TEK INSTRUCTION MANUAL

Part No. 070-5039-00
Product Group No. 42

R7103
OSCILLOSCOPE

WARNING

The following service instructions are for use by qualified personnel only. To avoid personal injury, do not perform any service other than that contained in operating instructions unless you are qualified to do so. Refer to Operators Safety Summary and Service Summary prior to performing any service.

Please Check for CHANGE INFORMATION at the Rear of This Manual

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Tektronix®
COMMITTED TO EXCELLENCE

INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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WARNING

The remaining portion of this Table of Contents lists the servicing instructions. These instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that called out in the operating instructions unless qualified to do so.

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OPERATORS SAFETY SUMMARY

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

TERMS

IN THIS MANUAL

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

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

AS MARKED ON EQUIPMENT

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

IN THIS MANUAL

Static-Sensitive Devices

This symbol indicates where applicable cautionary or other information is to be found.

AS MARKED ON EQUIPMENT

DANGER—High voltage.

Protective ground (earth) terminal.

ATTENTION—Refer to manual.

WARNINGS

POWER SOURCE

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

GROUNDING THE INSTRUMENT

The R7103 is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle, where earth ground has been verified by a qualified service person, before making connections to the input or output terminals of the instrument. A protective-ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating), can render an electric shock.

USE THE PROPER FUSE

To avoid fire hazard, use only the fuse specified in the parts list for your product, and which is identical in type, voltage rating, and current rating.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERE

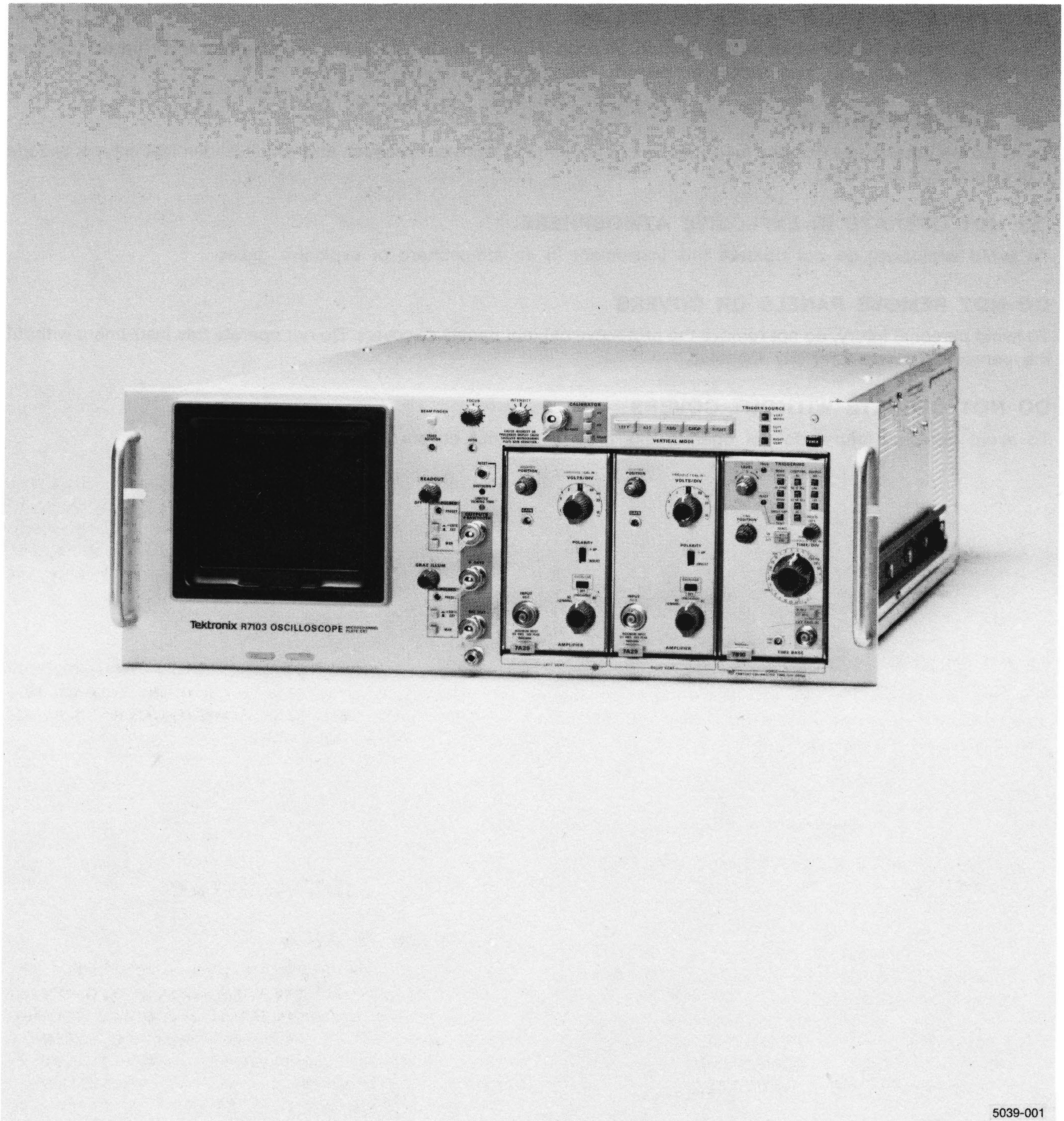
To avoid explosion, do not operate this instrument in an atmosphere of explosive gases.

DO NOT REMOVE PANELS OR COVERS

To avoid personal injury, do not remove the protective cabinet panels or covers. Do not operate this instrument without the panels or covers properly installed.

DO NOT OPERATE WITHOUT COVERS

To avoid personal injury, do not operate this product without covers



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R7103 FEATURES

The TEKTRONIX R7103 Oscilloscope is a solid-state, wide-bandwidth instrument designed for general-purpose applications. The R7103 can be used to display or make photographs of very fast repetitive or single-shot waveforms.

The R7103 accepts Tektronix 7000-series plug-in units; the flexibility of the plug-in feature and the variety of plug-in units available can configure the system to suit many measurement applications. The left pair of plug-in compartments are for vertical deflection and the right one is for horizontal deflection. Electronic switching between the two left compartments will produce a multi-trace vertical display.

GENERAL INFORMATION

INTRODUCTION

OPERATORS MANUAL

The Operators Manual has the following three sections:

Section 1—General Information, contains a description of the R7103, its electrical specifications, environmental characteristics, standard and recommended accessories, installation, and packaging for shipment instructions.

Section 2—Operating Instructions, contains information about operating and checking the instrument operation.

Section 3—Instrument Options, contains a description of available options and gives the location of the incorporated information about those options.

INSTRUCTION MANUAL

The first two sections of the Instruction Manual contain operating instructions which are identical to the first two sections of the Operators Manual.

WARNING

THE REMAINING PORTIONS OF THE INSTRUCTION MANUAL CONTAIN SERVICING INSTRUCTIONS. THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK OR OTHER PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT DESCRIBED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

Section 3—Theory of Operation, contains basic and general circuit analysis that may be useful for servicing or operating the instrument.

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

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

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

Section 7—Replaceable Electrical Parts, contains information necessary to order replaceable electrical parts and assemblies.

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

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

INSTALLATION

INITIAL INSPECTION

The R7103 was inspected both mechanically and electrically before shipment. It should be free of mars or scratches and should meet or exceed all electrical specifications. To confirm this, inspect the instrument for physical damage incurred in transit and test its electrical performance by following the Operators Checkout Procedure in Section 2, Operating Instructions. Verify Performance Requirements by referring a qualified service person to the servicing sections of the Instruction Manual. If there is damage or deficiency, contact your local Tektronix Field Office or representative.

OPERATING-POWER INFORMATION

This instrument can be operated from either a 115-volt or 230-volt nominal supply source, 48 to 440 hertz. The line fuse remains the same for both 115-volt and 230-volt operation.

CAUTION

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

WARNING

AC POWER SOURCE AND CONNECTION. The R7103 operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding-type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.

Before making connection to the power source, check that the R7103 line voltage selector is set to match the voltage of the power source, and has a suitable two-pole, three-terminal grounding-type plug. Refer any changes to qualified service personnel.

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

The power input plug must be inserted only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.

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

TABLE 1-1
Power-Cord Conductor Identification

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

POWER-CORD INFORMATION

A power cord with the appropriate plug configuration is supplied with each R7103. For your convenience the color-coding of the conductors in the power cord is given in Table 1-1. Also, should you require a power-cord plug other than that supplied, refer to Table 1-2, Power-Cord and Plug Identification.

OPERATING VOLTAGE

The LINE VOLTAGE SELECTOR (located on the rear-panel) allows you to select 115-volt or 230-volt nominal line voltage operation. To convert from 115-volt to 230-volt operation, change the power cord and plug to match the power-source receptacle, then use a small screwdriver to move the LINE VOLTAGE SELECTOR to the desired range. The line fuse remains the same for both 115-volt and 230-volt operation.

OPERATING TEMPERATURE

The R7103 can be operated where the ambient air temperature is between 0° and +50° C and can be stored in ambient temperatures from −55° to +75° C. After storage at temperatures outside the operating limits, allow the chassis to reach a safe operating temperature before applying power.

The R7103 is cooled by air drawn in through the rear of the instrument by the fan and blown out through the sides.

PACKAGING FOR SHIPMENT

If the R7103 is to be shipped for long distances by commercial transportation, it is recommended that the instrument be packaged in the original manner. The carton and packaging material in which your instrument was shipped should be saved and used for this purpose.

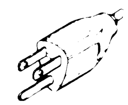
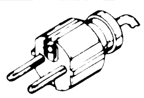
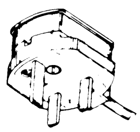
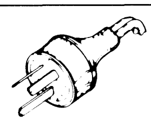
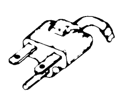
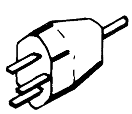
Also, if this instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument showing the following: Owner of the instrument (with address), the name of a person at your firm who can be contacted, complete instrument type and serial number, and a description of the service required.

If the original packaging is unfit for use or not available, package the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument dimensions; refer to Table 1-3 for carton test strength requirements.

2. Enclose the instrument with polyethylene sheeting or equivalent to protect the finish of the instrument.

TABLE 1-2
Power-Cord and Plug Identification Information

Plug Configuration	Usage	Nominal Line-Voltage (AC)	Reference Standards	Option #
	North American 120V/15A	120 V	[1]ANSI C73.11 [2]NEMA 5-15-P [3]IEC 83	Standard
	Universal Euro 220V/6-16A	220 V	[4]CEE (7),II,IV,VII [3]IEC 83	A1
	UK 240V/6-13A	240 V	[5]BS 1363 [3]IEC 83	A2
	Australian 240V/6-10A	240 V	[6]AS C112	A3
	North American 240V/15A	240 V	[1]ANSI C73.20 [2]NEMA 6-15-P [3]IEC 83	A4
	Switzerland 220V/6-10A	220 V	[7]SEV	A5

[1]ANSI—American National Standards Institute
[2]NEMA—National Electrical Manufacturer's Association
[3]IEC—International Electrotechnical Commission
[4]CEE—International Commission on Rules for the Approval Electrical Equipment
[5]BS—British Standards Institution
[6]AS—Standards Association of Australia
[7]SEV—Schweizevischer Elektrotechischer Verein

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing three inches on each side.

4. Seal the carton with shipping tape or with an industrial stapler.

5. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent locations.

TABLE 1-3
Shipping Carton Test Strength

Gross Weight (lb)	Carton Test Strength (lb)
0-10	200
10-30	275
30-120	375
120-140	500

SPECIFICATION

The electrical characteristics listed in Table 1-4 apply at an ambient temperature of 0° to +50° C, unless otherwise stated, when the following conditions are met: (1) the instrument must have been adjusted at an ambient temperature between +20° and +30° C, (2) the instrument must be allowed a 20-minute warm-up period, (3) the instrument must be in an environment that meets the limits described in Table 1-5.

Any applicable conditions not listed above are expressly stated as part of that characteristic. Table 1-5 lists Environmental characteristics and Table 1-6 gives the Physical characteristics.

TABLE 1-4
Electrical Characteristics

Characteristic	Performance Requirement
VERTICAL SYSTEM	
Deflection Factor	Compatible with all 7000-series plug-in units.
Difference Between Vertical Compartments	1% or less.
Low-Frequency Linearity	0.1 div or less compression or expansion of a center-screen two-division display positioned anywhere vertically within the graticule area.
Frequency Response	Varies with plug-in unit selected. See R7103 Oscilloscope Vertical Systems Specification, Table 1-8.
Step Response Rise Time (10 to 90%), with 7A29 Amplifier (0° to +35°C)	350 ps or less (calculated from bandwidth).
Isolation between Vertical Compartments (eight-division signal) LEFT, RIGHT, ALT modes	At least 160:1 from dc to 100 MHz and at least 80:1 from 100 MHz to 1 GHz.
Delay Line	Permits viewing leading edge of triggering signal. **NOTE** *7B50-series time bases will not display leading edge of the trigger signal in R7103 (except 7B50A).*
Difference in Signal Delay Between Vertical Compartments	50 ps or less.
Vertical Display Modes	Selected by front-panel VERTICAL MODE selector.
LEFT	Signal from left vertical plug-in unit displayed.
ALT	Display alternates between left and right vertical plug-in units at a rate determined by the horizontal plug-in unit.
ADD	Display is algebraic sum of left and right vertical plug-in units.
CHOP	Display chops between left and right vertical plug-in units asynchronously to horizontal plug-in unit.
Repetition Rate	1 MHz within 20%.
RIGHT	Signal from right vertical plug-in unit displayed.

TABLE 1-4 (CONT)
Electrical Characteristics

<table>
<tr><th>Characteristic</th><th>Performance Requirement</th></tr>
<tr><td colspan="2">TRIGGERING</td></tr>
<tr><td>TRIGGER SOURCE</td><td>Selected by front-panel TRIGGER SOURCE buttons. Lights behind buttons illuminate to indicate trigger source.</td></tr>
<tr><td>VERT MODE</td><td>The trigger source is controlled by vertical display mode selection. Source(s) is(are) shown by the illumination of the LEFT VERT and RIGHT VERT button(s). Source follows (is same as) the vertical display with the following two exceptions:
<table>
<tr><th>VERT MODE</th><th>Trigger Source</th></tr>
<tr><td>CHOP</td><td>Left</td></tr>
<tr><td>ALT</td><td>Right Trigger, then
Left Trigger</td></tr>
</table></td></tr>
<tr><td>LEFT VERT</td><td>Trigger source: Left vertical unit. LEFT VERT trigger source button illuminated.</td></tr>
<tr><td>RIGHT VERT</td><td>Trigger source: Right vertical unit. RIGHT VERT trigger source button illuminated.</td></tr>
<tr><td colspan="2">HORIZONTAL SYSTEM</td></tr>
<tr><td>Deflection Factor</td><td>Compatible with all 7000-series plug-in units.</td></tr>
<tr><td>DC Linearity</td><td>0.05 division or less error at each graticule line after adjusting for no error at second and tenth graticule lines.</td></tr>
<tr><td>Fastest Calibrated Sweep Rate</td><td>200 ps/div. (See R7103 Horizontal System Specs., Table 1-9).</td></tr>
<tr><td>Phase Shift Between Vertical and Horizontal Deflection Systems</td><td>2° or less from dc to at least 50 kHz.</td></tr>
<tr><td>Bandwidth</td><td>350 MHz.</td></tr>
<tr><td colspan="2">CALIBRATOR</td></tr>
<tr><td>Waveshape</td><td>Square wave.</td></tr>
<tr><td>Polarity</td><td>Positive going, with baseline near 0 volt.</td></tr>
<tr><td>Output Resistance</td><td>450 Ω.</td></tr>
<tr><td>Output voltage</td><td>(Selected by front-panel CALIBRATOR switch).</td></tr>
<tr><td>Into 100 kΩ or greater</td><td>40 mV, 0.4 V, 4 V.</td></tr>
<tr><td>Into 50 Ω</td><td>4 mV, 40 mV, 0.4 V.</td></tr>
<tr><td>Output Current</td><td>40 mA available through CALIBRATOR output with optional bnc-to-Current Loop adapter. CALIBRATOR must be set to 4 V for calibrated output.</td></tr>
<tr><td>Amplitude Accuracy (P-P Voltage)</td><td>Within 1%.</td></tr>
<tr><td>Repetition Rate</td><td>1 kHz within 0.25%.</td></tr>
</table>

TABLE 1-4 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement
CALIBRATOR (CONT)	
Duty Factor	49.8% to 50.2%.
Rise Time and Fall Time	500 ns or less into 100 pF or less.
SIGNAL OUTPUTS	
+SAWTOOTH OUT	
Source	HORIZ time-base.
Polarity	Positive-going with baseline at 0 V within 1 V into 1 MΩ.
Output Voltage	
Rate of Rise	
Into 50 Ω	50 mV/unit of time selected by time base time/div switch, within 15%, 100 ns/div maximum sweep rate.
Into 1 MΩ	1 V/unit of time selected by the time base time/div switch, within 10%; 1 μs/div maximum sweep rate.
Output Resistance	Approximately 950 Ω.
+GATE	
Source	Gate, derived from HORIZ time base main gate.
Polarity	Positive-going with baseline at 0 V within 1.0 V into 1 MΩ.
Output Voltage	
Into 50 Ω	0.5 V within 10%.
Into 1 MΩ	10 V within 10% (up to 1 μs/div sweep rate).
Rise Time Into 50 Ω	5 ns or less.
Fall Time Into 50 Ω	15 ns or less.
Output Resistance	Approximately 950 Ω.
SIG OUT	Selected by TRIGGER SOURCE selector.
Source	Same as TRIGGER SOURCE.
Output Voltage	
Into 50 Ω	25 mV/div of vertical deflection within 25%.
Into 1 MΩ	For a maximum output of ±2 V: 0.5 V/div of vertical deflection within 25%.
Bandwidth into 50 Ω	Varies with vertical plug-in selected; see Table 1-8, R7103 Oscilloscope Vertical System Specification.
DC Centering	0 V within 1 V into 1 MΩ.
Aberrations	15% or less p-p within 50 ns of step.
Output Resistance	Approximately 950 Ω.

TABLE 1-4 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement
READOUT DISPLAY	
Readout Modes	
Free-Run (not labeled)	Continuously displayed.
PULSED	Single-shot operation.
Pulse Source	Selected by front-panel switches. +GATE: Triggered by the trailing edge of the +GATE. EXT: Controlled through rear-panel remote control connector. MAN: Manual trigger, independent of other pulse sources.
DISPLAY	
Graticule	
Type	Internal, illuminated with variable edge lighting.
Lighting	
Normal	Continuously lighted.
PULSED	Signal-shot operation. Lights are pulsed on for approximately 0.5 seconds.
Pulse Source	Selected by front-panel switches. +GATE: Triggered by trailing edge of +GATE. EXT: Controlled through rear-panel remote control connector. MAN: Manual trigger, independent of other pulse sources.
Area	8 × 10 div (one division equals 8.5 mm).
Phosphor	P31.
Vertical and Horizontal Resolution	17 lines/div.
High Voltage	
Screen Voltage	Approximately 12.5 kV.
Limited Viewing Time Indicator	
Steady Yellow	Crt display time is limited to approximately 1 hour or less, depending on intensity of display.
Flashing Yellow	Crt display time is limited to approximately 1 minute and intensity is being limited.
Shutdown Indicator	
Flashing Red	Crt display will be shut off within 10 seconds.
Steady Red	Indicates crt display is shut off.
Geometry	Within 0.1 div of vertical and horizontal graticule lines.
BEAMFINDER	When actuated, limits display to within graticule area and defocuses display.

TABLE 1-4 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement
DISPLAY (CONT)	
Photographic Writing Speed	20 cm/nsec (without mesh or blue filter). PHOSPHOR: Standard P31. CAMERA: TEKTRONIX C53; f/1.9 1:0.85 lens. FILM: Polaroid Type 107; 3000 ASA.
REMOTE CONNECTORS AND SWITCHES	
Control Illumination	HIGH, MEDIUM and OFF. Three-position switch located on rear panel of power supply.
Camera Power	Three-contact connector compatible with TEKTRONIX C-50 Series Cameras.
Bottom Pin	Ground
Center Pin	Single sweep reset.
Top Pin	+15 V.
SINGLE SWEEP RESET	Connector (bnc) on rear panel to reset single-sweep function of time base installed in HORIZ compartment. Also resets the Limited View Time function.
Signal Required	Closure to ground or switching from the high level (+50 to +10 V; sink less than 40 μA) to low level (+0.5 V to −5 V; sink less than 12 mA) in less than 1 msec, resets the sweep and the Limited View Time function. Compatible with 15 V open-collector TTL source.
Minimum Pulse Width	10 μs at 50% amplitude points.
Maximum Safe Input Voltage	+50 V to −5 V (dc + peak ac).
SINGLE SWEEP READY	Connector (bnc) on rear panel. Remote ready indicator for HORIZ time base.
Output Signal	Open when not ready. +5 V at 47 Ω source impedance when ready. Output will light a No. 49 bulb.
GRATICULE/READOUT SINGLE SHOT	Connector (bnc) on rear panel. Switching to the low level (+1 V to −5 V; sink less than 2 mA) from the high level (+10 V to +15 V; sink less than 0.3 mA), in less than 1 μsec, triggers the readout to display one complete readout frame and the GRAT ILLUM to be illuminated for approximately 0.5 sec. Compatible to 15 V open collector TTL source.
Maximum Open Circuit Voltage	+15 V.
Maximum Safe Input Voltage	+15 V to −5 V (dc plus peak ac).
Probe Power	Two probe power connectors on rear panel.
Pin 1	+5 V.
Pin 2	Chassis ground.

TABLE 1-4 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement
REMOTE CONNECTORS AND SWITCHES (CONT)	
Probe Power (cont)	
Pin 3	−15 V.
Pin 4	+15 V.
Z-AXIS INPUT (External)	Connector (bnc) on rear panel.
Polarity and Sensitivity	Positive 2 V provides complete blanking from maximum intensity condition. Negative 2 V provides complete unblanking from minimum intensity condition.
Low Frequency Limit	Dc.
Input Resistance	Approximately 500 Ω.
Input Capacitance	Less than 50 pF.
Open Circuit Voltage	0 V.
Maximum Safe Input Voltage	15 V, dc plus peak ac.
Maximum Repetition Rate	1 MHz.
POWER SOURCE	
Voltage Range (AC, RMS)	Selected by rear-panel LINE VOLTAGE SELECTOR.
115 V Rated	From 90 V to 132 V.
230 V Rated	From 180 V to 250 V.
Line Frequency	From 48 Hz to 440 Hz.
Maximum Power Consumption	165 W, worst case.
Maximum Current	3.3 A at 60 Hz, 90 V Line.
	1.7 A at 60 Hz, 180 V Line.
Fuse	4 A fast blow. (For both LINE VOLTAGE SELECTOR settings.)

TABLE 1-5
Environmental Characteristics

Characteristics	Information
NOTE *This instrument will meet the electrical characteristics given in the Performance Requirement column of Table 1-4 over the following environmental limits.*	
Temperature	
Operating	0° to +50° C.
Storage	-55° to +75° C.
Altitude	
Operating	5 km (15,000 feet).
Storage	15 km (50,000 feet).
EMC (Electromagnetic Compatibility)	**NOTE** *The EMI mesh filter must be installed and any unused plug-in compartments must be covered with a blank plug-in panel (EMI shielded) in order to meet EMC specifications.* Meets requirements of MIL-STD-461B, when tested in accordance with the following test methods of MIL-STD-462: CE-03 part 4 curve 1, CS-01 part 4, CS-02 part 4, CS-06 part 5, RE-02 part 4 (limited to 1 GHz), RS-01 part 2, RS-03 part 7 (limited to 1 GHz), and VDE 0871 class B.

