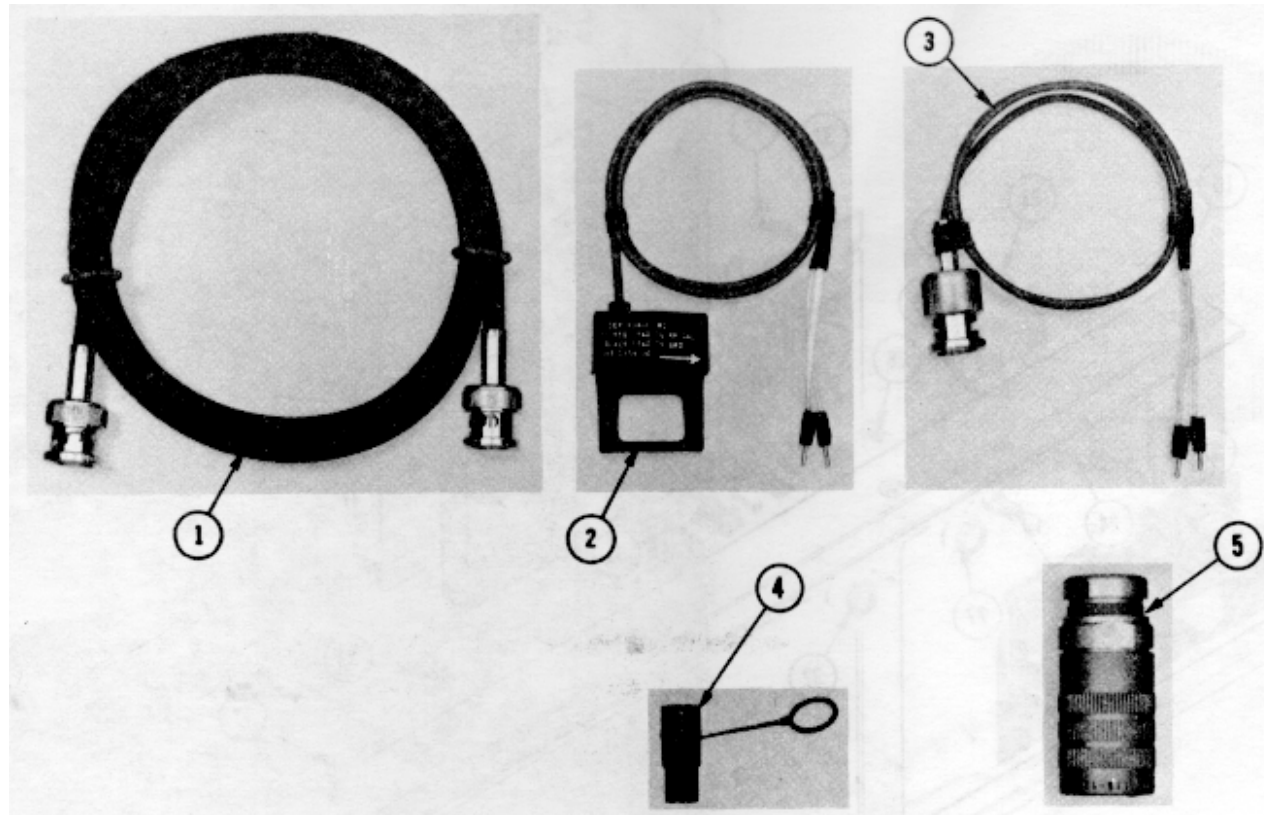
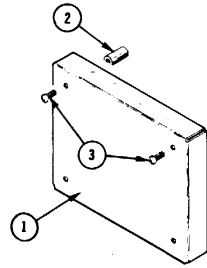


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q † y	Description				
					1	2	3	4	5
6-1	012-0057-01			1					CABLE ASSEMBLY, BNC to BNC
-2	012-0259-00			1					CABLE ASSEMBLY, probe to oscilloscope
-3	175-1178-00			1					CABLE, special purpose, RF
-4	012-0092-00			1					JACK, BNC post
-5	134-0049-00			1					SOCKET, 9-pin, w/male insert
	351-0086-00			1					TRACK, slide, stationary, (Pair not shown)
	016-0131-00			1					HARDWARE KIT (not shown)
	070-1088-00			1					MANUAL, instruction (not shown)