TABLE 1-6
Physical Characteristics

Characteristic	Information
Ventilation	Safe operating temperature maintained by dc fan. Automatic resetting thermal cutout protects instrument from overheating.
Finish	Anodized front panel.
Overall Dimensions (measured at maximum points)	See Figure 1-1.
Height	177 mm (6.98 inches).
Width	483 mm (19.0 inches).
Length	742 mm (29.22 inches).
Net Weight (Instrument without plug-in units)	19.96 kg (44 lbs).

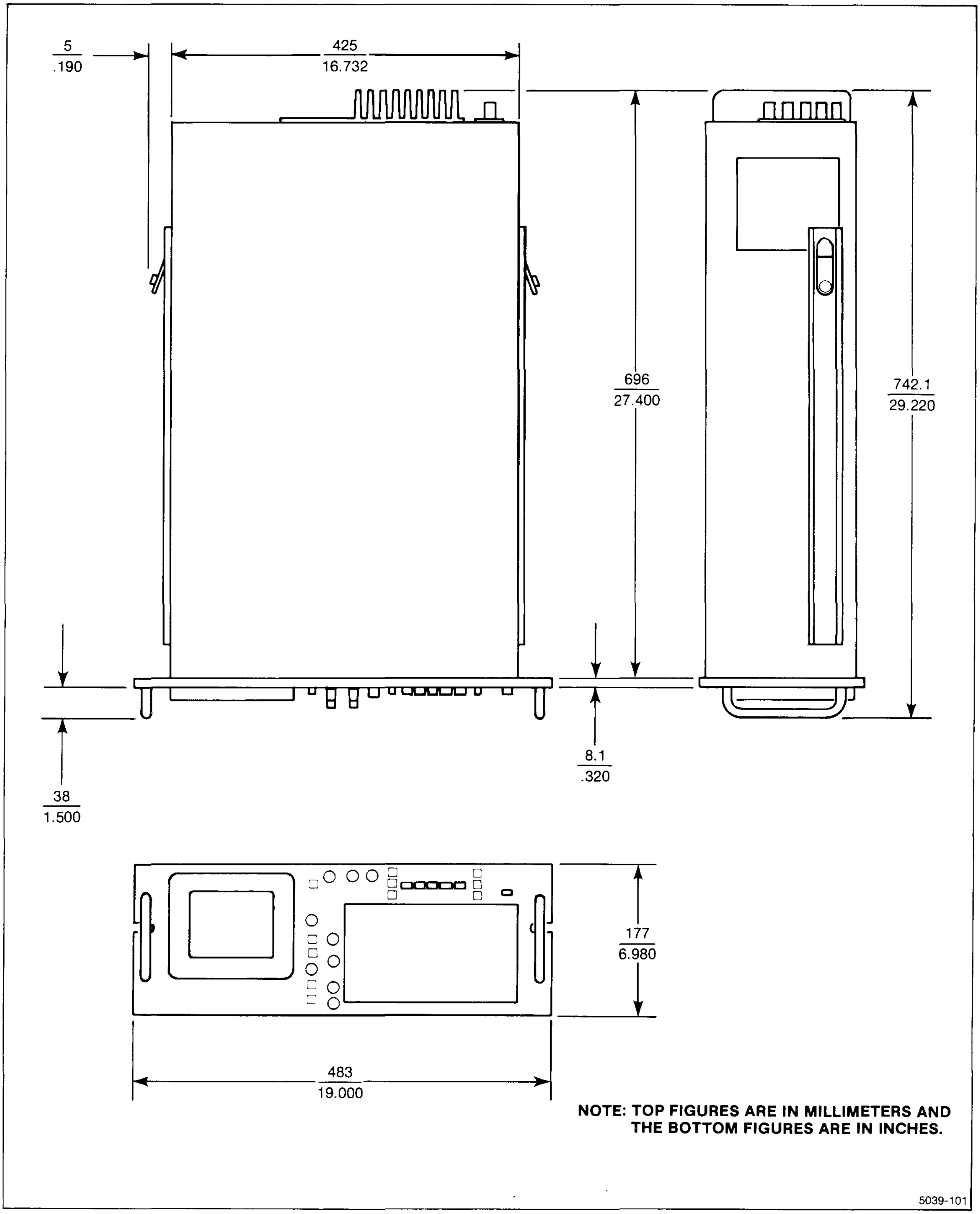


Figure 1-1. Dimensions of R7103.

SYSTEM ELECTRICAL SPECIFICATION

Your Tektronix R7103 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 that the unit is designed to operate in a 7000-series oscilloscope system.

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

A—Amplifier
B—"Real-time" time-base
C—Curve tracer
D—Digital unit
L—Spectrum analyzer
M—Miscellaneous
S—Sampling unit
T—Sampling time-base

The third and fourth digits of the plug-in type number carry no special connotation.

A "N" suffix letter added to the normal four-digit type number means that the instrument does not have the circuitry necessary to encode data for the 7000-series readout system.

Table 1-7 lists plug-in units which are incompatible with the R7103, gives reasons for that incompatibility, and lists the symptoms that will occur if the unit is used in the R7103.

Table 1-8 lists the vertical specifications which are system dependent. For more complete specifications on plug-in units for the 7000-series oscilloscope system, refer to the Tektronix Products catalog.

Table 1-9 lists the horizontal specifications which are system dependent. For more complete specifications on plug-in units for the 7000-series oscilloscope system, refer to the Tektronix Products catalog.

TABLE 1-7
Plug-In Incompatibility

The R7103 Oscilloscope is compatible with Tektronix 7000-Series Plug-In units with the exceptions listed in the following table.

Plug-In Conditions	Operating Conditions	Symptoms	Cause
7L13	7L13 set for single-sweep operation.	7L13 will not start by remote or camera connection.	7L13 does not provide single-sweep reset.
7L5	7L5 set for single-scan operation.	Pulsed readout and pulsed graticule from + gate source do not operate normally.	7L5 Sweep Gate remains high.
7S12	7S12 set for single-scan operation.	7S12 will not start by remote or camera reset connector.	7S12 does not provide single-sweep reset.
7B50 7B51 7B52 7B53N	All	Leading edge of triggering waveform cannot be viewed.	R7103 delay line length.
7B53AN 7B53A	Intensified zone.	The intensified zone is too bright and may be the only part of the display visible.	No contrast control.
7B92 7B92A	Time base set for alternate and single-sweep modes.	Pulsed readout and pulsed graticule from + gate source do not operate normally.	Time base sweeps only once when reset, whereas both main and delayed sweeps are required to produce a holdoff pulse.
7B85	7B85 set for single sweep operation with △ time function operational.	Pulsed readout and pulsed graticule from + gate source do not operate normally.	7B85 sweeps once but needs to sweep twice to generate holdoff pulse.

TABLE 1-7 (CONT)
Plug-In Incompatibility

Plug-In Conditions	Operating Conditions	Symptoms	Cause
7B15 7B85	Delta time function.	No intensified zones, no second sweep.	
7B50 7B51 7B52 7B53,A 7B70 7B71	Fast sweep rates (time per division typically 50 ns/div or faster).	Sweep nonlinearities and timing errors, particularly when externally triggered.	Extremely wide bandwidth of the R7103 horizontal system allows resolution of sweep aberrations and trigger crosstalk.
7D01 7D02 7D20	Any	Not compatible with the R7103 Oscilloscope. Any crt damage caused by use of the 7D01 or 7D02 or 7D20 in the R7103 Oscilloscope will not be covered under instrument warranty.	The R7103 display from these Logic Analyzers can cause permanent reduction in crt microchannel plate gain; consequently, a permanent reduction in writing rate. For more information, refer to "Reduction of Display Gain with Display Output Charge," in Section 2, Operating Instructions.

TABLE 1-8
R7103 Oscilloscope Vertical System Specification

Amplifier Plug-In Unit	Probe	Bandwidth (MHz)	Rise Time (ns)	0° to +50° C EXT CAL	Accuracy (1%)[1] 0° to +50° C INT CAL	VERT SIG OUT BW (MHz)	VERT SIG OUT Tr (ns)
7A11	Integral	250	1.4	2	3	150 MHz	2.4 ns
7A12	None	105	3.4	2	3	110 MHz	3.2 ns
	P6053B			3	4		
7A13	None	100	3.5	1.5	2.5	100 MHz	3.5 ns
	P6053B					100 MHz	3.5 ns
	P6055	65	5.4			65 MHz	5.4 ns
7A14	P6021	55	6.4	2	3	50 MHz	7.0 ns
	P6022	110	3.2			100 MHz	3.5 ns
7A15A/N	None	80	4.4	2	3	70 MHz	5.0 ns
	P6053A			3	4		
7A16A	None	225	1.6	2	3	150 MHz	2.4 ns
	P6053B			3	4		
7A17	None	150	2.4			15 MHz	24 ns

[1] **Deflection Factor accuracy is checked as follows:**
EXT CAL 0° to +50° C: Plug-in gain set at a temperature within 10° C of operating temperature, using an external calibrator with accuracy within 0.25%.
INT CAL 0° to +50° C: Plug-in gain set using the oscilloscope calibrator (within 10° C of the operating temperature) in a temperature range between 0° and +50° C.

TABLE 1-8 (CONT)
R7103 Oscilloscope Vertical System Specification

Amplifier Plug-In Unit	Probe	Bandwidth (MHz)	Rise Time (ns)	Accuracy (1%)[1] 0° to +50° C EXT CAL	0° to +50° C INT CAL	VERT SIG OUT BW (MHz)	Tr (ns)
7A18	None	75	4.7	2	3	70 MHz	5.0 ns
	P6053B			3	4		
7A19	None	600	0.6	3	4	600 MHz	0.6 ns
	P6056			4	5		
	P6057						
	P6201	500	0.7			500 MHz	0.7 ns
7A22	None or Any	1 MHz (within 10%)	350 (within 9%)	2	3	1.0 MHz ±10%	350 ns ±9%
7A24	None	400	0.9	3	4	200 MHz	1.75 ns
	P6056, P6057			4	5		
	P6201	350	1.0				
7A26	None	200[2]	1.75[2]	2	3	150 MHz	2.4 ns
	P6053B			3	4		
7A29	None	1000[3]	0.35[3]	3	4	750 MHz	0.47 ns
	P6056			4	5	700 MHz	0.50 ns
	P6057	800	0.45			600 MHz	0.60 ns
	P6201	600	0.60			500 MHz	0.70 ns
7A42	None	350[3]	1.0[3]	3	4		
	P6230			4	5		
	P6131	300[3]	1.2[3]				

[1] Deflection Factor accuracy is checked as follows:
EXT CAL 0° to +50° C: Plug-in gain set at a temperature within 10° C of operating temperature, using an external calibrator with accuracy within 0.25%.
INT CAL 0° to +50° C: Plug-in gain set using the oscilloscope calibrator (within 10° C of the operating temperature) in a temperature range between 0° and +50° C.
[2] System temperature range from 0° to +35° C; derate 10% from +35° to +50° C.
[3] System temperature range from 0° to +35° C.

TABLE 1-9
R7103 Oscilloscope Horizontal System Specification

Time Base	Performance Feature	Maximum Calibrated Sweep Rate	Triggering Frequency Range
7B10	Delayed Sweep	200 psec/div	Dc to 1000 MHz
7B15	Delaying Sweep	200 psec/div	Dc to 1000 MHz
7B92A	Display Switching	500 psec/div	Dc to 500 MHz
7B80	Delayed Sweep	1 ns/div	Dc to 400 MHz
7B85	Delaying Sweep	1 ns/div	Dc to 400 MHz
7B50A	Delayed Sweep	5 ns/div	Dc to 150 MHz
7B50 Series (except 7B50A) 7B70 Series 7B92	NOT RECOMMENDED. These time bases are not optimized for the extremely wide horizontal bandwidth of the R7103 and will likely exhibit unacceptable degradation in sweep accuracy and linearity.		

STANDARD ACCESSORIES

Operators Manual .... 1 ea.
Instruction Manual .... 1 ea.
Filter, CRT Faceplate, blue .... 1 ea.
Frame Mask, plastic .... 1 ea.
Power Cord .... 1 ea.
EMI Filter, mesh (installed) .... 1 ea.
Slide, Drawer, exterior .... 1 pair
Rackmount Kit .... 1 ea.

For more detailed information, refer to the tabbed Accessories page at the rear of this manual.

RECOMMENDED ACCESSORIES (not included)

The following accessories are available for use with your R7103 Oscilloscope. For more detailed information refer to the page tabbed "Accessories" at the rear of the instruction manual. Order recommended accessories through your local Tektronix Field Office or representative.

Current Loop Probe Adapter .... 1 ea.
Camera, for general use .... 1 ea.

OPERATING INSTRUCTIONS

PRELIMINARY OPERATION

To operate the R7103 effectively, the user must become familiar with its operation and capabilities. This section describes the use of front- and rear-panel controls and connectors.

WARNING

To avoid electric-shock hazard, see Installation in the General Information section of this manual before operating the R7103.

REDUCTION OF DISPLAY GAIN WITH DISPLAY OUTPUT CHARGE

It is a characteristic of the R7103 crt to have permanently diminished display gain in locations of sustained trace operation. This gain reduction manifests itself as reduced writing speed. The gain is diminished in proportion to the logarithm of the charge output (current-time product) from a given display area of the microchannel plate image amplifier.

The limited viewing time system with its two panel indicators, LIMITED VIEWING TIME and SHUTDOWN, and its RESET pushbutton, is included to enable long-term use of the crt display by discouraging (1) high continuous-trace-current operation and (2) long-term, unattended trace-on operation:

For average display currents below 25 nA the yellow LIMITED VIEWING TIME indicator remains off, and display shutdown does not occur. When the average display current is 25 nA, the indicator comes on and shutdown occurs in one hour. This time drops to one minute for an average display current of 1.8 μA. The average display current is limited by feedback to the 1.8 μA value. (Single-shot display current is not limited by this system.)

The user can minimize gain loss by taking precautions in three areas: (1) Readout intensity, (2) Trace baselines, and (3) X-Y Displays.

1. **Readout intensity**

   The fixed location, small area, and often fixed pattern of the readout tends to aggravate the gain loss in this area so it is advised that the readout display intensity be kept low.

2. **Trace baselines**

   There will, in time, be distinguishable gain loss in the region of the trace baseline(s). Less severe gain loss will result by using different baseline locations rather than repeatedly using fixed locations for these, such as the 0% line. Operating the timebase in Normal trigger mode rather than Auto trigger mode (bright baseline) will reduce the trace baseline gain loss by removing the trace in the absence of a triggering signal.

3. **X-Y displays**

   Operating in an X-Y mode often means more concentrated display current and hence more concentrated associated gain loss. The user will want to take care that stationary spots or small area displays are not allowed to be operated for extended time periods.

PLUG-IN UNITS

The R7103 accepts up to three Tektronix 7000-series plug-in units, allowing selection of bandwidth, sensitivity, display mode, etc., and provides for future expansion of the system.

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

INSTALLING PLUG-IN UNITS

CAUTION

Before installing or removing plug-in units, turn the R7103 power off to prevent instrument damage.

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

The gain of the R7103 vertical and horizontal systems has been normalized to allow plug-in units to be interchanged among plug-in compartments without adjustment of the system. The basic calibration of the plug-in units should be checked when installed to verify their accuracy (refer to the operating instructions in the plug-in manual).

CONTROLS AND CONNECTORS

The R7103 front and rear panels are shown in Figure 2-1 and Figure 2-2. A brief, functional description of each control and connector is included in the illustration. Refer to Detailed Operating Information for additional information.

FRONT-PANEL COLOR CODING

The R7103 front panel is color coded to define areas by function. Blue identifies the display mode controls; green identifies triggering controls.

Other colors, such as gray, have no functional assignment, but indicate a relationship among controls and/or connectors.

OPERATORS CHECKOUT PROCEDURE

The Operators Checkout Procedure may be used to verify proper operation of the front-panel controls and to get acquainted with the instrument. Only instrument functions (not measurement quantities or specifications) are checked in the procedure; therefore, a minimum amount of test equipment is required. If performing the Operators Checkout Procedure reveals improper performance or instrument malfunction, check the operation of associated equipment; then refer to qualified service personnel for repair or adjustment of the instrument.

TEST EQUIPMENT REQUIRED

The following test equipment was used in preparing the Operators Checkout Procedure. Other test equipment that meets these requirements may be substituted. When other equipment is substituted, the control settings or setup may need to be altered.

1. Function Generator

   Description: Frequency range, 250 kilohertz to 1 megahertz; output amplitude, two volts peak-to-peak into 50 ohms; waveform, sine wave.

   Type Used: Tektronix SG 503 Leveled Sine Wave Generator (used with TM 500 power module).

2. Cables, Coaxial (two required)

   Description: Length, 42 inches; connectors, bnc.

   Type Used: Type RG-58/U, 50-ohm coaxial, Tektronix part 012-0057-01.

3. Adapter, bnc 'T'

   Description: Connectors, bnc female, two; bnc male, one.

   Type Used: bnc T adapter, Tektronix Part 103-0030-00.

4. Adapter

   Description: Connectors, bnc female to bnc female.

   Type Used: Bnc female to bnc female adapter, Tektronix Part 103-0028-00.

PRELIMINARY SETUP

1. Set the front-panel controls as follows:

   INTENSITY .... counterclockwise
   FOCUS .... midrange
   READOUT .... OFF
   GRAT ILLUM .... counterclockwise
   POWER .... OFF
   CALIBRATOR .... 4 V
   VERTICAL MODE .... LEFT
   TRIGGER SOURCE .... VERT MODE

2. Connect the R7103 to a power source that meets its voltage and frequency requirements. If the available line voltage is outside the limits of the LINE VOLTAGE SELECTOR (on rear panel) setting, see Operating Power Information under Installation (General Information section).

3. Install Tektronix 7A-series amplifier units in the LEFT VERT and RIGHT VERT compartments. Install a Tektronix 7B-series time base in the HORIZ compartment.

4. Press the POWER switch to the on (locked in) position.

5. Set the time base as follows:

   Time/div............................ 1 ms
   Triggering
   Mode..............................Auto
   Coupling .... AC
   Source ....Int

6. Rotate the INTENSITY control until the trace is at a desirable viewing level (near midrange).

7. Connect the CALIBRATOR output to the input of the left amplifier unit with a 42-inch coaxial cable.

8. Set the left amplifier deflection factor to display a signal amplitude of two divisions on the crt.

9. Set the time-base Triggering Level control for a stable display.

DISPLAY FOCUS

10. Rotate the FOCUS and ASTIG controls and observe the square-wave display. Notice that the thickness of the trace varies. Set the FOCUS and ASTIG controls for a well-defined trace.

TRACE ALIGNMENT

11. Disconnect the input signal. Using the left amplifier position control, align the trace with the center horizontal graticule line. If necessary use the TRACE ROTATION control to align the trace with the center graticule line.

GRATICULE ILLUMINATION

12. Rotate the GRAT ILLUM control throughout its range and notice that the graticule lines illuminate more brightly as the control is turned clockwise.

CONTROL ILLUMINATION

13. Notice that the lighted push buttons are illuminated. Sequentially press all the VERTICAL MODE pushbuttons and watch the lights; an illuminated button indicates an active control. Set the CONTROL ILLUMINATION switch to MEDIUM, and observe that the lighted push buttons on the plug-in units are dimmed.

14. Set the rear-panel CONTROL ILLUMINATION switch to the HIGH position.

VERTICAL DEFLECTION SYSTEM

15. Connect the 4 V CALIBRATOR output to the input connectors of both amplifier units with two coaxial cables and a bnc T connector. Set the deflection factor of the left amplifier to display about two divisions of signal on the crt.

16. Notice that the position control of the left amplifier affects the vertical position of the displayed trace. Position the trace to the upper half of the graticule. (The right amplifier's position control should not affect the trace position.)

17. Set the VERTICAL MODE selector to RIGHT. Set the deflection factor of the right amplifier to display about two divisions of signal on the crt.

18. Notice that the position control of the right amplifier affects the vertical position of the displayed trace. (The left amplifier's position control should not affect the trace position.) Set the trace to the lower half of the graticule.

19. Set the VERTICAL MODE selector to ALT. Two traces should be displayed on the crt. The top trace is produced by the left amplifier and the bottom trace is produced by the right amplifier. Set the time-base to 50 ms; notice that the display alternates between the left and right amplifier plug-in units after each sweep. Turn the time-base Time/div control through its range and note that the display alternates vertical amplifiers at all sweep rates.

20. Set the VERTICAL MODE selector to CHOP. Turn the time-base Time/Div control through its range. A dual-trace display will be presented at all sweep rates, and both amplifier signals are displayed by the time base on a time-sharing basis. Set the time-base to 0.5 ms/div.

21. Set the VERTICAL MODE selector to ADD. The display should be four divisions in amplitude. Notice that the Position control of either amplifier moves the display. Set the VERTICAL MODE selector to LEFT.

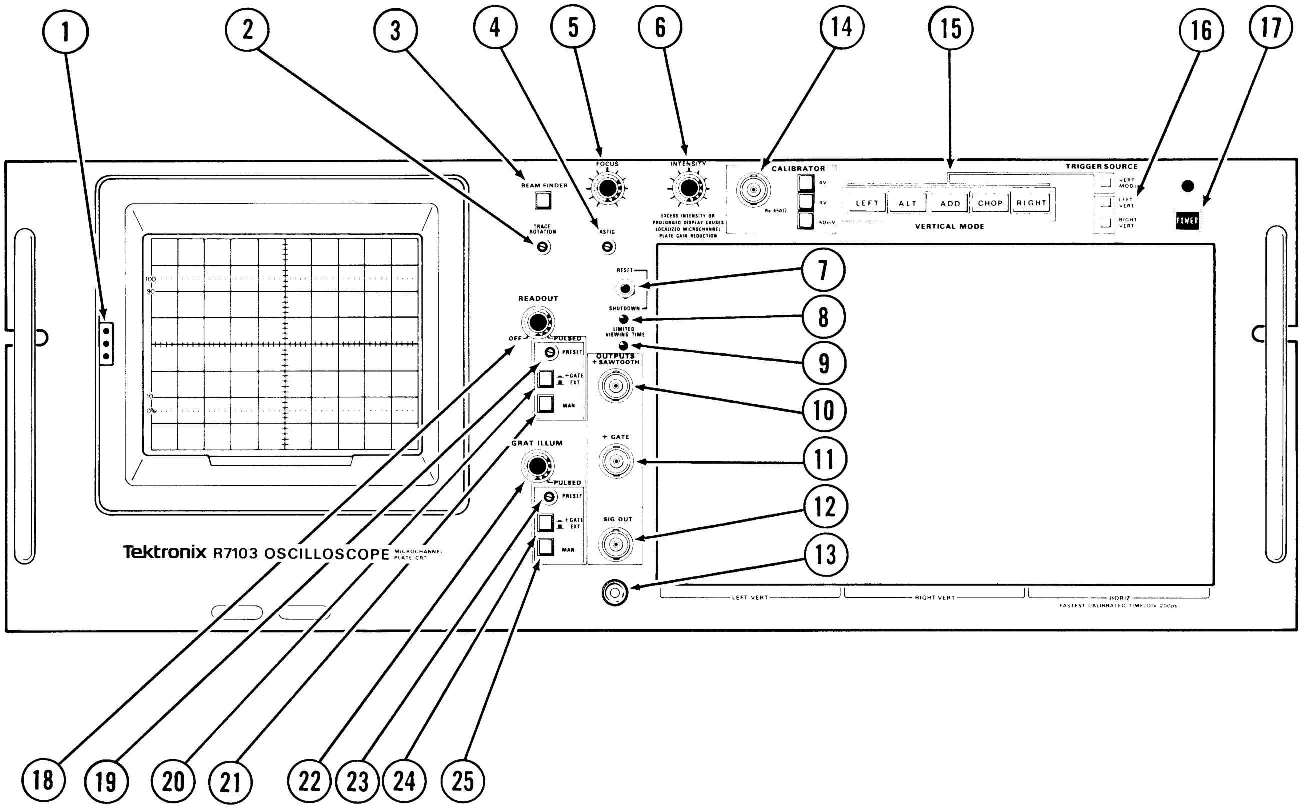
HORIZONTAL DEFLECTION SYSTEM

22. Set the start of the trace to the left graticule line with the time-base position control.

23. Set the CALIBRATOR to 0.4 V. Set the VERTICAL MODE to CHOP. Four traces should be displayed on the crt. If not, adjust the position controls of the amplifiers to bring the four traces into view. Set the position controls of the plug-in units to identify which trace is produced from each plug-in unit (if amplifier units have the identify feature, they can be used to identify the traces).

TRIGGERING

24. Set the VERTICAL MODE selector to LEFT. Center the display on the crt with the left amplifier Position control. Disconnect the input signal from the right amplifier connector. Sequentially select all of the



(1) **Camera Power Connector (not labeled)**—Three-pin connector provides power to operate camera; it also receives single-sweep reset signal.

(2) **TRACE ROTATION**—screwdriver adjustment to align trace with graticule line.

(3) **BEAMFINDER button**—when pressed, compresses and defocuses display within graticule area.

(4) **ASTIG**—screwdriver adjustment; used with FOCUS control to obtain a well-defined display.

(5) **FOCUS control**—optimizes crt trace definition.

(6) **INTENSITY control**—sets brightness of trace produced by the plug-in unit installed in the horizontal plug-in compartment.

5039-201A

Figure 2-1. Front-panel controls, connectors, and indicators.

(7) **RESET button**—when pressed, initiates another cycle of display time.

(8) **SHUTDOWN indicator**—when lit, indicates that crt display is off.

(9) **LIMITED VIEWING TIME indicator**—indicates that beam intensity is set at level high enough to cause crt display shutdown to occur.

(10) **+SAWTOOTH connector**—furnishes sawtooth signal derived from the time-base sweep signal.

(11) **+GATE connector**—furnishes positive-going gate signal from the time-base in the HORIZ plug-in compartment.

(12) **SIG OUT connector**—provides output signal from compatible vertical plug-in units installed in left or right vertical compartments, as selected by the TRIGGER SOURCE selector.

(13) **Ground connector (not labeled)**—binding post for establishing common ground for associated equipment.

(14) **CALIBRATOR connector and 4 V, .4 V, and 40 mV buttons**—the connector provides an accurate square-wave voltage as selected by the button that is pressed in.

(15) **VERTICAL MODE buttons**—select source of input signal (LEFT or RIGHT) and mode of display (ADD, ALT, or CHOP).

(16) **TRIGGER SOURCE buttons**—select source of signal to trigger the plug-in unit in the HORIZONTAL compartment.

(17) **POWER switch and indicator**—controls power to instrument and indicates when instrument is turned on.

(18) **READOUT control**—sets brightness of readout display. When set fully counterclockwise, in OFF position, disables readout system. When set fully clockwise, in PULSED position, the readout system operates in pulsed mode. It produces one frame of readout for each +Gate or external pulse it receives, as selected by the +GATE/EXT button (see item 20).

(19) **READOUT PRESET adjustment**—screwdriver adjustment that sets the brightness of the readout display when the READOUT control is set to PULSED position.

(20) **READOUT +GATE/EXT button**—selects the +Gate from the time base or a signal from the GRATICULE/READOUT SINGLE SHOT input on the rear panel as the stimulus for the readout display.

(21) **READOUT MAN button**—when pressed, causes one frame of readout display.

(22) **GRAT ILLUM control**—sets level of graticule illumination. When set fully clockwise to the PULSED position, the graticule illumination system operates in pulsed mode. The graticule will be illuminated once for each +Gate or Ext trigger pulse from the rear panel, as selected by the GRAT ILLUM +GATE/EXT button (see item 24).

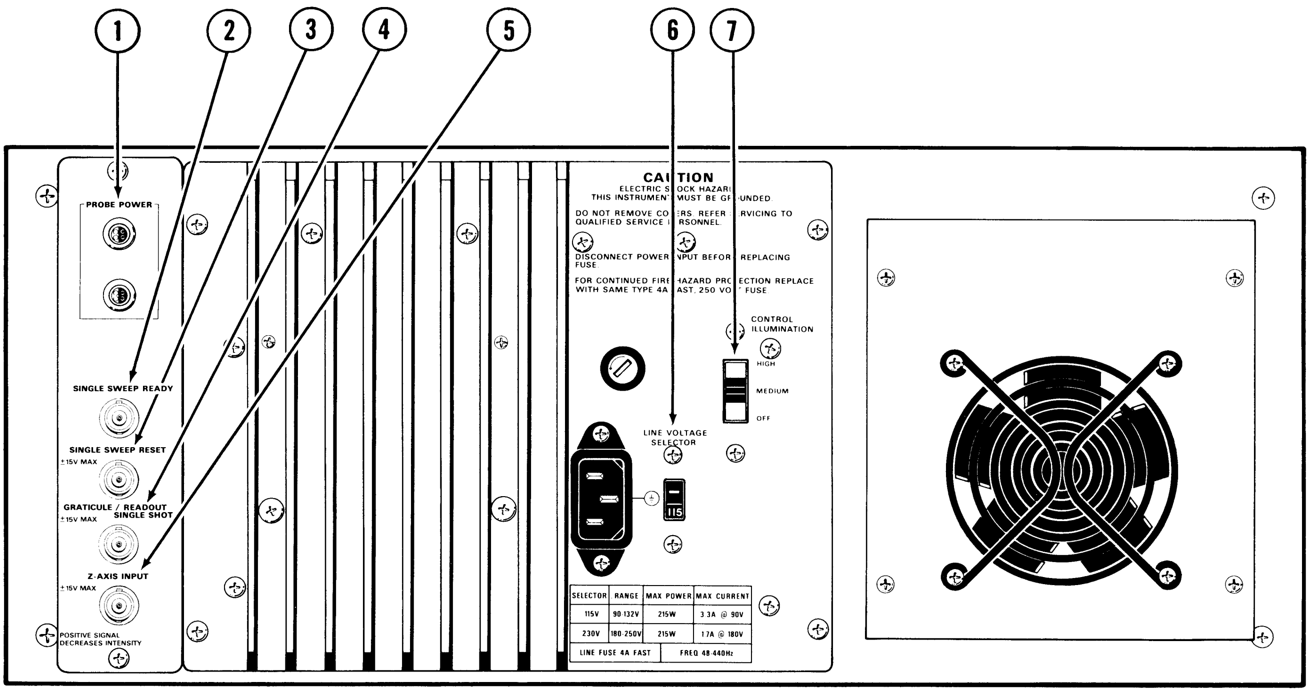
(23) **GRAT ILLUM PRESET adjustment**—screwdriver adjustment that sets the level of graticule illumination when the GRAT ILLUM control is set to PULSED position.

(24) **GRAT ILLUM +GATE/EXT button**—selects the +Gate from the time base or a signal from the GRATICULE/READOUT SINGLE SHOT input on the rear panel as the stimulus for the graticule illumination circuit.

(25) **GRAT ILLUM MAN button**—when pressed, causes one momentary illumination of the graticule.

5039-201B

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



(1) **PROBE POWER connectors (2)**—provide power for active probe system.

(2) **SINGLE SWEEP READY connector**—provides the single-sweep ready signal from the time base in the HORIZ plug-in compartment.

(3) **SINGLE SWEEP RESET connector**—provides means of connecting an external signal to the single-sweep circuit in the time base in HORIZ plug-in compartment. Also resets the Limited View Time function.

(4) **GRATICULE/READOUT SINGLE SHOT connector**—provides input for signal to actuate single-shot graticule illumination and single-frame readout. The READOUT and GRAT ILLUM controls must be set to PULSED, and the READOUT +GATE/EXT and GRAT ILLUM +GATE/EXT buttons must be set to EXT (out).

(5) **Z-AXIS INPUT connector**—provides path for signal to intensity-modulate the display.

(6) **LINE-VOLTAGE SELECTOR**—sets the R7103 to accept 115- or 230-volt nominal line voltage.

(7) **CONTROL ILLUMINATION selector**—controls the illumination level of the lighted pushbuttons on associated plug-in units, and the TRIGGER SOURCE buttons.

5039-202

Figure 2-2. Rear-panel controls, connectors, and indicators.

VERTICAL MODE selector positions. Notice that a stable display is obtained for all positions of the VERTICAL MODE selector (straight line display in RIGHT position).

25. Set the TRIGGER SOURCE selector to LEFT VERT. Again, sequentially select all of the VERTICAL MODE selector positions; notice that the display is again stable in all positions, as in the previous step, and that the LEFT VERT pushbutton is illuminated.

26. Set the TRIGGER SOURCE selector to RIGHT VERT. Sequentially select all of the VERTICAL MODE selector positions and notice that a stable display cannot be obtained in any position (this is because there is no input signal connected to the right vertical amplifier) and that the RIGHT VERT pushbutton is illuminated. Return the A TRIGGER SOURCE selector to VERT MODE and notice that it is illuminated.

READOUT

27. Turn the READOUT control clockwise until an alphanumeric display is visible within the top or bottom division of the crt. Change the deflection factor of the amplifier selected for display. The readout position of the display should change as the deflection factor is changed. Likewise, change the sweep rate of the time base; the readout display for the time base should change as the sweep rate is changed.

28. Set the time base for X10 magnification. Notice that the readout display will change to indicate the correct magnified sweep rate. If a readout-coded 10X probe is available for use with the amplifier, install it on the input connector of the right amplifier. Notice that the deflection factor indicated by the readout is multiplied by 10 when the probe is connected. Return the time base to unmagnified sweep operation and disconnect the probe.

29. Sequentially select all of the positions of the VERTICAL MODE selector. Notice that the readout from a particular plug-in occupies a specific location on the display area. If either vertical amplifier is a dual-trace unit, the readout for channel 2 is displayed within the lower division of the crt. Return the VERTICAL MODE to LEFT. Set the READOUT control to OFF.

BEAMFINDER

30. Set the deflection factor of the left amplifier to 10 millivolts/division and the calibrator for a 4 V output. Notice that the square-wave display is not visible, because the deflection exceeds the scan area of the crt.

31. Press the BEAMFINDER pushbutton; notice that the display is returned to the viewing area in compressed form. Release the BEAMFINDER switch and notice that the display again disappears from the viewing area.

32. With the BEAMFINDER button pushed in, increase the amplifier deflection factor until the display is reduced to about two divisions vertically. Adjust the Position control of the displayed amplifier to position the compressed display near the center of the graticule. Release the BEAMFINDER button and observe that the display remains within the viewing area.

CALIBRATOR

33. Connect the CALIBRATOR output to both the left and right vertical units with two coaxial cables and a bnc T connector. The display amplitude should be approximately two divisions. If not, adjust the deflection factor accordingly.

34. Press the different CALIBRATOR push buttons (labeled 4 V, 0.4 V, and 40 mV) and notice that the displayed signal changes accordingly (CALIBRATOR output must be terminated into more than a 100 kilohm load for stated output). When the CALIBRATOR output is terminated into 50 ohms, the output is 10 percent of the stated output.

Z-AXIS INPUT

35. If an external signal is available (two volts peak-to-peak minimum), the function of the Z-AXIS INPUT can be demonstrated. Connect the external signal to the input connector of the displayed amplifier and the Z-AXIS INPUT connector. Set the sweep rate of the time base to display about five cycles of signal. Set the amplitude of the signal generator until intensity modulation is visible on the display (change the amplifier deflection factor as necessary to produce an on-screen display). The positive peaks of the waveform should be blanked and the negative peaks should be intensified. Notice that the setting of the intensity controls determines the amount of intensity modulation that is visible. Disconnect the cables.

INTENSITY LIMITING

36. Connect a sine-wave to the input of the displayed amplifier. Set the amplifier deflection factor to display eight divisions of signal. Set the time base to display at least 20 cycles. Rotate the INTENSITY control clockwise and observe that the yellow LIMITED VIEWING TIME light turns on, then flashes on and off as the intensity control is rotated further clockwise. With the LIMITED VIEWING TIME light flashing, the intensity is limited. Rotating the

intensity control clockwise does not increase the displayed brightness. Notice that after about one minute the red SHUTDOWN light starts flashing and after about 10 seconds turns on steady; at the same time the crt display is turned off. Press the RESET button and the display should return.

DETAILED OPERATING INFORMATION

GRATICULE

The graticule is marked on the inside of the crt faceplate to enable accurate, parallax-free measurements. The graticule has eight vertical and 10 horizontal divisions. Each divison is a 0.85 centimeter square divided into five minor divisions along each axis. The vertical gain and horizontal timing of the plug-in units are calibrated to the graticule so that accurate measurements can be made from the crt. The illumination of the graticule lines can be varied with the GRAT ILLUM control.

Figure 2-3 shows the graticule and defines the various measurement lines. The terminology defined here will be used in all discussions involving measurements from the graticule. The markings: 0%, 10%, 90%, and 100% on the left side of the graticule are for accurate rise-time measurements.

GRATICULE ILLUMINATION

The GRAT ILLUM control varies the illumination of the graticule lines. The GRAT ILLUM can also be operated in the PULSED mode. With the GRAT ILLUM control set to the PULSED position (detent), and the +GATE/EXT switch set to +GATE, the graticule will be illuminated momentarily after the +GATE occurs. With the GRAT ILLUM +GATE/EXT switch set to EXT the momentary graticule illumination can be actuated by applying a remote signal to the rear panel GRATICULE/READOUT SINGLE SHOT connector (see Table 1-4 for specifications). When operating in the PULSED mode, the level of illumination is controlled by the GRAT ILLUM PRESET screwdriver adjustment.

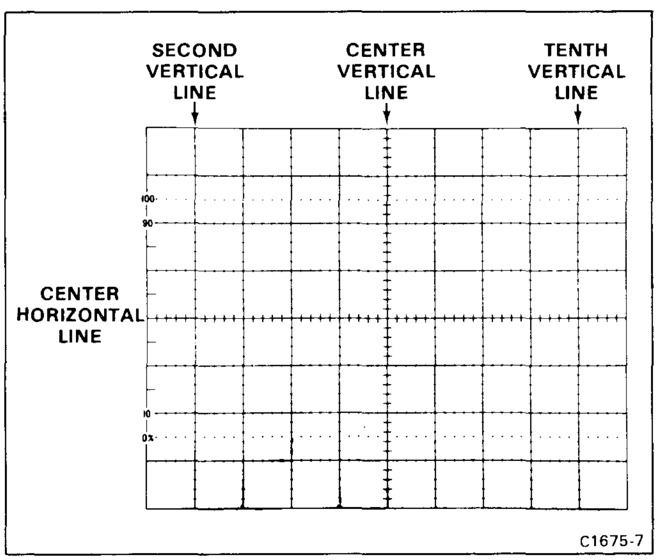


Figure 2-3. Definition of graticule measurement lines.

LIGHT FILTER/EMI FILTER

The mesh filter installed in front of the crt improves the display contrast when viewing the crt under high-ambient-light conditions. This metal screen, with its matte black surface, reduces light reflections and provides shielding against radiated electro-magnetic interference (EMI). It may be removed for waveform photography or for viewing high-writing-rate displays. To remove, pull outward from the bottom and replace it with the plastic frame mask (standard accessory).

WARNING

Do not remove the clear plastic face-protector (implosion shield) that covers the crt faceplate; the implosion shield provides protection to the operator from crt implosion and protects the crt face from scratches.

The blue crt faceplate filter may be used instead of the mesh filter to reduce crt reflections in high-ambient-light conditions. However, it does not provide EMI shielding. When used, this filter should be installed behind the plastic frame mask that is used in lieu of the mesh filter.

CONTROL ILLUMINATION

The CONTROL ILLUMINATION switch, located on the rear panel, sets the illumination level of the TRIGGER SOURCE buttons, and the lighted pushbuttons on the plug-in units. The positions available are OFF, MEDIUM, and HIGH. The CONTROL ILLUMINATION switch does not affect the function-indicator lights (such as triggered or single-sweep ready lights).

INTENSITY CONTROL

The INTENSITY control determines the brightness of the display produced by the plug-in unit installed in the HORIZ compartment. The READOUT intensity control affects the brightness of the readout portion of the crt display only.

CAUTION

Be careful when operating the INTENSITY control. See Reduction of Display Gain with Display Output Charge at the beginning of this section.

DISPLAY FOCUS

The R7103 has an automatic-focusing circuit which maintains optimum focus for all intensity settings after a correct setting of the FOCUS control is established. The easiest way to obtain the correct setting of the FOCUS control is to set the READOUT INTENSITY control so that the readout portion of the display is clearly visible. Adjust the FOCUS control for the best definition of the readout display.

ASTIGMATISM-FOCUS ADJUSTMENTS

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

NOTE

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

1. Install an amplifier in the LEFT VERT compartment and a time base in the HORIZ compartment.

2. Set the VERTICAL MODE to LEFT.

3. Connect the output of a sine-wave generator to the input of the amplifier. Set the sine-wave generator frequency to 1 kilohertz and the vertical amplifier deflection factor for a two-division display.

4. Set the time-base Time/Div to 0.2 millisecond and the triggering for a stable display. Set the INTENSITY control so the display is at a usable intensity level (about midrange).

5. Turn the FOCUS control fully counterclockwise and set the ASTIG adjustment to midrange.

6. Set the FOCUS control so the thickness of the sine-wave trace is as thin as possible.

7. Adjust the ASTIG adjustment so the width of the sine-wave trace is as thin as possible.

8. Repeat steps 6 and 7 for the best overall focus.

BEAMFINDER

The BEAMFINDER helps to locate a display that overscans the crt viewing area vertically or horizontally. When the BEAMFINDER button is pressed, the display is compressed and defocused within the graticule area. To locate and reposition an overscanned display, use the following procedure:

1. Press the BEAMFINDER button. While the display is compressed adjust the vertical and horizontal position controls to center the display. Change the vertical and horizontal deflection factors until the vertical deflection is about four divisions high and the horizontal deflection is about six divisions wide (the horizontal deflection need be reduced only when operating in an X-Y mode).

2. Release the BEAMFINDER button; the display should remain within the graticule area.

TRACE ALIGNMENT

The TRACE ROTATION control allows the trace to be aligned with the horizontal graticule lines. To set the control, position the trace to the center horizontal line and adjust the TRACE ROTATION control so that the trace is parallel with the center horizontal graticule line.

READOUT DISPLAY

The Readout System provides an alphanumeric display of information on the crt along with the analog waveform display. The information displayed by the Readout System is obtained from the plug-in units installed in the plug-in compartments.

The readout information from each channel of the plug-in units is called a word. Up to six words of readout information can be displayed on the crt (two channels from each of the three plug-in compartments). The location of each readout word is fixed and is directly related to the plug-in unit and channel of origin. Figure 2-4 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 in the top division of the graticule and the readout from channel 2 is displayed directly below in the bottom division of the graticule. Usually, the readout information for plug in units and/or channels, which are selected by the mode switches, appear in the readout display. (Some special purpose plug-in units may override the mode switches to display readout even though the compartment is not selected for display.)

Readout Identify

An "Identify" feature is provided by the Readout System to correlate the readout word with the originating plug-to the VERT MODE position, 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. When the LEFT VERT or RIGHT VERT TRIGGER SOURCE button is pressed in, the two signals are displayed showing their true time relation. However, if the signals are not time related, the display from the plug-in that is not providing a trigger signal will be unstable. The trigger source switches are illuminated to indicate the source of the trigger signal.

Chopped Mode. The CHOP position of the VERTICAL MODE selector produces a display which is electronically switched between channels at about a one-megahertz rate. In general, the CHOP mode provides the best display at sweep rates slower than about 2 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.

When the TRIGGER SOURCE selector is set to VERT MODE, the time base is triggered from the left vertical plug-in trigger signal. The LEFT VERT or RIGHT VERT trigger-source positions provide trigger signals to the time-base unit from the selected vertical unit only. The trigger source is indicated by the illuminated trigger source pushbuttons. This allows two time-related signals to be displayed showing true-time relationship. (If the signals are not time-related, the display from the channel that is not providing the trigger signal will appear unstable.)

The CHOP mode can be used to compare two single-shot, transient, or random signals that occur within the time interval determined by the time-base unit (ten times selected sweep rate). To provide correct triggering, the displayed signal which provides the trigger signal must precede the second display in time. Because the signals show true-time relationship, time-difference measurements can be made from the display.

TABLE 2-1
Displays*

Vertical Mode	Comments
Left	One trace. Vertical deflection from plug-in unit in LEFT VERT plug-in compartment; horizontal deflection from plug-in unit in HORIZ plug-in compartment.
Alt	Two traces. Vertical deflection from plug-in units in LEFT VERT and RIGHT VERT; horizontal deflection from plug-in unit in HORIZ plug-in compartment.
Add	One trace. Amplitude of vertical deflection is algebraic sum of signals from LEFT VERT and RIGHT VERT plug-in units; horizontal deflection is produced by plug-in unit in HORIZ plug-in compartment.
Chop	Two traces. Vertical deflection from plug-in units in LEFT VERT and RIGHT VERT; horizontal deflection from plug-in unit in HORIZ plug-in compartment.
Right	One trace. Vertical deflection from plug-in unit in RIGHT VERT plug-in compartment; horizontal deflection from plug-in unit in HORIZ plug-in compartment.

***Displays given for single-channel vertical and horizontal plug-in units only.**

Algebraic Addition. The ADD position of the VERTICAL MODE selector can be used (1) to display the sum or difference of two signals, (2) for common-mode rejection to remove an undesired signal, or (3) 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 is at least 160:1 from dc to 100 MHz. The rejection ratio decreases to 80:1 from 100 MHz to 1 GHz. The overall deflection on the crt in the Add mode is the algebraic sum of the signals from the 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-in units is known. This is particularly true when the vertical units are set to different deflection factors, because it is not obvious which portion of the display results from the signal applied to a given plug-in unit. The polarity and repetition rate of the applied signals will also affect the Add display.

The following precautions should be observed when using Add mode.

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

2. Do not apply large signals to the plug-in inputs. A good rule is not to apply a signal of more than about eight times the vertical deflection factor. Larger voltages may result in a distorted display.

3. To ensure the greatest dynamic range in 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 selector.

4. For familiar response from each channel, use identical plug-in units and set them for the same input coupling mode.

TRIGGER SOURCE

The TRIGGER SOURCE selector selects the internal trigger signals for the HORIZ time base. For most applications, the selector can be left in the VERT MODE position. This is the most convenient position because the internal trigger signal is automatically switched as the VERTICAL MODE selector is changed or as the display is electronically switched between the Left and Right vertical plug-in units, in the ALT position of the VERTICAL MODE selector. It also provides a usable trigger signal in the ADD Vertical Mode, because in this mode the internal trigger signal is the algebraic sum of the signals applied to the vertical plug-in units. In the CHOP position the left vertical plug-in unit is the trigger source. Therefore, the VERT MODE position ensures that the time base receives a trigger signal regardless of the VERTICAL MODE selector setting without the need to change the trigger source selection. The TRIGGER SOURCE selector is illuminated and indicates the source of the trigger.

If correct triggering for the desired display is not obtained in the VERT MODE position, the trigger source for the time base can be changed to obtain the trigger signal from the left or right vertical plug-in unit. The internal trigger signal is obtained from the selected vertical compartment whether or not the plug-in in that compartment is selected for display. If the internal trigger signal is obtained from one of the vertical units while the other vertical unit is selected for display, the internal signal must be time-related to the display signal in order to obtain a triggered (stable) display.

CALIBRATOR OUTPUT

The Calibrator provides a convenient signal for checking basic vertical gain and sweep timing. The calibrator signal is also useful for adjusting probe compensation as described in probe instruction manuals. The calibrator can be used as a convenient signal source for external equipment.

Voltage

The Calibrator provides accurate output voltages of 40 millivolts, 0.4 volt, and 4 volts into high impedance loads; or 4 millivolts, 40 millivolts, and 0.4 volt into 50-ohm loads.