OPTION 1



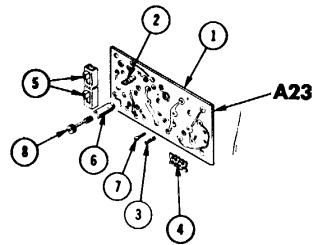
Ⓐ

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Q					Description	
				y	1	2	3	4		5
-1	200-1200-00				1					COVER, readout board pins
-2	385-0149-00					2				ROD, spacer, 0.625 inch long
-3	211-0008-00						4			SCREW, 4-40 x 0.25 inch, PHS
	131-0512-02							2		CONNECTOR, terminal

Ⓐ

STANDARD ACCESSORIES same as R7704

OPTION 2



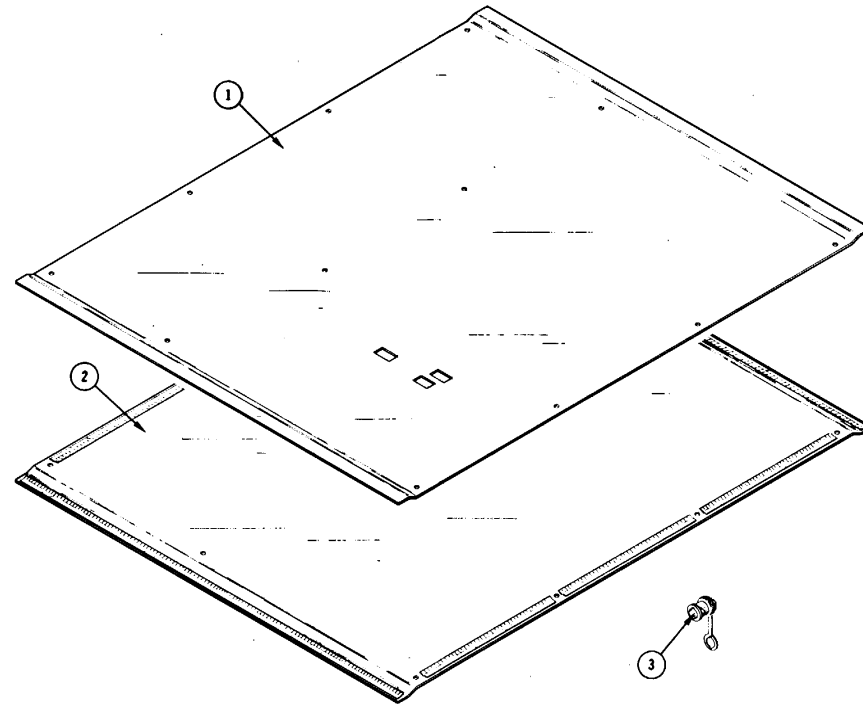
Ⓐ

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Q					Description	
				y	1	2	3	4		5
-1	670-0627-00				1					CIRCUIT BOARD ASSEMBLY—X-Y DELAY COMP A23
	388-1158-00					1				circuit board assembly includes: CIRCUIT BOARD
-2	129-0024-00					4				POST, connecting
-3	136-0263-03					11				SOCKET, terminal pin
-4	136-0337-00					3				SOCKET, relay, 8-pin
-5	260-0723-00					2				SWITCH, slide
-6	361-0238-00					2				SPACER, sleeve
-7	214-0579-00					2				PIN, test point
-8	211-0155-00					2				SCREW, relieved shank, 4-40 x 0.375 inch

Ⓐ

STANDARD ACCESSORIES same as R7704

OPTION 3



Ⓐ

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Q					Description	
				y	1	2	3	4		5
-1	390-0195-00				1					CABINET TOP, EMI
-2	390-0196-00				1					CABINET BOTTOM, EMI
-3	200-0678-00					3				COVER, BNC, nonshorting
	346-0045-00					3				STRAP, connector, plastic
	378-0603-00					1				FILTER, mesh, CRT (not shown)
	426-0514-00									FRAME, mask, plastic (not shown)
	378-0625-00									FILTER, light, CRT (not shown)

STANDARD ACCESSORIES same as R7704—also includes:

- 1 FRAME, mask, plastic (not shown)
- 1 FILTER, light, CRT (not shown)

Ⓐ
R7704 OSCILLOSCOPE

R7704 OSCILLOSCOPE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM, CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

PUBLICATION DATE

PUBLICATION TITLE

BE EXACT... PIN-POINT WHERE IT IS

PAGE NO.

PARA-GRAPH

FIGURE NO.

TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2
1 JUL 79

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

PIN: 046174-000