Current

The optional current loop accessory provides a 40-milliampere output current (when the Calibrator is set for a 4-volt output), which can be used to check and calibrate current-measuring probe systems. The current signal is obtained by clipping the probe around the current loop.

Repetition Rate

The Calibrator repetition rate is 1 kilohertz. The calibrator circuit uses frequency-stable components to maintain accurate frequency and a constant duty factor. Thus, the Calibrator can be used for checking the basic sweep timing of time bases (1-kilohertz rate only).

Wave Shape

The square-wave CALIBRATOR signal can be used as a reference wave shape when checking or adjusting the compensation of passive, high-resistance probes. 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 Out

The +SAWTOOTH OUT connector provides a positive-going sawtooth signal derived from the time base installed in the HORIZ compartment.

The unit of time for the sawtooth output is determined by the time-base Time/Div control. Refer to Table 1-4, in the General Information section, for signal parameters.

+Gate Out

The +GATE OUT connector provides a positive-going rectangular pulse derived from the time base installed in the horizontal plug-in compartment. The duration of the +GATE signal is the same as the duration of the unmagnified sweep. The amplitude of the +GATE OUT signal is about 0.5 volt into 50 ohms or about 10 volts into 1 megohm.

Signal Out

The SIG OUT connector provides a sample of the vertical deflection signal. The source of the output signal is determined by the TRIGGER SOURCE selector. In the VERT MODE position of the TRIGGER SOURCE selector, the output signal is determined by the setting of the VERTICAL MODE selector. The output signal in the LEFT and RIGHT positions of the VERTICAL MODE selector is obtained only from the selected vertical unit. In the ALT position of the VERTICAL MODE selector, the output signal at the SIG OUT connector switches between signals from the two vertical units, along with the crt display. However, the vertical output signal in the ADD position is a composite signal. In the CHOP position the signal out is derived from the LEFT vertical plug-in unit.

Probe Power

The two PROBE POWER connectors on the R7103 rear panel provide operating power for active probe systems. It is not recommended that these connectors be used as a power source for applications other than the

TRIGGER SOURCE

The TRIGGER SOURCE selector selects the internal trigger signals for the HORIZ time base. For most applications, the selector can be left in the VERT MODE position. This is the most convenient position because the internal trigger signal is automatically switched as the VERTICAL MODE selector is changed or as the display is electronically switched between the Left and Right vertical plug-in units, in the ALT position of the VERTICAL MODE selector. It also provides a usable trigger signal in the ADD Vertical Mode, because in this mode the internal trigger signal is the algebraic sum of the signals applied to the vertical plug-in units. In the CHOP position the left vertical plug-in unit is the trigger source. Therefore, the VERT MODE position ensures that the time base receives a trigger signal regardless of the VERTICAL MODE selector setting without the need to change the trigger source selection. The TRIGGER SOURCE selector is illuminated and indicates the source of the trigger.

If correct triggering for the desired display is not obtained in the VERT MODE position, the trigger source for the time base can be changed to obtain the trigger signal from the left or right vertical plug-in unit. The internal trigger signal is obtained from the selected vertical compartment whether or not the plug-in in that compartment is selected for display. If the internal trigger signal is obtained from one of the vertical units while the other vertical unit is selected for display, the internal signal must be time-related to the display signal in order to obtain a triggered (stable) display.

CALIBRATOR OUTPUT

The Calibrator provides a convenient signal for checking basic vertical gain and sweep timing. The calibrator signal is also useful for adjusting probe compensation as described in probe instruction manuals. The calibrator can be used as a convenient signal source for external equipment.

Voltage

The Calibrator provides accurate output voltages of 40 millivolts, 0.4 volt, and 4 volts into high impedance loads; or 4 millivolts, 40 millivolts, and 0.4 volt into 50-ohm loads.

Current

The optional current loop accessory provides a 40-milliampere output current (when the Calibrator is set for a 4-volt output), which can be used to check and calibrate current-measuring probe systems. The current signal is obtained by clipping the probe around the current loop.

Repetition Rate

The Calibrator repetition rate is 1 kilohertz. The calibrator circuit uses frequency-stable components to maintain accurate frequency and a constant duty factor. Thus, the Calibrator can be used for checking the basic sweep timing of time bases (1-kilohertz rate only).

Wave Shape

The square-wave CALIBRATOR signal can be used as a reference wave shape when checking or adjusting the compensation of passive, high-resistance probes. 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 Out

The +SAWTOOTH OUT connector provides a positive-going sawtooth signal derived from the time base installed in the HORIZ compartment.

The unit of time for the sawtooth output is determined by the time-base Time/Div control. Refer to Table 1-4, in the General Information section, for signal parameters.

+Gate Out

The +GATE OUT connector provides a positive-going rectangular pulse derived from the time base installed in the horizontal plug-in compartment. The duration of the +GATE signal is the same as the duration of the unmagnified sweep. The amplitude of the +GATE OUT signal is about 0.5 volt into 50 ohms or about 10 volts into 1 megohm.

Signal Out

The SIG OUT connector provides a sample of the vertical deflection signal. The source of the output signal is determined by the TRIGGER SOURCE selector. In the VERT MODE position of the TRIGGER SOURCE selector, the output signal is determined by the setting of the VERTICAL MODE selector. The output signal in the LEFT and RIGHT positions of the VERTICAL MODE selector is obtained only from the selected vertical unit. In the ALT position of the VERTICAL MODE selector, the output signal at the SIG OUT connector switches between signals from the two vertical units, along with the crt display. However, the vertical output signal in the ADD position is a composite signal. In the CHOP position the signal out is derived from the LEFT vertical plug-in unit.

Probe Power

The two PROBE POWER connectors on the R7103 rear panel provide operating power for active probe systems. It is not recommended that these connectors be used as a power source for applications other than the

The 7S14 is a dual-channel sampling unit with delaying sweep capability. It must be used in the right two plug-in comparF ents.

Dual-trace sampling displays can also be made with a 7S12 in the right two compartments and a 7S11 in the LEFT VERT compartment. In this application, the 7S12 supplies the time base for both traces.

X-Y Sampling

One 7S11 inserted in the RIGHT VERT compartment and one in the HORIZ compartment automatically share a 50 kilohertz free-running strobe condition specified for X-Y displays. The 7S14 has an X-Y operation incorporated as one of its normal mode functions.

SPECIAL PURPOSE PLUG-IN UNITS

The variety of special-purpose plug-in units available allows the R7103 Oscilloscope to be used for many special applications. The following is a brief discussion of some of the available special-purpose plug-in units.

Digital Counters and Multimeter Plug-In Units

Digital-multimeter plug-in units measure current, voltage, temperature and resistance; digital-frequency counter plug-in units measure frequency, from dc to above 500 megahertz. These units make use of the readout system to display the measured information on the crt and can function in any compartment, in combination with each other or with any other plug-in units available for use with the R7103 oscilloscope system.

The ability of digital readout plug-in units to operate with other plug-in units makes it possible to process and monitor signals while the digital measurement is being made. For example, by installing a frequency counter in one vertical compartment and an amplifier in the other vertical compartment, the crt can display the trigger waveform, superimposed on the displayed signal, to show the actual triggering point. Or, if the counter is placed in the horizontal compartment, a low-amplitude signal can be applied to a vertical amplifier and amplified before it is internally routed by the trigger source switches to the counter trigger circuit. This allows the counnter to monitor signals too small to trigger other counters.

Transistor Curve-Tracer Plug-In Units

The 7000-series transistor curve-tracer plug-in unit checks small-signal transistors and diodes by producing a display showing the basic characteristic curves for the device being tested. Stepped sweep signals from an internal power supply are applied to the device under test. The resulting output signals are, in turn, applied to the horizontal and vertical deflection systems of the oscilloscope to plot a family of characteristic curves.

This plot can be used to check for damaged transistors and diodes, or to select for special or matched characteristics and to calculate gain, leakage, breakdown voltage, etc.

Spectrum Analyzer Plug-In Units

The 7000-series spectrum analyzer plug-in units display signal amplitudes dispersed over portions of the rf spectrum. Absolute signal energy is plotted on the vertical axis against frequency on the horizontal axis. Applications include waveform and distortion analysis, EMC and random noise measurements, filter design, spectrum surveillance, etc.

X-Y OPERATION

In some applications, it is desirable to display one signal versus another (X-Y) rather than against time (interval sweep). The flexibility of the amplifier plug-in units available for use with the R7103 provide the means of applying external signals to the horizontal-deflection system.

RASTER DISPLAYS

A raster-type display can be used to increase the apparent sweep length. For this type of display, the trace is deflected both vertically and horizontally by sawtooth signals. This is accomplished in the R7103 by installing a 7B-series time base in one vertical plug-in compartment. Normally, the time base in the vertical compartment should be set at a slower sweep rate than the time base in the horizontal compartment; the number of horizontal traces in the raster depends upon the ratio between the two rates.

Information can be displayed on the raster using several different methods. In the ADD position of the VERTICAL MODE selector, the signal from an amplifier can be algebraically added to the vertical waveform. With this method, the vertical signal amplitude on the crt should not exceed the distance between the horizontal lines of the raster. Another method of displaying information on the raster is to use the Z-AXIS INPUT to provide intensity modulation for the display. This type of raster display could be used to provide a television-type display. Complete information on operation using the Z-axis feature is given under Intensity Modulation.

To provide a stable raster display, both time bases must be correctly triggered. Internal triggering is not provided for the time bases when they are in the vertical compartments; external triggering must be used. Also, blanking is not provided from the time bases when they are installed in a vertical compartment.

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary

DO NOT SERVICE ALONE

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

USE CARE WHEN SERVICING WITH POWER ON

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing parts.

CRT HANDLING

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

THEORY OF OPERATION

This section describes the circuitry used in the R7103 Oscilloscope. The description begins with a discussion of the instrument, using the block diagram shown in Figure 3-1, and continues in detail, showing the relationships between the stages in each major circuit. Schematics of all major circuits are given in Section 8, Diagrams and Circuit Board Illustrations. Stages are outlined on the schematics with wide shaded lines. Stage names are in shaded boxes. Refer to these schematics throughout the following circuit description for specific electrical values and relationships.

BLOCK DIAGRAM

The following discussion is provided to assist in understanding the overall concept of the R7103 Oscilloscope mainframe before the individual circuits are discussed in detail. Figure 3-1 is a basic block diagram of the R7103. Only the basic interconnections between the individual blocks are shown on this diagram. Each major circuit within the instrument is given a block. The number of each block refers to the complete circuit diagram located at the rear of this manual.

DESCRIPTION

Vertical signals to be displayed on the crt are applied to the Vertical Channel Switch circuit from both vertical plug-in compartments. The VERTICAL MODE switch is connected to the logic circuit and determines whether the signal from the LEFT VERT or RIGHT VERT compartment is displayed on the crt. The Vertical Channel Switch receives an X-Y Inhibit signal from the Readout system to provide the time sharing between the vertical and readout signals.

The selected vertical signal passes through the Delay Line and is amplified by the Vertical Amplifier circuit to drive the vertical deflection plates of the crt (cathode-ray tube). The Vertical Amplifier circuit includes an input from the Readout System to produce the vertical portion of the alphanumeric readout display.

Horizontal signals for display on the crt are connected to the Horizontal Amplifier from the horizontal plug-in compartment. The signal from the HORIZ plug-in compartment passes through the Horizontal Input Stage. The Horizontal Amplifier receives an X-Y Inhibit signal from the Readout System to provide the time sharing between the vertical and readout signals.

The Horizontal Amplifier enlarges the horizontal signal enough to provide full horizontal deflection of the crt. The Horizontal Amplifier circuit accepts an input signal from the Readout System to produce the horizontal portion of the alphanumeric readout display.

The Readout System provides an alphanumeric display of information encoded by the plug-in unit(s). The readout display is written on the crt on a time-shared basis with the analog waveform display. The VERTICAL MODE switch circuits determine which plug-in unit(s) display(s) readout information. The Readout system sends inhibit commands to the Vertical Channel Switch and Z-Axis Logic circuits. The Readout System provides signals to produce the alphanumeric display to the Vertical, Horizontal and Z-Axis Amplifier circuits.

The Logic circuit develops control signals for use in other circuits within the instrument and the plug-in units. These control signals automatically determine the correct instrument operation in relation to the plug-in units, plug-in unit control settings, and R7103 front-panel control settings. The Logic circuit performs three functions. It:

1. Receives
   a. the external Z-Axis Input signal,
   b. the Single Sweep Reset Input from the rear panel, and
   c. the Z-Axis Inhibit Command from the Readout system.
2. Sends the SINGLE SWEEP READY signals to the rear panel.
3. Develops the Z-Axis signal for use by the Z-Axis Amplifier.

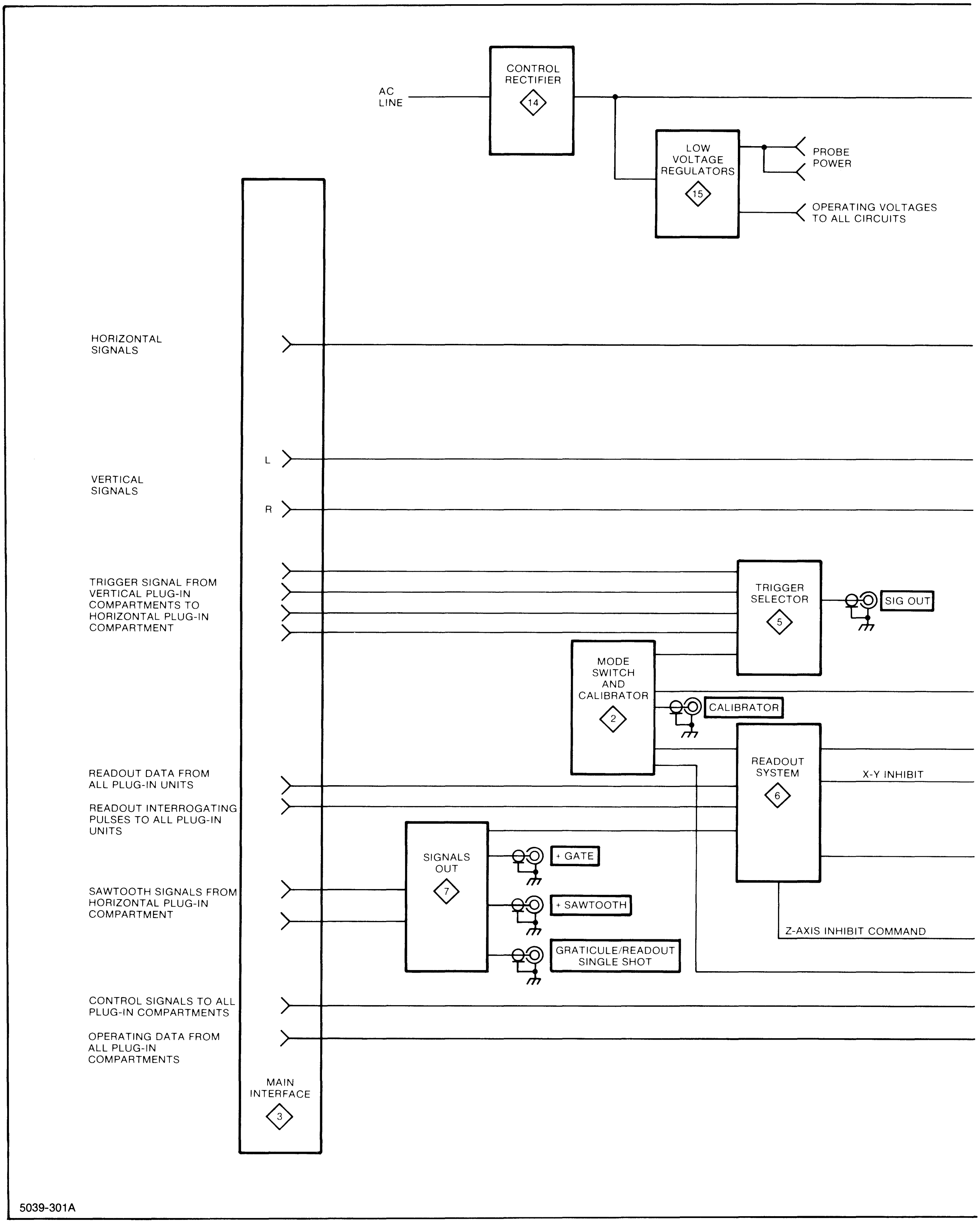


Figure 3-1. Basic block diagram of the R7103 Oscilloscope.

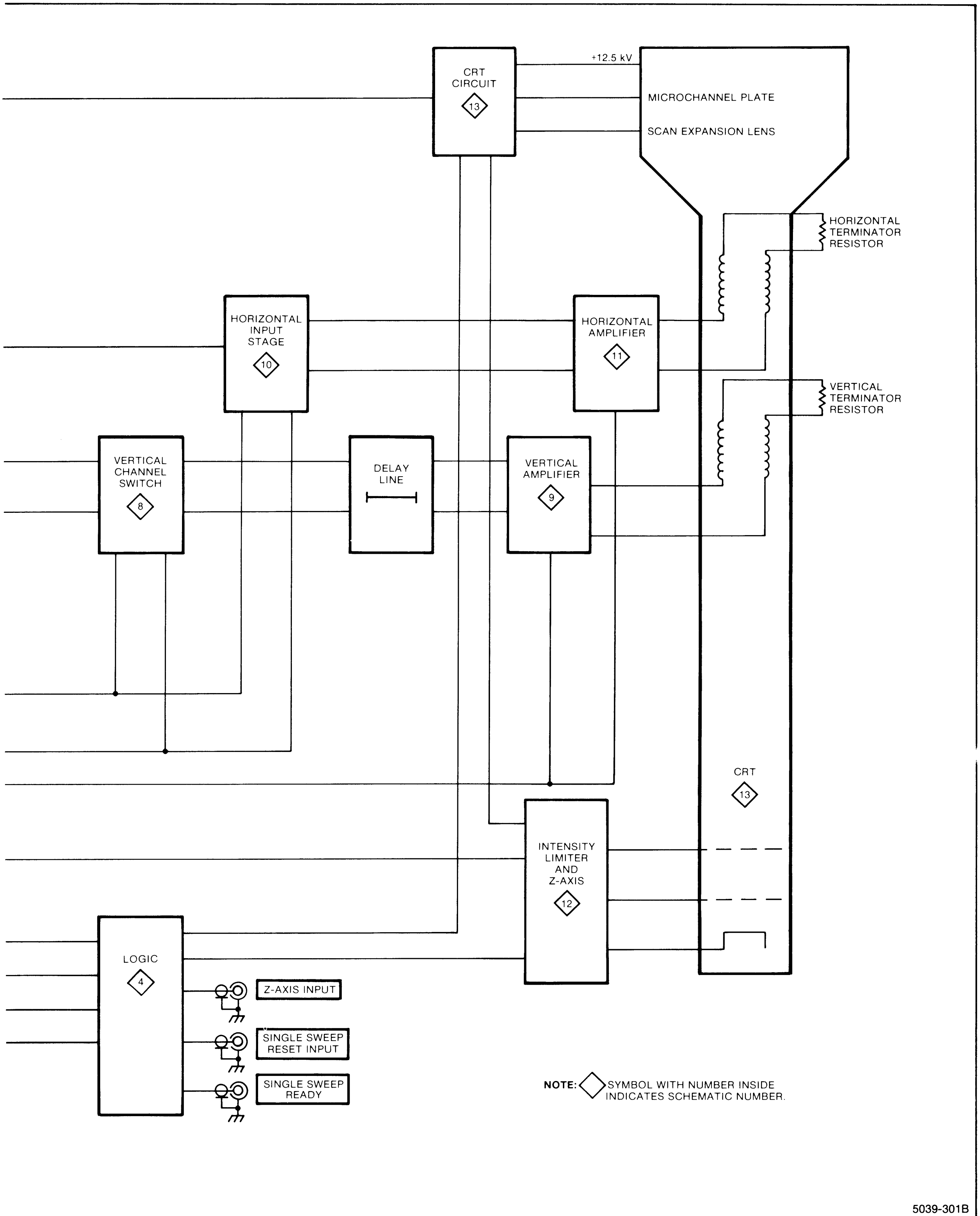


Figure 3-1 (cont). Basic block diagram of the R7103 Oscilloscope.

In addition to control circuitry, the CRT Circuit supplies voltages necessary for operation of the crt by:

- Developing the operating voltages for the crt Microchannel Plate and the Scan Expansion Lens.
- Providing a signal proportional to the average screen current to the input of the intensity limiter level.
- Receiving a signal proportional to the intensity level setting from the logic circuit to be used by the Microchannel Plate supply for biasing. The Z-Axis Amplifier provides the drive signal to control the intensity level of the crt display.

The Calibrator circuit produces a one-kilohertz square-wave signal which can be used to check the calibration of the R7103 and the compensation of probes. The calibrator signal is available as a voltage at the CALIBRATOR connector or as a current through a 40 milliampere optional current loop accessory.

The internal trigger signals from the vertical plug-in units are connected to the Trigger Selector circuit. The Trigger Selector circuit determines whether the trigger signal from the left or right vertical unit is connected to the horizontal plug-in unit. The trigger switch also produces the drive signal that the SIG OUT circuit sends to the output as a sample of the vertical signal.

The Signals Out circuit processes signals from the plug-in units for the front-panel +GATE and +SAWTOOTH outputs.

The Control Rectifier and Low-Voltage Regulator circuits provide the power necessary to operate the instrument. These voltages are connected to all circuits within the instrument.

DETAILED CIRCUIT OPERATION

A detailed description of the electrical operation and relationship of the circuits in the R7103 Oscilloscope mainframe is provided here. The theory of operation for circuits unique to this instrument is described in detail in the discussion. Circuits commonly used in the electronics industry are not described in detail.

1

CABLE DISTRIBUTION

Diagram 1 shows the cable interconnections between circuit boards in the R7103.

2

MODE SWITCH AND CALIBRATOR

Diagram 2, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, is a schematic of the Mode Switch and Calibrator circuitry. Gray shaded lines divide the circuitry into major stages. These stages aid in locating components mentioned here. Subheadings use the stage names to further identify portions of the circuitry on diagram 2.

CALIBRATOR

The Calibrator circuit provides voltage outputs of 40 millivolts, 0.4 volt and 4 volts at the CALIBRATOR output connector. A current output of 40 millamperes is available from the Calibrator circuit with an optional current-loop adapter. When using the current-loop adapter the Calibrator must be operated only in the 4 V switch position, for stated output.

Transistors Q376 and Q382 form a 1 kilohertz, square-wave oscillator. Oscillation occurs as follows: Initially assume that Q376 is conducting and Q382 is not conducting. The voltage at the emitter of Q382 becomes more negative as C376 discharges through R381. Capacitor C376 discharges until the emitter-base junction of Q382 becomes forward biased. As Q382 begins conducting the oscillator changes states. Regeneration starts when Q382 conducts and C376 stops discharging; this reduces the collector current of Q376. Thus, the collector voltage of Q376 rises positive which causes the base and emitter of Q382 to rise positive. The positive going voltage is coupled by C376 to the emitter of Q376, turning it off.

At this time, Q382 is conducting and Q376 is not conducting. The voltage at the emitter of Q376 goes negative as C376 charges through R376. When the emitter-base junction of Q376 becomes forward biased the oscillator will again change states to complete the cycle.

TABLE 3-1
Mode Switching Inputs/Outputs

FRONT-PANEL SWITCH POSITIONS (INPUTS)								MODE SWITCHING OUTPUTS					
TRIGGER SOURCE SWITCH			VERTICAL MODE SWITCH					VERT MODE SIG	RIGHT	$\overline{\text{ADD}}$	TRIGGER SWITCH LIGHTS		
VERT MODE	LEFT VERT	RIGHT VERT	LEFT	ALT	ADD	CHOP	RIGHT				VERT MODE	LEFT VERT	RIGHT VERT
	●								**L**	**H**		On	
		●							**H**	**H**			On
●			●					**L**	**L**	**H**	On	On	
●					●			**L**	**L**	**L**	On	On	On
●						●		Chop	**L**	**H**	On	On	
●							●	**H**	**H**	**H**	On		On
●				●				Alt	Alt	**H**	On	On	On

The square-wave signal produced at the collector of Q382 switches Q384 on and off. When Q384 is on, the current from R383 and R384 flows to ground. When Q384 is off, this current flows through CR386 and R386 into the voltage divider network of R387, R392, R393, R394, R395, R396, and R397 to produce the 4 volt, 0.4 volt and 40 millivolt Calibrator output voltages. The accuracy of the Calibrator is set by the 0.4 Volts adjustment, R385. Both the 4 V and 0.4 V calibrator switches must be engaged when adjusting R385. The Calibrator frequency is set by the 1 kHz adjustment, R375.

MODE SWITCHING

The Mode Switching circuit includes front-panel switching and provides the logic for selecting which vertical compartment is to provide deflection for the crt. The Mode Switch circuit operates in conjunction with the Logic circuit (Diagram 4) to develop control signals for use in other circuits in the R7103 and its plug-in units. Table 3-1 shows the outputs produced with all combinations of the front-panel switch positions.

3

MAIN INTERFACE

Diagram 3 shows the plug-in interface and the interconnections between the plug-in compartments, circuit boards, etc., of the R7103. The signal and voltage connections of each interface connector are also identified on diagram 3.

4

LOGIC

The Logic circuit develops control signals for use in other circuits in the R7103 and any plug-in units installed in the vertical and horizontal compartments. These control signals automatically determine the correct instrument operation in relation to the plug-in units installed or selected, plug-in control settings, and R7103 control settings.

Diagram 4, in Section 8 of this manual, shows the Logic circuit. Gray shaded lines divide the circuitry into major stages. Sub-headings in the following discussion use these stage names to further identify portions of the circuitry on Diagram 4.

Logic Block Diagram. Figure 3-2 is a block diagram of the Logic circuit. It shows the sources of the input control signals, the output signals it produces, and the main interconnections between blocks. The interconnections shown are intended only to indicate interrelation between blocks and do not indicate a direct connection or that only a single connection exists between the depicted blocks.

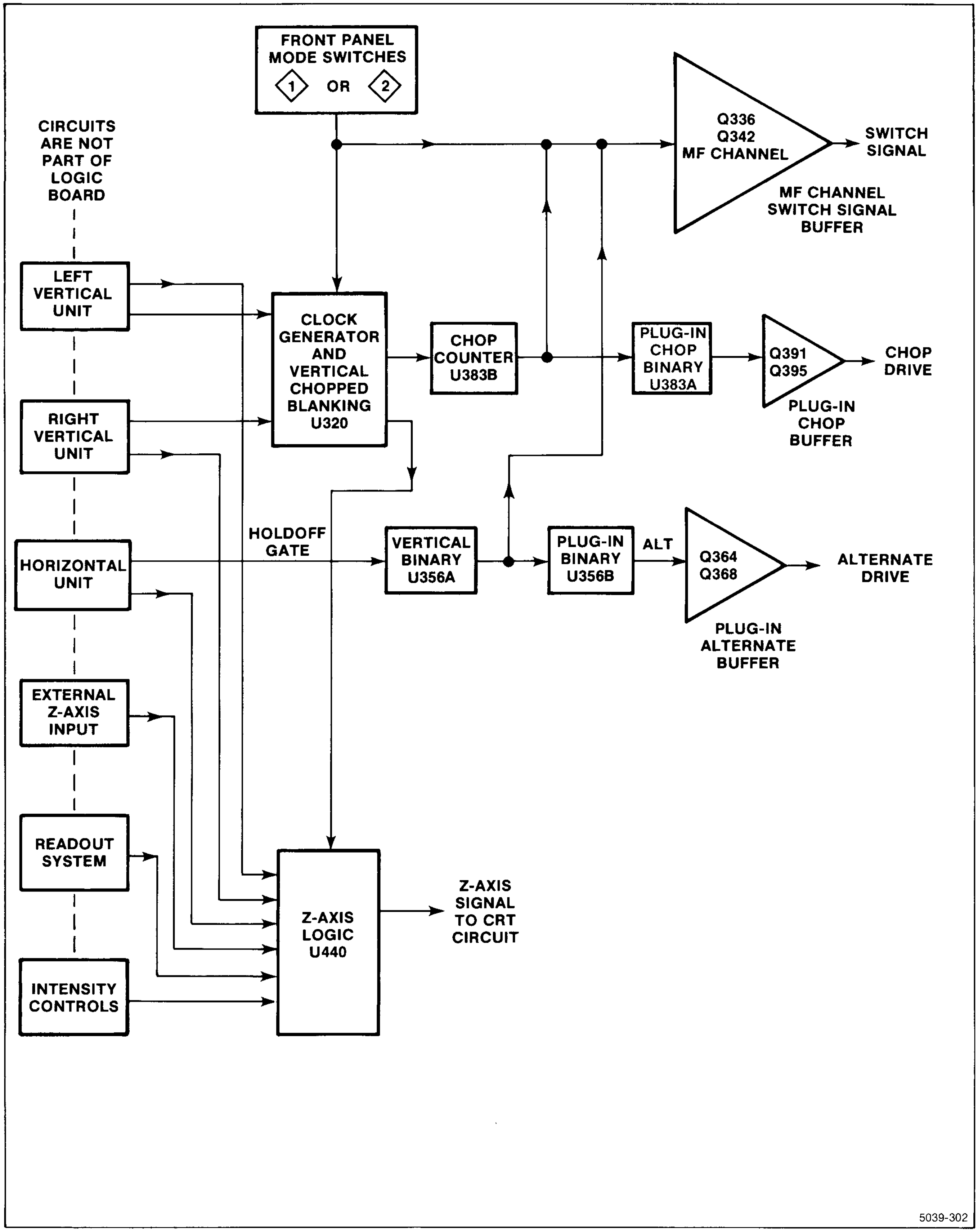


Figure 3-2. Block diagram of Logic circuit.

The operation of each stage is discussed by relating its input signals or levels to the output, considering the various modes of operation that may affect the stage. A logic diagram is provided where applicable. Logic diagrams are not discussed in detail, but are included to aid in relating the function performed by a given stage to standard logic techniques. These logic diagrams are not exact representations of circuits, but only show the function the stage performs. Where applicable, an input/output table is included for use with this description and the logic diagram. The input/output tables show the combination of input conditions that are important to perform the prescribed function of the stage.

CLOCK GENERATOR

Half of U320 and associated parts make up the Clock Generator stage. Figure 3-3a is an equivalent circuit of the Clock Generator stage. Resistor R1, Q1, Q2 and Q3 represent the equivalent of the internal workings of U320. This circuit and external parts C314. R312, R313, and R314 comprise a 2-MHz free-running oscillator which provides a clock signal for mainframe vertical and plug-in chopping, and blanking.

The stage operates as follows: Assume that Q2 is conducting and Q1 is turned off. The low collector voltage from Q2 holds Q1 off, and via Q3 reaches pin 14 (see waveforms in Fig. 3-3b at time T0). Because Q1 is not conducting, C314 starts to charge toward −15 V through R312-R313. The emitter of Q1 goes negative as C314 charges until it is about 0.6 V more negative than its base. At that time Q1 starts conducting and its emitter voltage goes positive rapidly. The positive transition from Q1's emitter is coupled directly through C4314 to Q2's emitter, which reverse-biases Q2. When reverse-biased, Q2's collector produces a positive level at pin 14 (see time T1 in Fig. 3-3b).

Conditions are now reversed. Q2 is off and C314 begins to discharge through R314. The emitter voltage of Q2 follows the discharge of C314 until it is about 0.6 V more negative that its base. At that time Q2's collector voltage will go negative and reverse-bias Q1. Transistor Q3 couples the negative voltage from Q2's collector to Q3's emitter, and the cycle is complete. Capacitor C314 again starts to charge toward −15 V through R312-R313 to start the second cycle.

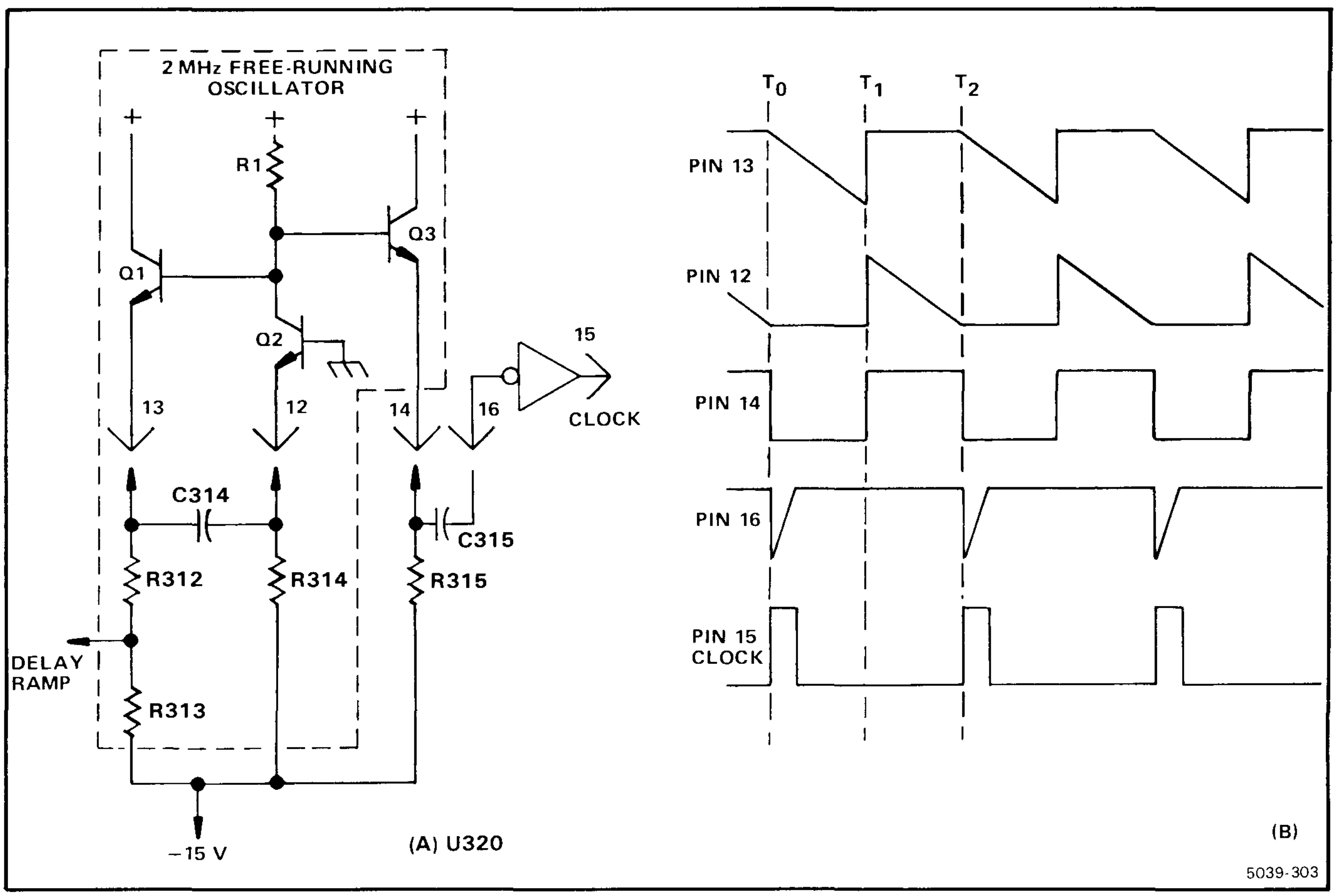


Figure 3-3. a) Simplified Clock Generator and b) its waveforms.

The clock generator produces two outputs. The Delay Ramp signal, from the junction of R312-R313, is connected to the Vertical Chopped Blanking stage. This signal has the same shape as the waveform at pin 13, with its slope determined by the ratio of R312-R313. A square wave is available at U320 pin 14. The frequency of this square wave is determined by the C314 and R1, and the duty cycle is set by the ratio of R312-R313 to R314.

The square wave from U320 pin 14 is connected to pin 16 via C315. Capacitor C315, along with the internal resistance of U320, differentiates the square-wave to form a negative-going pulse coincident with the negative transition of the square wave (the positive-going pulse that coincides with the positive transition of the square wave has no effect on the circuit operation).

CHOPPED BLANKING

The Chopped Blanking stage consists of the other part of U320; see Figure 3-4a. This stage decides whether Vertical Chopped Blanking pulses are required, based on the operating mode of the vertical system or (if used) dual-trace plug-in units. Vertical Chopped Blanking pulses are produced if:

a. the VERTICAL MODE selector is set to CHOP,

b. a dual-trace vertical unit is operating in chop mode and being displayed, and

c. a dual-trace vertical unit is operating in chop mode with the R7103 VERTICAL MODE selector set to ADD.

The frequency of the Vertical Chopped Blanking pulse output at pin 4 is always 2 MHz, as set by the Clock Generator stage.

The Delay Ramp from the Clock Generator determines the repetition rate and pulse width of the Vertical Chopped Blanking pulses. The Delay Ramp applied to U320 pin 10 starts to go negative from about +1.1 V, coincident with the leading edge of the Clock pulse (see Fig. 3-4b). This results in a high quiescent condition for the Vertical Chopped Blanking line. The slope of the negative-going Delay Ramp is set by the Clock Generator. As it reaches a level just below zero volts, the Vertical Chopped Blanking pulse level changes to the low state, and stays low until the Delay Ramp goes high again. The leading edge of the Vertical Chopped Blanking pulse is delayed from the leading edge of the Clock pulse from U320 (see Fig 3-4b). The amount of delay is determined by the slope of the Delay Ramp applied to U320 pin 10. The delay is necessary due to the delay line in the vertical deflection system. Without delay, the trace blanking resulting from the Vertical Chopped Blanking pulse would not coincide with the switching between display traces. The duty cycle of the square-wave Clock pulse determines the pulse width of the Vertical Chopped Blanking pulses.

Whenever the R7103 is turned on, it produces Vertical Chopped Blanking pulses at a 2 MHz rate. However, U320 produces these pulses (at pin 4) only when its inputs are at specified levels. The following conditions cause Vertical Chopped Blanking pulses to blank the crt during vertical trace switching. Figure 3-4a shows the functions of U320's inputs.

1. Chop Vertical Mode. When the VERTICAL MODE selector is set to CHOP, Vertical Chopped Blanking pulses are available at U320 at all times. The input conditions U320 needs are:

   a. pin 3, high—VERTICAL MODE set to CHOP,

   b. pin 7, low—VERTICAL MODE not set to ADD, and

   c. pin 10, low—Delay Ramp more negative than 0 volts.

2. Left Vertical unit set for Chopped Operation. When the Left vertical unit is set for chopped operation, the setting of the VERTICAL MODE selector determines whether Vertical Chopped Blanking pulses are available. If the VERTICAL MODE selector is set to CHOP, conditions will be as described in No. 1, above. Operation in the ADD mode will be described later. When the R7103 VERTICAL MODE is set to LEFT, or the left vertical unit is set to Alternate mode, Vertical Chopped Blanking pulses are available times at a 2 MHz rate. The input conditions U4320 requires are:

   a. pin 3, low—VERTICAL MODE set anywhere except CHOP,

   b. pin 5, low—left vertical unit set to Chopped mode,

   c. pin 6, low—left vertical unit to be displayed (Vertical Mode Command low),

   d. pin 7, low—VERTICAL MODE set anywhere except ADD, and

   e. pin 10, low—Delay Ramp more negative than 0 volts.

   Note that the Mode command at U320 pin 6 must be low for output pulses to available at pin 4. This means that when the R7103 VERTICAL MODE is set to ALT, Vertical Chopped Blanking pulses are produced only while the left vertical unit is displayed (unless the right vertical unit is also set for chopped operation).

3. Right Vertical unit set to Chop. When the right vertical unit is set for chop mode, the operation is the same as when the left vertical is set for chop mode, *except* that Vertical Chopped Blanking pulses will be produced when the R7103 VERTICAL MODE is set to RIGHT or when the Alternate Mode command is high in Alternate mode. The input conditions U320 requires are:

   a. pin 3, low—VERTICAL MODE set anywhere but CHOP,

   b. pin 6, high—right vertical unit to be displayed (Alternate Mode command high),

   c. pin 7, low—VERTICAL MODE set anywhere but ADD,

   d. pin 8, low—right vertical unit set to chop mode, and

   e. pin 10, low—Delay Ramp more negative than 0 volts.

4. Add Vertical Mode. When the R7103 VERTICAL MODE is set to ADD and either vertical unit is operating in chop mode, Vertical Chopped Blanking pulses must be available to blank the transition between traces of the vertical units. The input conditions U320 requires are:

   a. pin 3, low—VERTICAL MODE set anywhere but CHOP,

   b. pin 5, low—left vertical unit set to chop mode (pin 5 can be high if pin 8 is low),

   c. pin 7, high—VERTICAL MODE set to ADD,

   d. pin 8, low—right vertical unit set to chop mode (pin 8 can be high if pin 5 is low), and

   e. pin 10, low—Delay Ramp more negative than 0 volts.

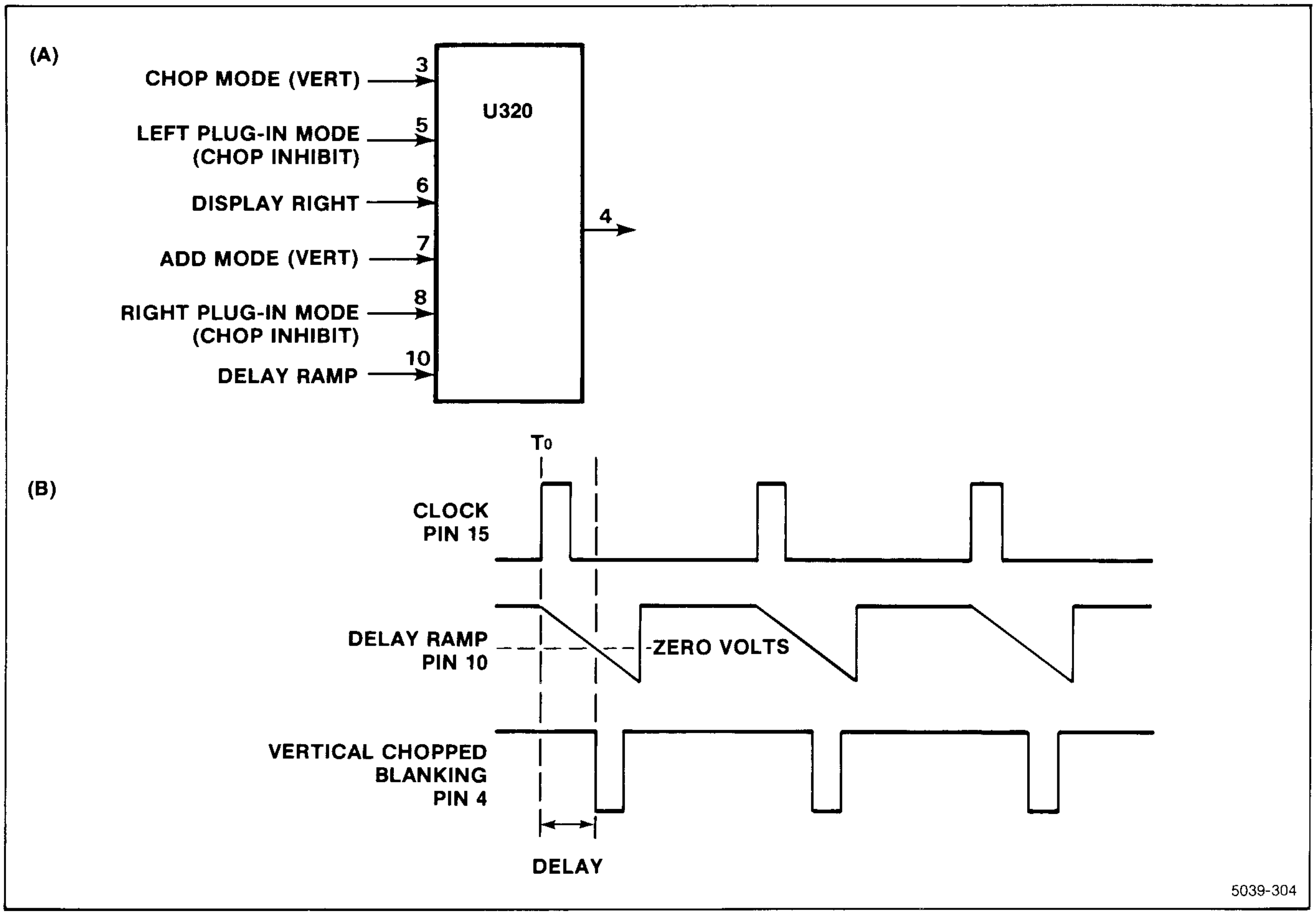
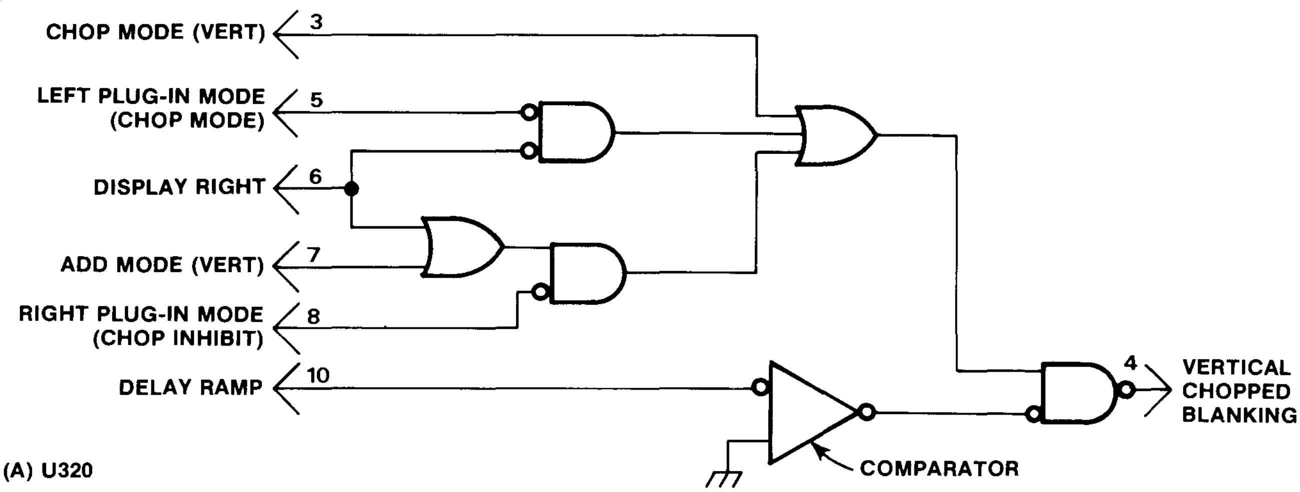


Figure 3-4. a) Input and output pins of U320, and b) its waveforms.

Figure 3-5a is a logic diagram of the Chopped Blanking circuit. The output of the comparator is determined by the relation between its two inputs. If the Delay Ramp is more positive than the grounded input, the output will be high; if the Delay Ramp is more negative, the output will be low. Figure 3-5b is an input/output table for the Chopped Blanking circuit.

CHOP COUNTER

The Chop Counter produces the Display Right signal and the Chop signal. Clock pulses from U320 provide timing for the Chop counter. Figure 3-6 is a logic diagram of the Chop Counter.



(A) U320

INPUT: CHOP MODE (VERT)	LEFT PLUG-IN MODE (CHOP INHIBIT)	DISPLAY RIGHT	ADD MODE (VERT)	RIGHT PLUG-IN MODE (CHOP INHIBIT)	DELAY RAMP	OUTPUT: VERTICAL CHOPPED BLANKING	
3	5	6	7	8	10[1]	4[2]	CONDITIONS
H	ϕ	ϕ	L	ϕ	L	L	CHOP MODE (VERT)
L	L		L	ϕ	L	L	LEFT PLUG-IN CHOPPED
L	ϕ	H	L	L	L	L	RIGHT PLUG-IN CHOPPED
L	L[3]	ϕ	H	L[3]	L	L	ADD MODE, LEFT OR RIGHT PLUG-IN CHOPPED
ALL OTHER COMBINATIONS						H	NO VERTICAL CHOPPED BLANKING PULSES AT OUTPUT

ϕ = HAS NO EFFECT IN THIS CASE

[1] RAMP SIGNAL; CONSIDERED LOW WHEN MORE NEGATIVE THAN ABOUT ZERO VOLTS.

[2] NEGATIVE-GOING PULSE AT TWO MEGAHERTZ RATE.

[3] PIN 5 CAN BE HIGH AND NOT AFFECT OPERATION IF PIN 8 IS LOW; AND VICE VERSA.

(B)

5039-327

Figure 3-5. a) Logic diagram for Vertical Chopped Blanking, and b) its I-O table.

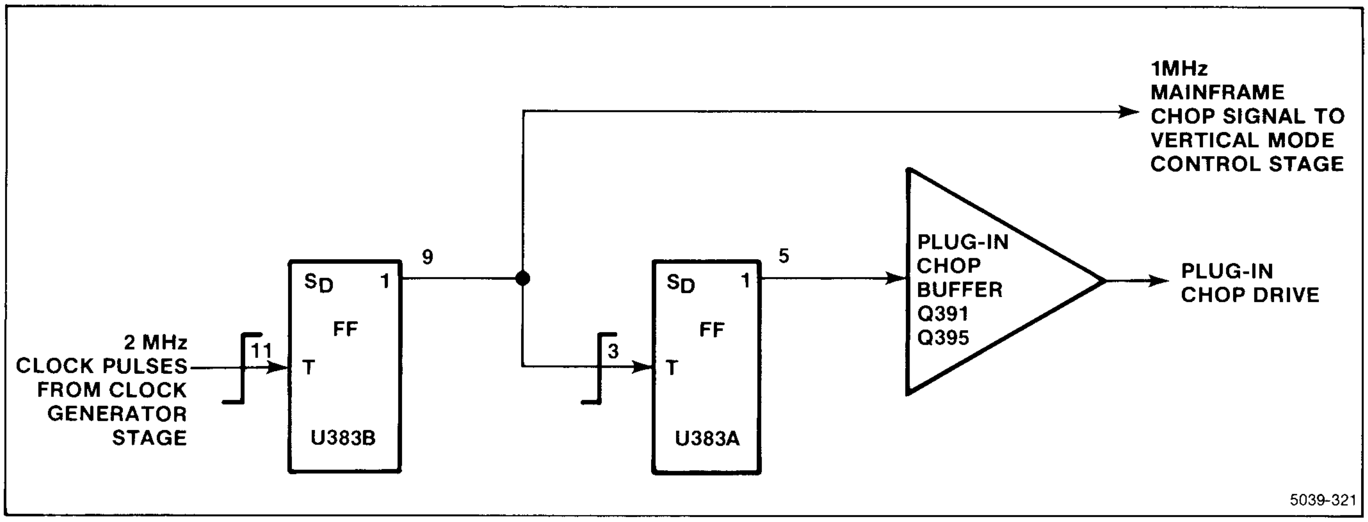


Figure 3-6. Logic diagram of Chop Counter.

The Chop Counter consists principally of U383, a dual D (edge triggered) flip-flop. As connected here, U383 operates as a toggled (T) flip-flop.

As shown in Figure 3-6, two-megahertz pulses from U320 stimulate the trigger input of U383B, which changes states on each positive transition at that T input. The signal at U383B's Q output is a one-megahertz square wave, which is connected to the Vertical Mode Control circuit to provide the Display Right signal, and to the T input of U383A. Flip-flop U383A produces a 500 kHz square wave which, via Q391 and Q395, becomes the Chop Drive signal. Figure 3-7 shows the timing relation of the signals in the Chop Counter.

VERTICAL MODE CONTROL

The Vertical Mode Control circuit consists of CR333, CR332, CR329, CR328, CR327 and buffer amplifier Q336-Q342. These components produce the Display Right signal for 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 the Display Right line is high, the right vertical unit is displayed, and when it is low the left vertical is displayed.

The R7103 VERTICAL MODE selector (shown on diagrams 1 and 2) provides a high level on one of its four output lines to indicate the selected vertical mode. The other three lines stay low. The fifth mode, Left, is indicated when all four output lines are low. Operation of the Vertical Mode Control in all positions of the VERT MODE selector is as follows:

Right

When the VERTICAL MODE selector is set to RIGHT, a high level is connected to Q336 via R327 and CR327. The low level at the anodes of diodes CR328 and CR333 reverse-biases them. The resultant output of Q342 is a high level to indicate that the right vertical unit is to be displayed

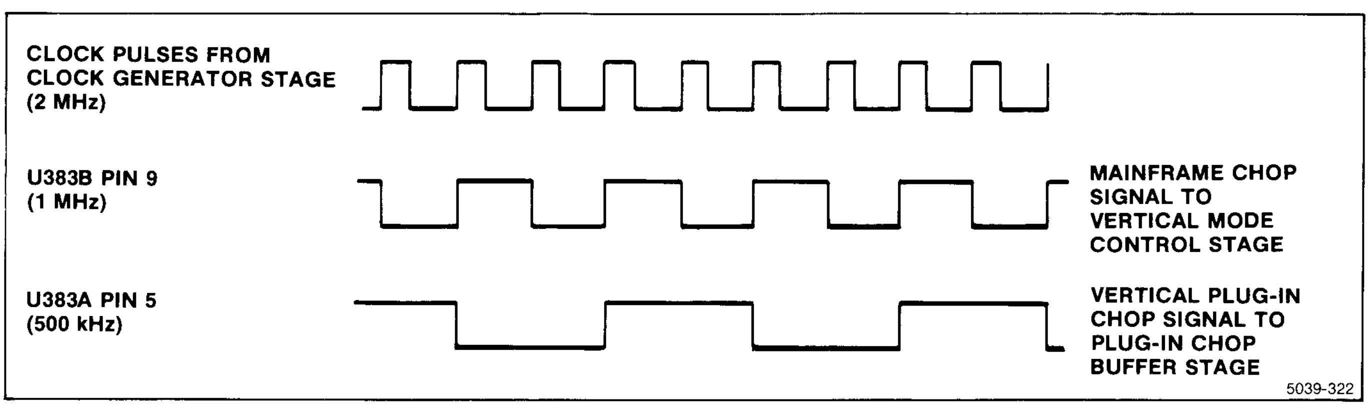


Figure 3-7. Idealized input and output waveforms for Chop Counter.

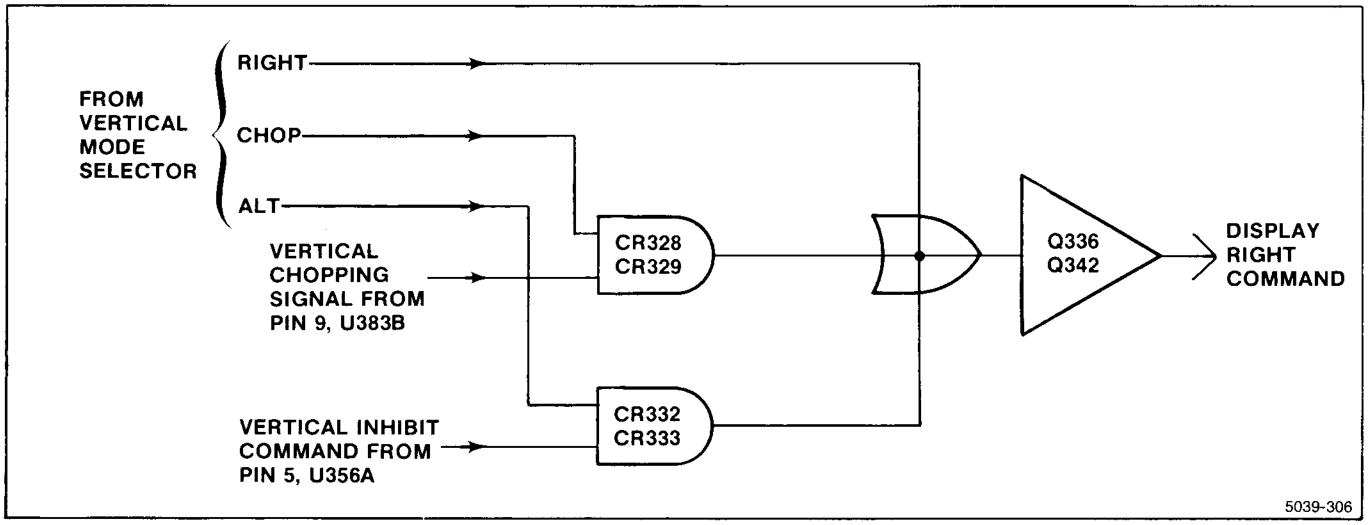


Figure 3-8. Logic diagram of Vertical Mode Control circuit.

Chop

When the VERTICAL MODE selector is set to CHOP, a high level is applied to the anodes of diodes CR329 and CR328 via R328. This forward-biases both diodes so the vertical Chop signal from U383B pin 9 can reach the emitter of Q336. This signal switches at a 1 MHz rate and produces a corresponding Display Right signal at the output of Q342.

Alternate

When the VERTICAL MODE selector is set to ALT it applies a high level to the anodes of CR333 and CR332 via R332. These diodes are forward-biased, permitting the Display Right command from U356A to reach the emitter of Q336 and determine the Display Right signal. The output of U356B switches at a rate set by the Vertical Binary stage.

Add and Left

Because there are only three output lines (Right, Chop, and Alternate) from the VERTICAL MODE selector, when it is set to ADD or LEFT those three lines must stay low. Therefore, the emitter of Q336 stays low to produce a low Display Right signal. Final selection of Add or Left mode is made by the Vertical Interface circuit.

Figure 3-8 shows a logic diagram of the Vertical Mode Control circuit.

VERTICAL BINARY

The Vertical Binary circuit consists of U356A and Q352. Figure 3-9 is a logic diagram of the Vertical Binary circuit.

The operation of the Vertical Binary circuit is controlled by the Alt line from the VERTICAL MODE selector. When it is set to ALT, the VERTICAL MODE selector applies a high level to the emitter of Q352 via R351. This reverse-biases Q352, whose collector stays high. As a result, Q352 has no effect on the operation of the Vertical Binary stage. (The high output of Q352 does not affect U356A.) Therefore, U356A operates as a triggered FF which changes states with each positive transition of the Sweep Holdoff Gate, which occurs at the end of each sweep. The output of U356A switches at half the rate of the Sweep Holdoff Gate from the time base. Figure 3-10 show the time relationships between the input and output signals for this stage, and shows the resultant display for each combination of signals.

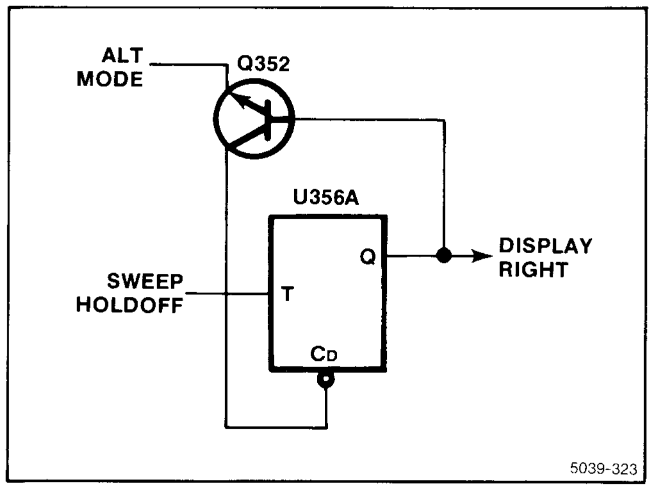


Figure 3-9. Logic diagram for Vertical Binary circuit.

When the VERT MODE selector is set to any position other than ALT, the Alt line will be low, enabling Q352. However, Q352 does not turn on unless the Q output of

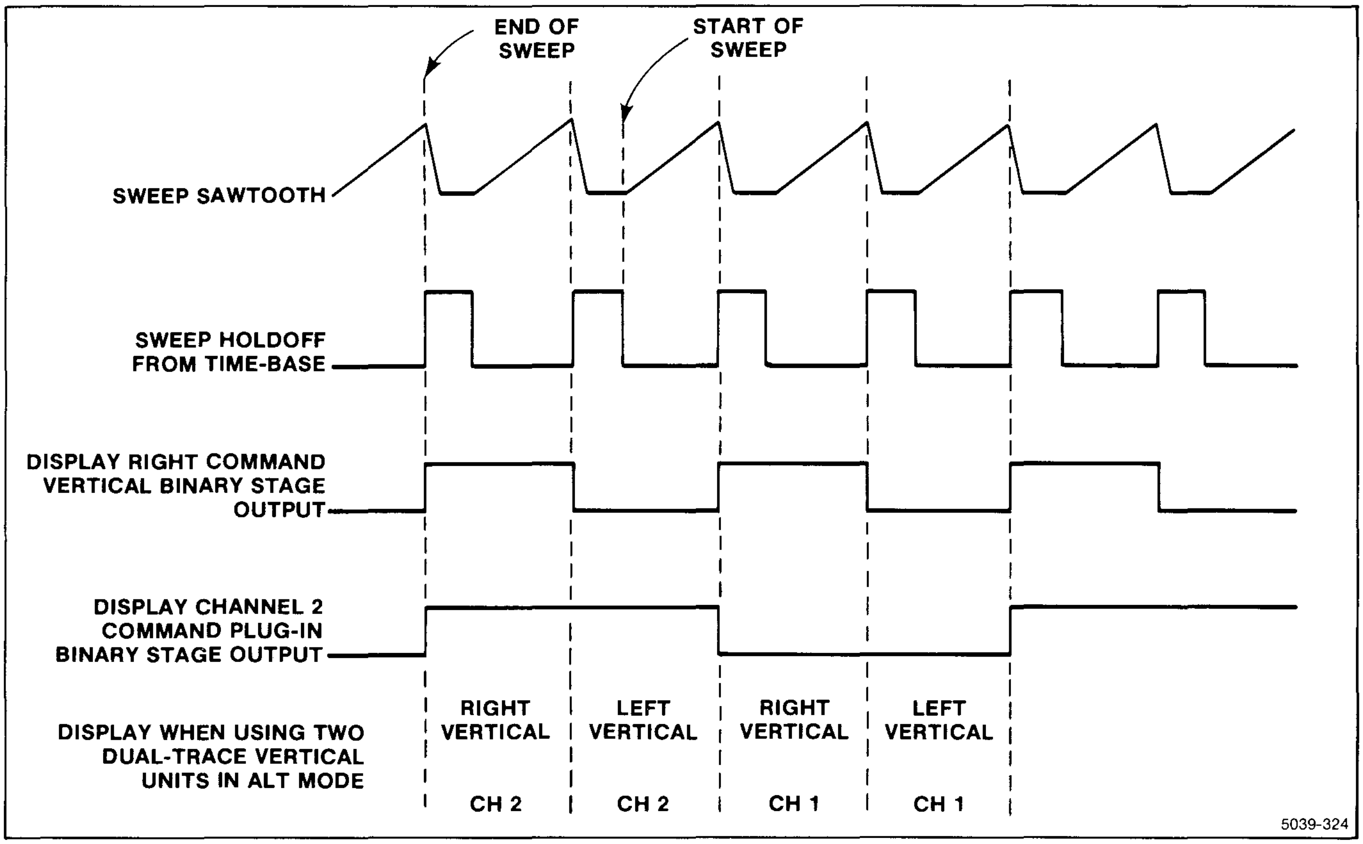


Figure 3-10. Idealized relation between input and output waveforms of Vertical Binary and Plug-In Binary circuits when R7103 is set to Alternate mode.

U356A goes high. Quiescently, the output of Q352 is low. Therefore, when a positive Sweep Holdoff Gate triggers U356A at the end of the sweep, the positive output of U356A turns on Q352. Q352's output then goes low and clears U356A, and the output of U356A again disables Q352. The stage is then ready for the next Sweep Holdoff Gate. This action is the same each time, so the signal at the output has the same repetition rate as the Sweep Holdoff Gate. Therefore, this stage is now operating as a divide-by-one counter rather than as the divide-by-two counter described previously. The output in this condition is used only by the Plug-In Binary stage.

Because the Vertical Binary stage can change states only at the end of each sweep, there is no Alternate Drive signal for the mainframe or the vertical plug-in units if no sweep is being produced by the horizontal plug-in unit.

PLUG-IN BINARY

The Plug-In Binary stage consists of U356B. The trigger input for U356B is the Display Right command from the Vertical Binary stage. When the VERTICAL MODE selector is set to ALT, the repetition rate of the Display Channel 2 Command output of this stage is one-fourth the rate of the Sweep Holdoff Gate (see Fig. 3-10). For any VERTICAL MODE setting other than ALT, the repetition rate of U356B's output will be half the rate of the Sweep Holdoff Gate. Figure 3-11 is a logic diagram of the Plug-In Binary stage.

CHANNEL SWITCH BUFFER

The Channel Switch buffer receives the output from the Vertical Mode Control circuit, buffers it, and presents it to the other parts of the R7103 on the Display Right line.

Common-base transistor Q336 presents a low impedance to the Vertical Mode Control circuit. Emitter follower Q342 supplies the Display Right signal to the rest of the R7103, and isolates the logic circuits from other circuits in the R7103 and its plug-in units.

PLUG-IN ALTERNATE BUFFER

The Plug-In Alternate Buffer receives the output of the Plug-In Binary circuit, buffers it, and presents it to the other parts of the R7103 as Alternate Drive.

Like the Channel Switch buffer, the Plug-In Alternate Buffer has a common-base input (Q364) and an emitter-follower output (Q368).

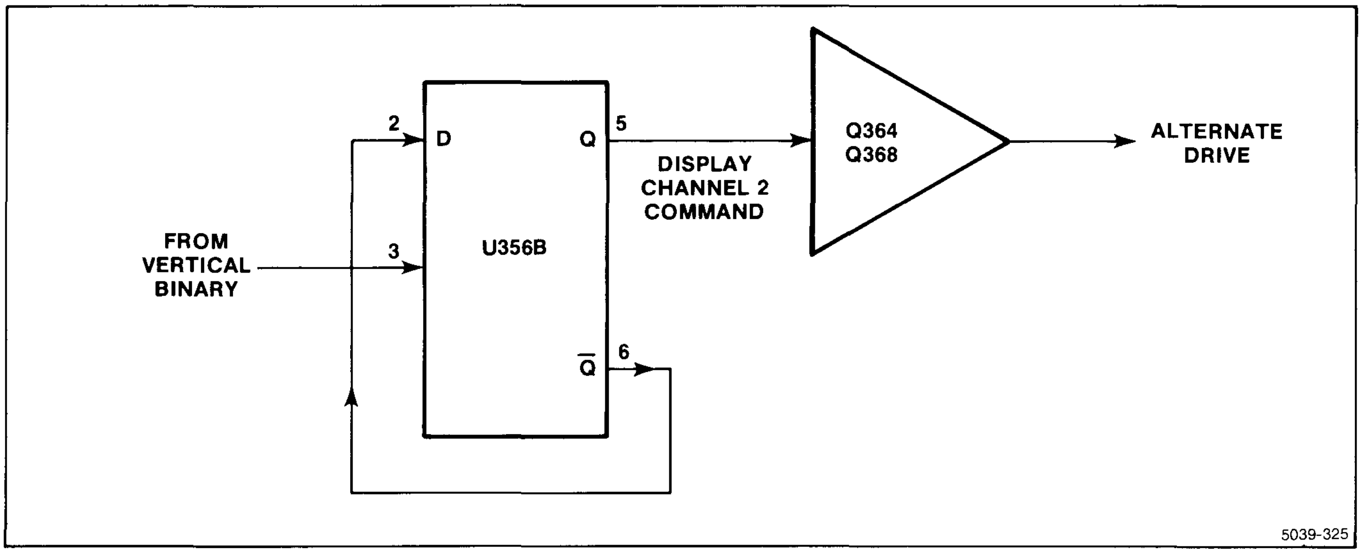


Figure 3-11. Plug-In Binary stage.

PLUG-IN CHOP BUFFER

The Plug-In Chop Buffer receives the output of the Chop Counter and presents it to the other parts of the R7103 as Chop Drive.

Like the Channel Switch Buffer, the Plug-In Chop Buffer has a common-base input (Q391) and an emitter-follower output (Q395).

Z-AXIS LOGIC

The Z-Axis Logic stage produces an output current signal, at pin 8 of U440, which sets the intensity of the crt display. (The intensity of the readout display is controlled by the Readout System.) The output current at pin 8 is determined by the setting of the INTENSITY control and the Auxiliary Z-Axis input. The Auxiliary Z-Axis input is produced by either the External Z-Axis input or by an input from any of the plug-in units; see Main Interface, diagram 3. The input current from the INTENSITY control is switched, matching the output current to the horizontal display. The Vertical Chopped Blanking and readout blanking signals are applied to this stage to block the output current and thus blank the crt display vertical chopping or during a readout display.

The Z-Axis Logic stage consists of Q416 and U440, which serves as a signal conditiioner for the main Z-Axis Amplifier.

The Sweep Gate signal at pin 14 of U440 provides the unblanking signal for the sweep. The Aux Z-Axis input at U440 pin 9 controls the intensity level, depending on the input signal at the Z-Axis input connector on the rear panel, or the Aux Z-Axis input from the plug-in compartments allows trace intensification. The intensity Limit decreases the Z-Axis output at slow sweep speeds to protect the crt phosphor.

MCP (MICROCHANNEL PLATE) INTENSITY TRACKING

The MCP output voltage increases as the INTENSITY control is rotated past midrange. Tracking is provided by Q452.

5

TRIGGER SELECTOR

The Trigger Selector circuit determines the source of the internal triggering signals connected to the horizontal compartment. Diagram 5, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, is a schematic of the Trigger Selector circuit. Gray shaded lines divide the circuitry into major stages. Subheadings in the following discussion use these stage names to further identify portions of the circuitry on Diagram 5.

TRIGGER CHANNEL SWITCH

Amplifier units installed in the vertical compartments provide a differential trigger signal to the mainframe.

Channel switch U232 has two differential inputs and one differential output. Control voltages at pins 1, 2, 11 and 12 determine whether the input signals are terminated within the channel switch or are coupled through to the output. Comparator U252A and Q254 keep the output dc common-mode voltage on pins 3 and 13 at +3.2 volts for all modes of channel switch U232. The dc common-mode voltage is sensed by resistors R237 and R247 and is compared with a +3.2 volt reference set by divider R251 and R252. If resistors R237 and R247 sense a voltage higher than +3.2 volts, the output of U252A goes negative lowering the base voltage on Q254. This reduces the current into pin 3A which causes the dc common mode voltage at pin 3 and 13 to decrease. The voltage at pin 3A depends on the channel switch mode. When the VERTICAL MODE selector is set to LEFT, RIGHT, or ALT the voltage on pin 3A is +3.8 volts. When the VERTICAL MODE selector is set to ADD the voltage on pin 3A is +4.6 volts.

Each channel within U232 has an independent pair of control pins for channel selection. If the "On" pin is more positive than the "Off" pins that channel is selected. All of the "On" pins are held at +2.0 volts, the "Off" pins are either at +2.5 volts or at a T^2L LO level. The Trigger Channel Switch has four operating modes: Left, Right, Alt, and Add; in the Left and Right modes the Add logic level is high (on pin CE) and the Right logic level (on pin CD) is low for Left and high for Right. In the ALT mode Add is high and Right alternates between low and high. In the ADD Mode both Add and Right are low. (See the discussion on Mode Switching, Diagram 2, in this section of the Manual).

Zener diodes VR237 and VR247 shift the dc level negative by 9 volts, to set the output of U274 near ground. Diodes VR237 and VR247 are matched to within 100 mV.

TRIGGER AMPLIFIER

Integrated circuit U274 provides final amplification of the trigger signal. Zener diodes VR237 and VR247 have a 5% voltage tolerance, therefore the dc voltage level at pins 7 and 9 of U274 is -5.8 volt within 0.45 volt. The dc common mode voltage with its 0.45 volt uncertainty is picked off at pin 5 and pin 12 of U274 and applied to the noninverting input of U252B. The output of U252B is 1.2 volts more positive than the input and is used for internal biasing at pin 15 of U274. Variable resistor R274 determines the gain of U274. The overall voltage gain of the trigger selector, from the input connectors J200, J201 or J400 and J401 to the output at J270, J271 into a load of 50 ohms per side, is one. The dc output level of U274 is zero volts, R256 sets the dc centering and R279 adjusts the DC Common Mode voltage.

RC circuit R240 and C240, and C250 provide thermal compensation for U232.

VERTICAL SIGNAL OUTPUT AMPLIFIER

A differential signal is taken from pins 2 and 4 of U274 and amplified by U492. Before the signal reaches the input of U492 it passes through a compensation circuit consisting of C483, R483, R486, L486, R496, C493 and R493. The characteristic impedance of this circuit is 100 ohms differentially, which terminates the 50-ohm strip transmission lines running from the pickoff points (pins 2 and 4 of U274). At pins 2 and 4 there is an uncertainty in the dc common mode level due to the 5% voltage tolerance of zener diodes VR237 and VR247. Integrated circuit U252B passes on this uncertainty to bias U492. The output signal at J497 is centered at 0 volt by R485. The signal out amplitude is 25 millivolts/division of vertical deflection into a load of 50 ohms, and 0.5 volt/division of vertical deflection into a 1 megohm load. Two time constants, R480-L480, and R490-C490, provide thermal compensation.

6

READOUT SYSTEM

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

Diagram 6, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, shows a schematic diagram of the Readout System. Gray shaded lines divide the schematic into major stages. These stage name headings are used in the following discussion to further identify portions of the circuitry on Diagram 6.

The following terms are used to describe the Readout System:

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

Word—A group of related characters. In the Readout System, a word can consist of up to 10 characters.

Frame—A display of all words for a given operating mode and plug-in combination. Up to eight words can be displayed in one frame. Figure 3-12 shows the position of each word in a complete frame.

Column—One of the vertical lines in the Character Selection Matrix (see Fig. 3-13). Columns C-0 (column zero) through C-10 (column 10) can be addressed by the system.

Row—One of the horizontal lines in the Character Selection matrix. Rows R-1 (row 1) through R-10

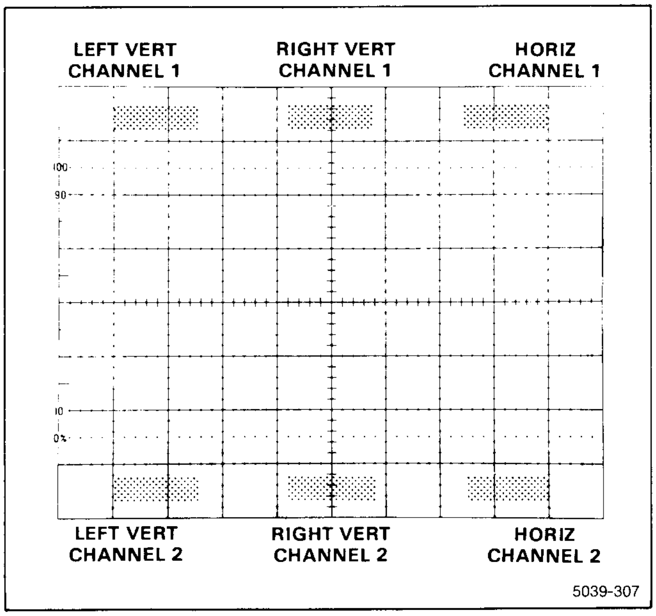


Figure 3-12. Location of readout display on the crt identifying the originating plug-in and channel.

(row 10) and R-14 (row 14) can be addressed by the system.

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

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

Display Format. Up to eight words of readout information can be displayed on the crt. The position of each word is fixed and is directly related to the plug-in unit where it originated. Figure 3-12 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 in the top division of the crt and Channel 2 is displayed directly below in the bottom division. Figure 3-13 shows a typical display where only Channel 2 of the Right Vertical unit is selected for display.

Each word in the readout display can contain up to 10 characters, although the typical display will contain from two to seven characters per word. The characters are selected from the Character Selection Matrix shown in Figure 3-14. In addition, 12 operational addresses are provided for special instructions to the Readout System. The unused locations in the Matrix (shaded area) are available for future expansion of the Readout System. The method of addressing the locations in the Character Selection Matrix is described in the following discussion.

Developing The Display. 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 (see schematic 6). This stage produces the basic signals that establish the timing sequences within the Readout System. The period of the timing signal is about 250 microseconds (drops to about 210 microseconds when Display-Skip is received; see detailed description of Timer stage further on for more information). This stage also produces control signals for other stages in this circuit and interrupt signals to the Vertical Amplifier, Horizontal Amplifier, and Logic circuits, which allow a readout display to be presented. The Time-Slot Counter stage receives a trapezoidal voltage signal from the Timer stage and directs it to one of 10 output lines. These output lines are labeled TS-1 through TS-10 (time-slots 1 through 10) and are connected to the vertical and horizontal plug-in compartments and to various stages within the Readout System. The output lines are activated sequentially, so there is a pulse on only one of the 10 lines during any 250 microsecond timing period. After the Time-Slot Counter stage has counted time-slot 10, it produces an End-of-Word pulse which advances the system to the next channel.

Two output lines (row and column) are connected from each channel of the plug-in unit back to the Readout System. Data is typically encoded on these output lines by connecting resistors between them and the time-slot input lines. The resultant output is a sequence of 10 analog current levels that range from 0 to 1 millampere (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 Figure 3-14.

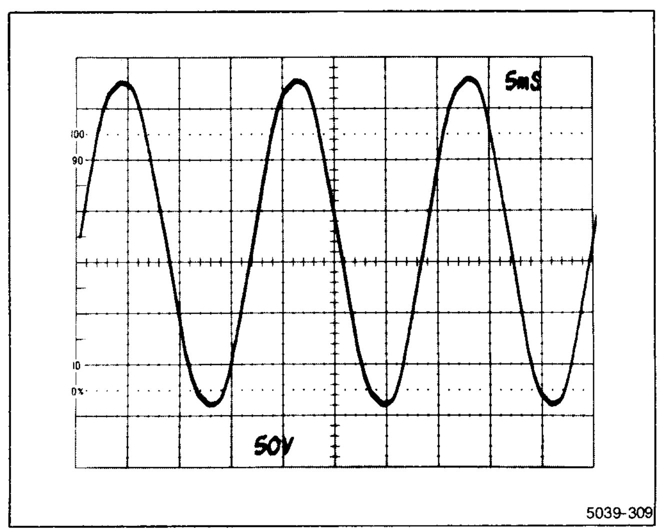


Figure 3-13. Typical readout display where only channel 2 of the Right Vertical unit is displayed.

ROW NUMBER ↓ / COLUMN NUMBER →		C-0	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
	CURRENT (MILLI-AMPERES)	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[1]	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
R-2	0.1	SKIP[1]	ł	<	*I*	/	+	−	+	*C*	Δ	>
R-3	0.2	SKIP[1]	ADD[1] ONE ZERO	ADD[1] TWO ZEROS	SHIFT[1] PREFIX ←	SHIFT[1] PREFIX ← AND ADD ONE ZERO						*IDENTIFY*[1]
R-4	0.3	SKIP[1]	*m*	*μ*	*n*	*p*	*X*	*K*	*M*	*G*	*T*	*R*
R-5	0.4	SKIP[1]	*S*	*V*	*A*	*W*	*H*	*d*	*B*	*c*	Ω	*E*
R-6	0.5	SKIP[1]	*U*	*N*	*L*	*Z*	*Y*	*P*	*F*	*J*	*Q*	*D*
R-7	0.6	SKIP[1]			DECIMAL[1] POINT LOCATION NO. 3	DECIMAL[1] POINT LOCATION NO. 4	DECIMAL[1] POINT LOCATION NO. 5	DECIMAL[1] POINT LOCATION NO. 6	DECIMAL[1] POINT LOCATION NO. 7			
R-8	0.7	SKIP[1]									DECIMAL POINT	
R-9	0.8	SKIP[1]										
R-10	0.9	ADD SPACE IN DISPLAY[1]										

☐ UNUSED LOCATIONS. AVAILABLE FOR FUTURE EXPANSION OF READOUT SYSTEM

[1] OPERATIONAL ADDRESS.

5039-308

Figure 3-14. Character selection matrix for R7103 Readout System.

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

The standard format for encoding information 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 current from the eight data lines (two channels from each of the four plug-in compartments) and produce a time-multiplexed analog voltage output containing all of the column and row information from the plug-in units. The Column Data Switch and Row Data Switch are sequenced by the binary Channel Address Code from the Channel Counter.

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

The analog outputs of the Column Data Switch and Row Data Switch are connected to the Column Decoder and Row Decoder stages respectively. These stages sense the magnitude of the analog voltage input and produce an output current on one of the ten lines. The outputs of the Column Decoder stage are identified as C-1 through C-10 (column 1 through 10) corresponding to the encoded column information. Likewise, the outputs of the Row Decoder stage are identified as R-1 through R-10 (row 1 through 10) corresponding to the encoded row information. The primary function of the row and column outputs is to select a character from the Character Selection Matrix to be produced by the Character Generator stage. These outputs are also used at other points in 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 whether zero-adding or prefix-shifting information has been encoded by the plug-in unit, and stores it in the memory until time-slots TS-5, TS-6, or TS-8. After storing this information, it triggers the Display-Skip Generator stage so that there is no display during TS-1 (as defined by Standard Readout Format; see Table 3-2). When TS-5, TS-6, and TS-8 occur, the memory is addressed and any information stored there during TS-1 is transferred to the input of the Column Decoder stage to modify the analog data during the applicable time-slot.

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

The Character Generator stages produce the characters which are displayed on the crt. Any of the 50 characters shown on the Character Selection Matrix of Figure 3-14 can be addressed by proper selection of the column and row currents. Only one character is addressable in any one time-slot; a space can be added to the displayed word by the Decimal Point Logic and Character Position Counter stage when encoded by the plug-in unit. The latter stage counts the number of characters generated and produces an output current to step the display one character position to the right for each character. In addition, the character position is advanced once during each of time-slots TS-1, TS-2, and TS-3, whether or not a character is generated. 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 in each word regardless of the information encoded in time-slot TS-1, TS-2, or TS-3 preceding this digit. Also, by encoding row 10 and column zero during any time-slot, a blank space can be added to the display. Decimal points can be added to the display at any time by addressing the appropriate row and column. (See Character Selection Matrix for location of decimal points.) The Decimal Point Logic and Character Position Counter stage is reset after each word by the Word Trigger pulse.

The Format Generator stage provides the output signals to the vertical and horizontal deflection systems of the instrument to produce the character display. The binary Channel Address Code from the Channel Counter stage is connected to this stage, so that the display from each channel is positioned to the area of the crt associated with the plug-in and channel originating the word (see Fig. 3-12). The positioning current or decimal point location current generated by the Decimal Point Logic and Character Position Counter stage is added to the Horizontal (X) signal at the input to the Format Generator stage to provide horizontal positioning of the characters within each word. The X- and Y-Readout signals are connected to the Horizontal Amplifier and Vertical Amplifier through the X- and Y-Buffer stages.

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

TIMER

The Timer stage establishes the timing sequence for all circuits within the Readout System. This stage produces seven time-related output waveforms (see Fig. 3-15). 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 R3434 and C3434. The triangle waveform is clipped and amplified by U3433 to form the trapezoidal output signal at pin 10. The amplitude of this output signal is exactly 15 volts as determined by U3433 (exact amplitude is necessary to accurately encode data in plug-in units; see Encoding the Data). The Trigger output at pin 5 provides the switching signal for the Time-Slot Counter and Word Trigger stages.

The signals at pins 12, 13, 14, and 16 are produced only when the triangle waveform is on its negative slope and the trapezoidal waveform has reached the lower level. The timing sequence of these waveforms is important to the operation of the Readout System (see expanded

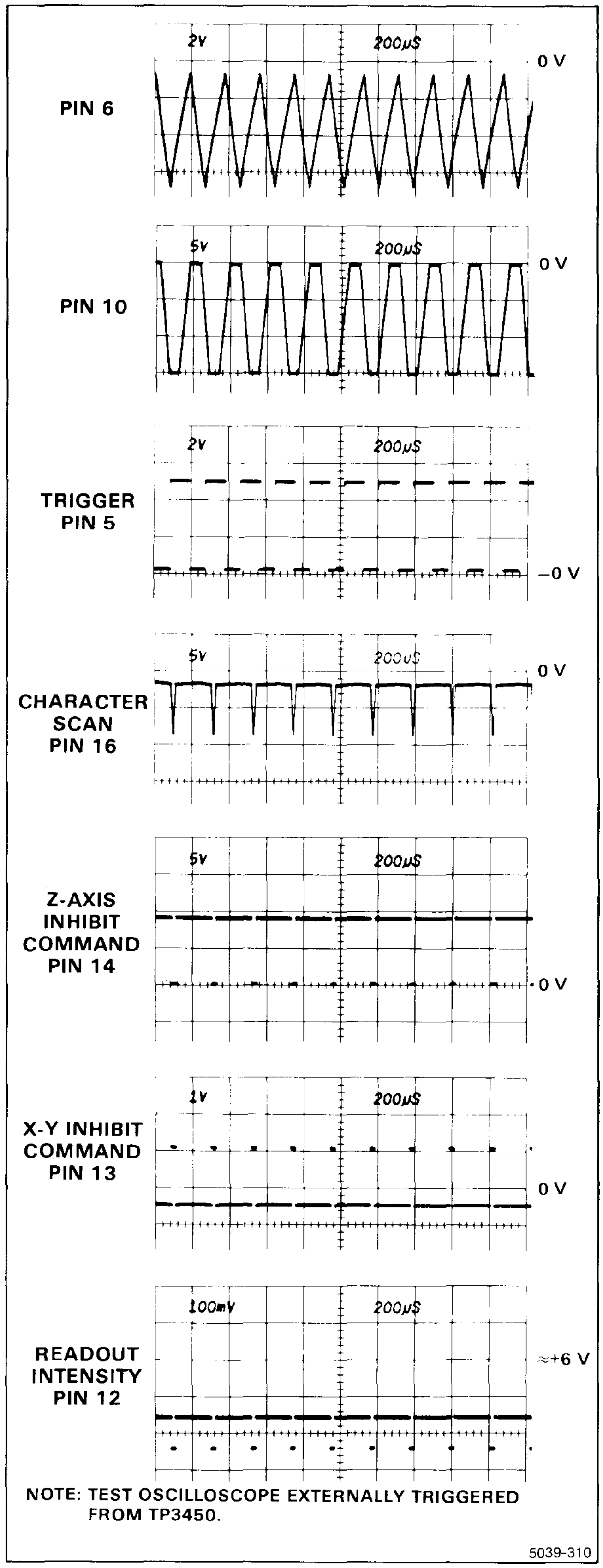


Figure 3-15. Output waveforms of the Timer stage.

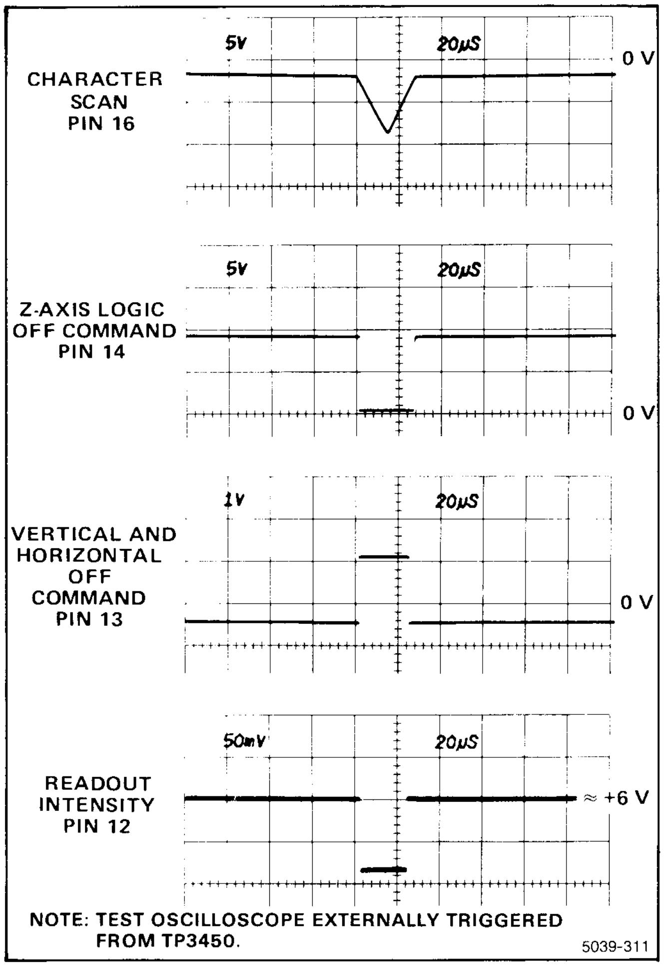


Figure 3-16. Detail of output at pins 12, 13, 14 and 16 of U3433.

waveforms in Fig. 3-16). The Z-Axis Inhibit command at pin 14 is produced first. This negative-going signal provides a blanking pulse to the Z-Axis Logic stage (see Diagram 4) to blank the crt before the display is switched to the Readout System. It also produces the strobe pulse through Q3442 and CR3442 to signal other stages within the Readout System to begin the sequence necessary to produce a character. The collector level of Q3442 is also connected, via CR2443, to the symbol Character Generator U3463. This activates U3463 during the quiescent period of the strobe pulse (collector of Q3442 negative) and diverts the output current of Row Decoder U3429 to row 2. The purpose of this configuration is to prevent the Zeros Logic and Memory stage U3401 from storing incorrect data during the quiescent period of the strobe pulse. When the strobe pulse goes positive, CR3443 is reverse biased to disconnect Q3442 from U3463 and allow the Row Decoder to operate in the normal manner. Figure 3-16 shows greater detail of the outputs of Timer U3433.

The next signal U3433 produces is the X-Y Inhibit command at pin 13. This positive-going signal disconnects the plug-in signals from the vertical and horizontal deflection systems. The Ready signal derived from this output is connected to the Decimal Point Logic and Character Position Counter stage and the Format Generator stage.

The Z Readout output at pin 12 is produced next. This current is connected to the crt circuit to unblank the crt to the intensity level determined by the voltage on the Gate Readout Intensity line. The Character Scan ramp at pin 16 started to go negative as this timing sequence began. However, character generation does not start until the readout intensity level has been established. The triangular Character Scan ramp runs from about -2 volts to about -8.5 volts, then returns back to the original level. This waveform provides the scanning signal for the Character Generator stages. Character Scan adjustment R3437 sets the dc level of the Character Scan ramp for 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 that occurs only when 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 low and the circuit operates as just described. However, when no character is to be displayed, a high level is applied to pin 4 of U3433 through CR3432 from the Display-Skip Generator stage. This signal causes the Timer to shorten its period of operation to about 210 microseconds. The waveforms in Figure 3-17 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 in this condition. This means that the crt display is not interrupted to display characters. Also notice that the triangle waveform at pin 6 does not go as far negative, and that the negative portion of the trapezoidal waveform at pin 10 is shorter. Complete details on operation of the Display-Skip Generator are given later.

The Timer operation is also controlled by the Single-Shot Lockout level at U3433 pin 2. If this level is low, the Timer operates as just described. However, if the Single-Shot Lockout stage sets a high level at this pin, the Timer stage is locked out and cannot produce any output signals (see Single-Shot Lockout description for further information).

A negative voltage on the Readout Intensity line sets the intensity of the readout display independently of the INTENSITY control. The Readout Intensity line also provides a means of turning the Readout System off when a readout display is not desired. When the Readout Intensity line is left open, the current from pin 11 of U3433 is interrupted, and at the same time, a

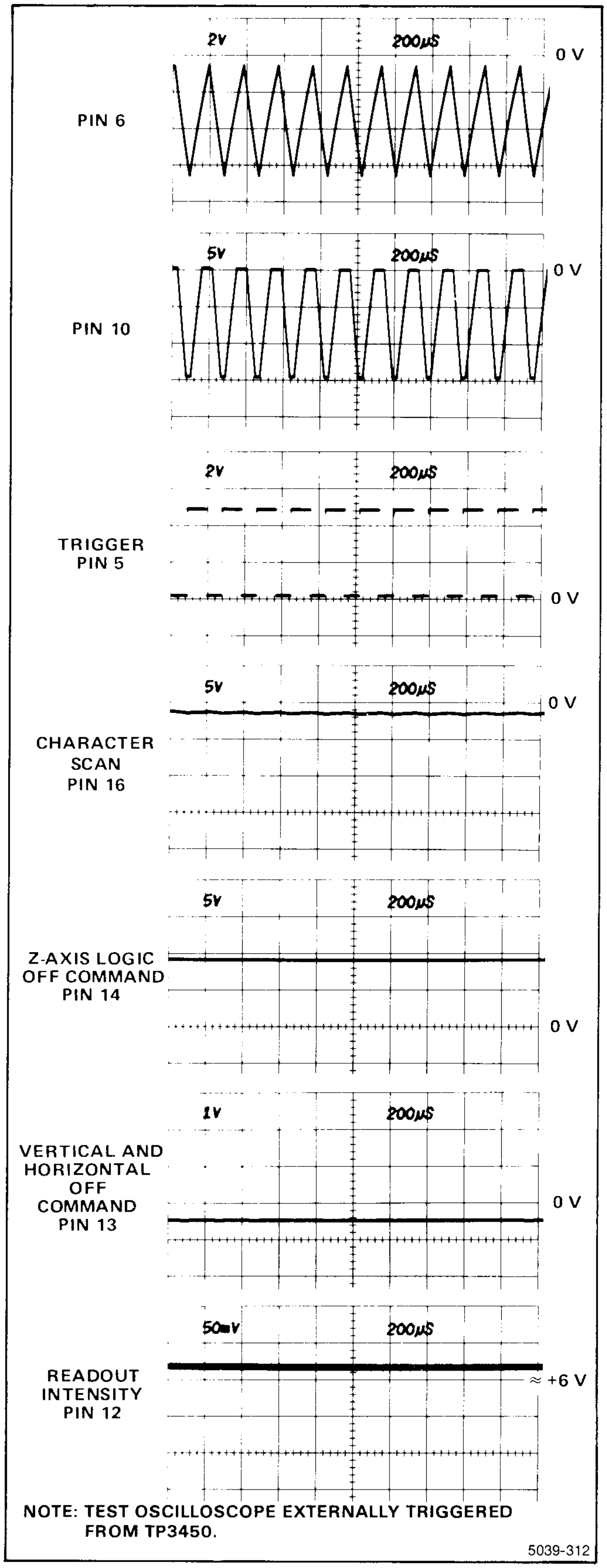


Figure 3-17. Timer stage operation when display-skip condition occurs.

positive voltage is applied to pin 4 through CR3431. The positive voltage switches the stage to the same conditions as were present under the Display-Skip condition. Therefore, the crt display is not interrupted to present characters. However, time-slot pulses continue to be generated.

TIME-SLOT COUNTER

Time-Slot Counter U3445 is a sequential switch which directs the trapezoidal waveform input at pin 8 to one of its 10 output lines. These time-slot pulses are used to interrogate the plug-in units to obtain data for the Readout System. The trigger pulse at pin 15 switches the Time-Slot Counter to the next output line; the output signal is sequenced consecutively from time-slot 1 through time-slot 10. Figure 3-18 shows the time relationship of the time-slot pulses. Notice that only one line carries a time-slot pulse at any given time. When time-slot 10 is completed, a negative-going end-of-word pulse is produced at pin 2. The end-of-word pulse provides a drive pulse for the Word Trigger stage and also provides an enabling level to the Display-Skip Generator during time-slot 1 only.

Pin 16 is a reset input for the Time-Slot Counter. When this pin is held low, the Time-Slot Counter resets to time-slot 1. The Time-Slot Counter can be reset in this manner only when a Jump-Command is received by U3447B and A (see following discussion).

WORD TRIGGER

The Word Trigger stage consists of U3447C and D. Quiescently, pin 8 of U3447C is low as established by the operating conditions of U3447B and A. Therefore, the low end-of-word pulse produced by the Time-Slot Counter results in a high level at pin 10 of U3447C. U3447D inverts this level to provide a negative-going Word Trigger pulse to the Channel Counter.

Aso, U3447D produces a Word Trigger pulse when U3447B pin 6 receives a Jump Command. This condition can occur during any time-slot (see Row Decoder for further information on origin of the Jump Command). Integrated circuit U3447B and A are connected as a bistable flip-flop. The positive-going Jump Command at U3447B pin 6 produces a low at U3447B pin 4. Inverter U3447A inverts the low from U3447B to produce a high at pin 1, which via CR3447, allows pin 6 of U3447B to be pulled high. The flip-flop has now been set and remains in this condition until reset, even though the Jump Command at pin 5 returns to its low level. The high output level at pin 1 turns on Q3445 to pull pin 16 of the Time-Slot Counter low. This resets the Time-Slot Counter to time-slot 1 and holds it there until the Word Trigger is reset. At the same time, a high level is applied to pin 4 of the Timer through CR3445 and CR3432. This high level causes the Timer to operate in the Display-Skip mode, so no character is generated.

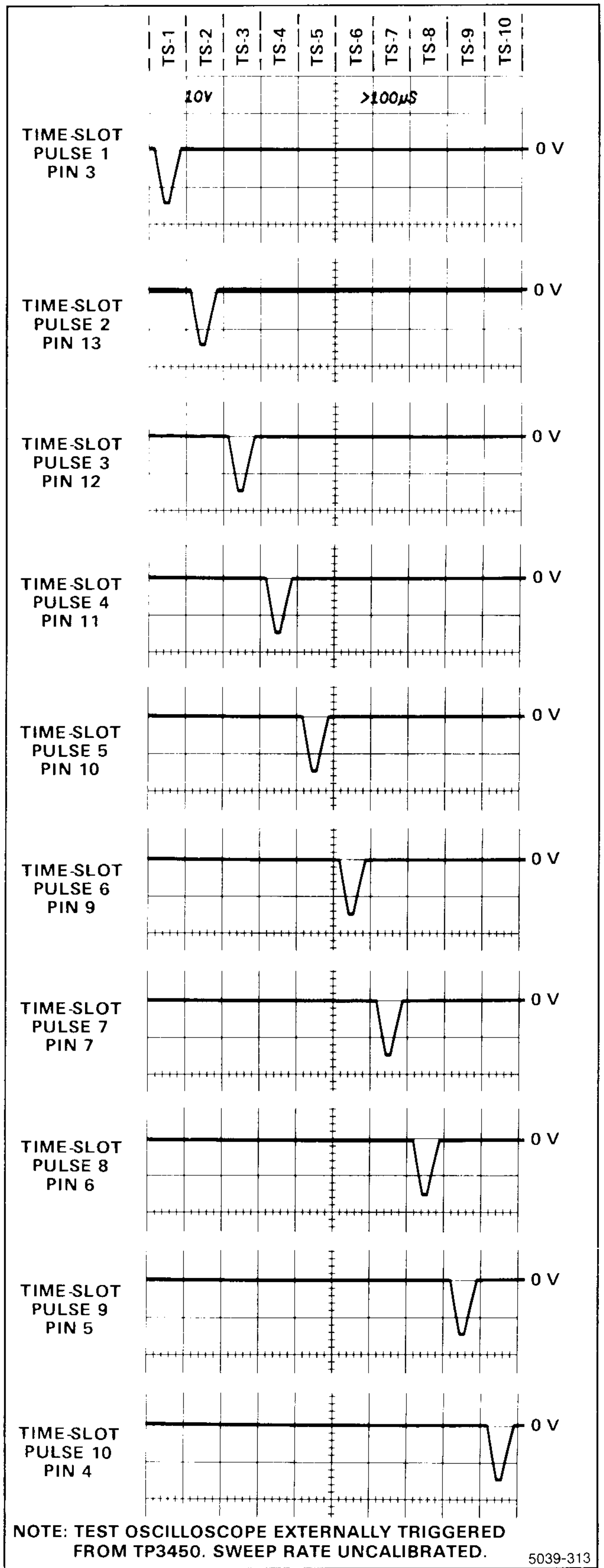


Figure 3-18. Time relationship of the time-slot (TS) pulses produced by Q2159.

Because U3445 is locked in time-slot 1 by U3447, the Time-Slot Counter does not recognize the next Trigger pulse. However, this Trigger pulse resets the Word Trigger stage through C3445. Pin 1 of U3447A goes low to enable the Time-Slot Counter and Timer stages for the next time-slot pulse. Simultaneously, when U3447A switches output states, the resulting negative-going edge is connected to pin 8 of U3447C. This results in a negative-going Word Trigger output at pin 13 of U3447D to advance the Channel Counter to the next word. When the next Trigger pulse is received at pin 15 of U3445, the Time-Slot Counter returns to the normal sequence of operation and produces an output on the time-slot 1 line.

CHANNEL COUNTER

Channel Counter U3450 is a binary counter that produces the Channel Address Code for the Column and Row Decoder stages and the Format Generator stage. This code instructs these stages to sequentially select and display the six channels of data from the plug-in units. Table 3-3 gives the six combinations of the Channel Address Code and the resultant channel selected with each combination.

TABLE 3-3
Channel Address Code

Level on U3450			Channel Displayed
Pin 11	**Pin 8**	**Pin 9**	
High	High	High	Channel 1 Left Vertical
High	High	Low	Channel 2 Left Vertical
High	Low	High	Channel 1 Right Vertical
High	Low	Low	Channel 2 Right Vertical
Low	High	High	Channel 1 Horizontal
Low	High	Low	Chanenl 2 Horizontal

SINGLE-SHOT LOCKOUT

The Single-Shot Lockout stage allows a single readout frame (six 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. Integrated circuit U3449C and U3449D are connected to form a bistable flip-flop. For free-run operation, pin 8 of U3449C is held high. This activates U3449C and results in a low output level at pin 10, enabling the Timer stage to operate in a free-running manner.

The output of the Single-Shot Lockout stage remains low to allow U3433 to operate in the free-running mode until a low is received at pin 8 of U3449C. When this occurs, the output level at pin 10 of U3449C 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 8, the Readout System continues to operate in the normal manner. However, when word 8 is completed, the negative-going end-of-frame pulse is produced at pin 11 of U3450 as the Channel Counter shifts to the code necessary to display word one. The end-of-frame pulse disables U3449B and U3449A. Gate U3449A is disabled for the time needed for the positive output from U3449B to charge C3449 positive enough to activates U3449D, whose low output disables U3449C (its pin 8 input is already low). The output of U3449C goes high to disable the Timer stage, so it operates in the Display-Skip mode. The high at pin 10 of U3449C also holds U3449D enabled, so it maintains control of the flip-flop.

The Single-Shot Lockout stage remains in this condition until a positive-going trigger pulse is applied to pin 8 of U3449C. This trigger pulse produces a low at pin 10 of U3449C to enable U3433 and disable U3449D. Now, the Timer stage 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 lock out the Timer stage.

ENCODING THE DATA

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

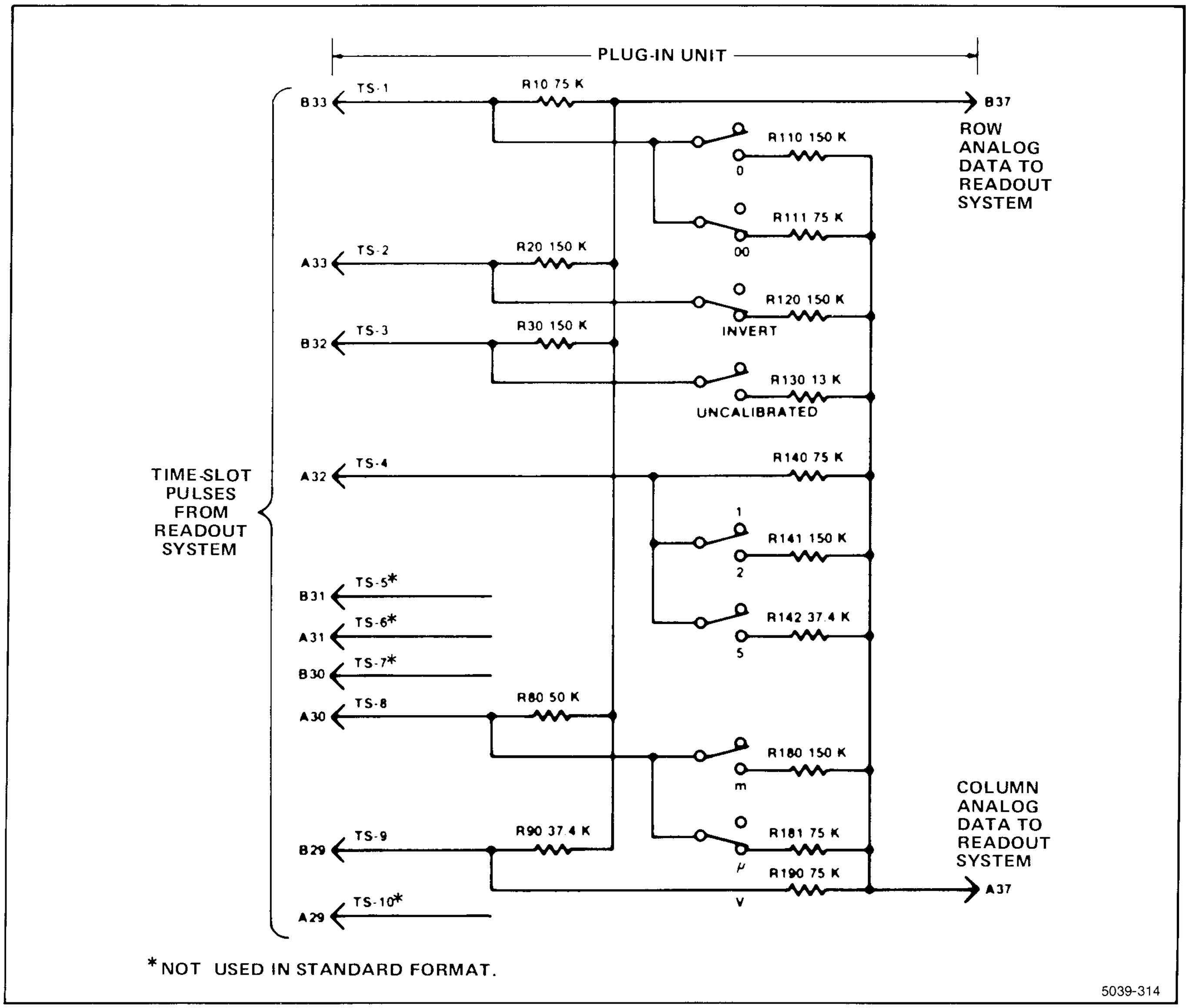


Figure 3-19. Typical encoding scheme for voltage-sensing plug-in unit. Coding shown for deflection factor of 100 microvolts.

14). Each character requires two currents to define it; these currents are identified as the column current and the row current, corresponding to the column and row of the matrix. The column and row data is encoded by the programming the plug-in units. Figure 3-19 shows a typical encoding scheme using resistors for a voltage-sensing amplifier plug-in unit. Notice that the 10 TS (time slot) pulses produced by the Time-Slot Counter stage are connected to the plug-in unit. However, time-slots 5, 6, 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 pulse is exactly −15 volts as determined by the Timer stage. Therefore, the resultant output current from the plug-in units can be accurately controlled by the programming resistors in the plug-in units.

For example, in Figure 3-19 resistors R10 through R90 control the row analog data, which is connected back to the Readout System. Figure 3-20 shows an idealized output current waveform of row analog data, which results from the time-slot pulses. Each of the row levels of current shown in these waveforms correspond to 100 microamperes of current. The row numbers on the left-hand side of the waveform correspond to the rows in the Character Selection Matrix (see Fig. 3-14). The row analog data is connected back to the Readout System via terminal B37 of the plug-in interface.

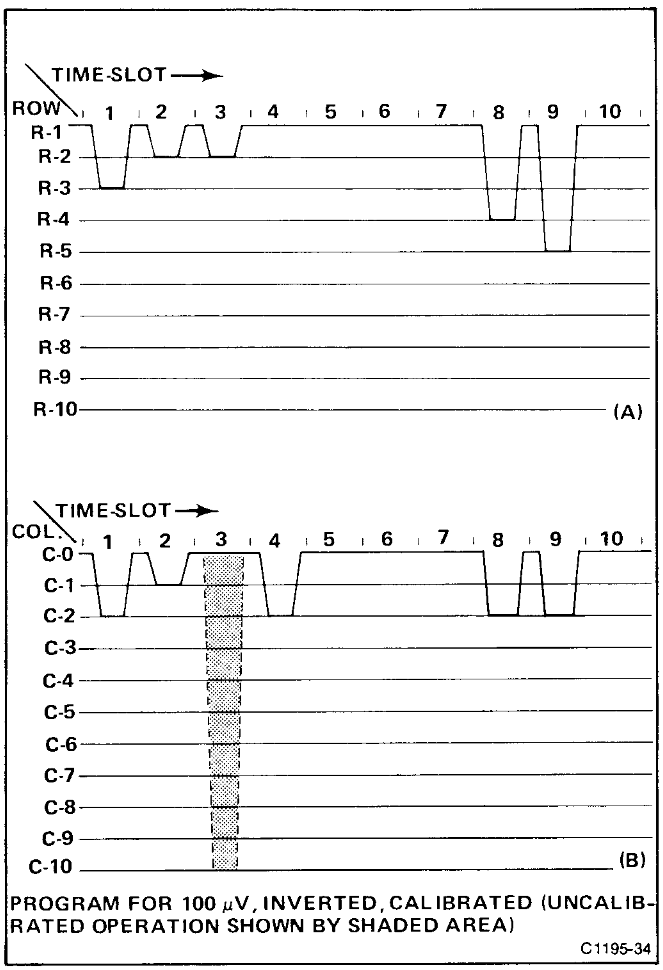


Figure 3-20. Idealized current waveforms of a) Row analog data and b) Column analog data.

Resistors R110 through R190 determine the column analog data. The program resistors are connected to the time-slot lines by switch closures to encode the desired data. The data, as encoded by the circuit shown in Figure 3-19, indicates a 100 microvolt sensitivity with the crt display inverted and calibrated deflection factors. This results in the idealized output current waveforms shown in Figure 3-20 at the column analog data output, terminal A37 of the plug-in interface.

Resistor R111, connected between time-slot 1 and the column analog data output, encodes two units of current during time-slot 1. Referring to the Character Selection Matrix, two units of column current, along with the two units of row current encoded by resistor R10 (row 3), indicates that two zeros should be added to the display. Resistor R120 adds one unit of column current during time-slot 2 and, along with the one unit of current from the row output, the Readout System is instructed to add an invert arrow to the display. Resistor R130 is not connected to the time-slot 3 line, because the deflection factor is calibrated. Therefore, 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; this results in the numeral 1 being displayed on the crt. Neither row nor column analog data is encoded during time-slots 5, 6, and 7 as defined by the Standard Readout Format. During time-slot 8, two units of column current and three units of row current are encoded by resistors R181 and R80, respectively. This addresses the μ prefix in the Character Selection Matrix. The final data output is provided from time-slot 9 by R190 connected to the column output and R90 to the row output. These resistors encode two units of column current and four units of row current to cause a V (volts) symbol to be displayed. Time-slot 10 is not encoded, in accordance with the Standard Readout Format. The resultant crt readout will be ↓ 100 μV.

In the above example, the row analog data was programmed to define which row of the Character Selection Matrix was addressed to obtain information in each time-slot. The column data changes to encode the applicable readout data as the operating conditions change. For example, if the variable control of the plug-in unit was activated, R130 would be connected between time-slot 3 and the column analog data output line. This encodes 10 units of column current (see shaded area in time-slot 3 of the waveform shown in Fig. 3-20). Since one unit of row current is also encoded during this time-slot by R30, a > (greater than) symbol is added to the display. The crt readout will now show > 100 μV. In a similar manner, the other switches can change the encoded data for the column output and thereby change the readout display. See the descriptions which follow for decoding this information.

The column analog data encoded by most plug-in units can be modified by attenuator probes connected to the input connectors of amplifier plug-in units. A special coding ring around the input connector of the plug-in unit senses the attenuation ratio of the probe (with readout-encoded probes only). The probe contains a circuit that provides additional column current. For example, if a 10X attenuator probe is connected to a plug-in unit encoded for 100 microvolts as shown in Figure 3-19, an additional unit of current is added to the column analog data during time-slot 1. Since two units of current were encoded by R111, this additional current results in a total of three units of column analog current during this time-slot. Referring to the Character Selection Matrix, three units of column current, along with the two units of row current encoded by R10, indicates that the prefix should be shifted one column to the left. Since this instruction occurs in the same time-slot that previously indicated that two zeros should be added to the display and only one instruction can be encoded during a time-slot, the zeros do not appear in the display. The crt readout will now be changed to 1 mV (readout program produced by plug-in same as for previous example).

Three other lines of information are connected from the plug-in compartments to the Readout System. The column and row analog data from channel 2 of a dual-channel plug-in are connected to the Readout System through terminals A38 and B38 of the plug-in interface, respectively. Force readout information is encoded on terminal A35; the function of this input is described under Column and Row Data Switches. The preceding information gave a typical example of encoding data from an amplifier plug-in unit. Specific encoding data and circuitry is shown in the individual plug-in unit manuals.

COLUMN AND ROW DATA SWITCHES

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

The Column Data Switch U262 and the Row Data Switch U232 receive the Channel Address Code from the Channel Counter (refer to Diagram 6 at the rear of this manual). This binary code directs the Column Data Switch and the Row Data Switch as to which channel should be the source of the encoding data. Table 3-3 gives the six combinations of the Channel Address Code and the resultant channel selected with each combination. These stages have nine inputs and provide a time-multiplexed output at pin 7, which includes the information from all of the input channels. Eight of the nine inputs to each stage originate in the plug-in units; the ninth input comes from a special data-encoding network composed of resistors R241 through R248 and R251 through R258. (See Zeros Logic and Memory description for further information on ninth channel.)

In addition to the encoding data inputs from the plug-in units, inputs are provided to the Column Data Switch from the VERTICAL MODE switch to inhibit the readout for any plug-in unit(s) not selected for display. When a unit is not selected, the line corresponding to the opposite channel is high to forward-bias the associated diodes: CR212 and CR213, CR214 and CR215. The forward-biased diodes cause the channel switches to bypass the encoded data from the inhibited channel. However, because it may be desirable 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 override the channel inhibit. This is done by applying a low to the associated Force Readout input. The low level diverts the high channel-inhibit current and allows the data from this plug-in unit to reach the Column Data Switch, even though it has not been selected for display by the mode switch.

Row Match adjustment, R3422, sets the gain of the Row Data Switch to match the gain of the Row Decoder for correct output. Column Match adjustment, R3407, performs the same function for the Column Data Switch stage.

DISPLAY-SKIP GENERATOR

The Display-Skip Generator is made up of Q3406, Q3411, Q3414, and Q3416. This stage monitors the time-multiplexed column data at the output of the Column Data Switch during each time-slot to determine if the information is valid data that should result in a crt display. Quiescently, there is about 100 microamperes of current flowing through R3409 from Q3419 and the Zeros Logic and Memory stage. (The purpose of this quiescent current will be discussed in connection with the Zeros Logic and Memory stage.) This current biases Q3406A so that its base is about 0.2 volt more positive than the base of Q3406B in the absence of column data. Therefore, because Q3406A and B are connected as a comparator, Q3406A will remain on unless its base is pulled more negative than the base of Q3406B.

The analog data output from the Column Data Switch produces a 0.5 volt (approximately) change for each unit of column current that has been encoded by the plug-in unit. Whenever any information appears at the output of the Column Data Switch, the base of Q3406A is pulled more negative than the base of Q3406B, resulting in a negative (low) Display-Skip output to the Timer stage through Q3416. Remember that a low was necessary at the skip input of the Timer so it could perform the complete sequence necessary to display a character.

Transistors Q3411 and Q3414 also provide Display-Skip action. The end-of-word level connected to their emitters is low only during time-slot 1. This means they are enabled only during this time-slot. These transistors allow the Zeros Logic and Memory stage to generate a Display-Skip signal during time-slot 1 when information that is not to be displayed on the crt has been stored in memory (further information is given under Zeros Logic and Memory).

COLUMN AND ROW DECODERS

The Column Decoder U3418 and Row Decoder U3429 sense the magnitude of the analog voltages at their inputs (pin 10) and produce a binary output on one of 10 lines corresponding to the column or row data encoded by the plug-in unit. These outputs provide the Column Digital Data and Row Digital Data, which is used by the Character Generator stages to select the desired character for display on the crt. The column and row data is also used throughout the Readout System to perform other functions.

The input current at pin 9 of U3418, the Column Decoder stage, is steered to only one of the ten Column Digital Data outputs. When a Display-Skip signal is present (collector of Q3416 high), pin 9 is pulled high through CR3416. 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 Q3427 and its associated components, is a Row-14 detector that produces the Jump Command. This row current is encoded by special-purpose plug-in units to cause all or part of a word to be jumped. Whenever row 14 (13 units of row current, or 1.3 milliamperes) is encoded, the base of Q2153 is pulled negative enough so that this transistor is reverse-biased to produce a high Jump Command output at its collector. The Jump Command is connected to the Word Trigger stage to advance the Channel Counter to the next word and to reset the Time-Slot Counter to time-slot 1.

ZEROS LOGIC AND MEMORY

The Zeros Logic and Memory stage U3401 stores data encoded by the plug-in units to provide zeros-adding and prefix-shifting logic for the Readout System. The Strobe pulse at pin 15 goes positive when the data has stabilized and can be inspected. This activates the Zeros Logic and Memory stage so that it can store the encoded data.

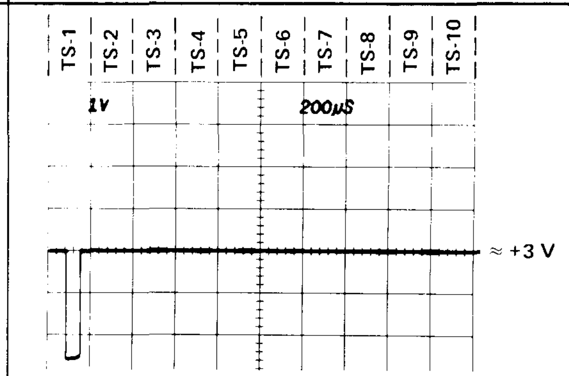
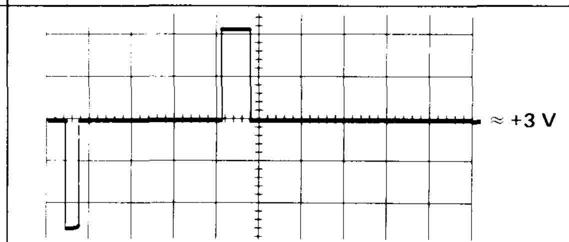
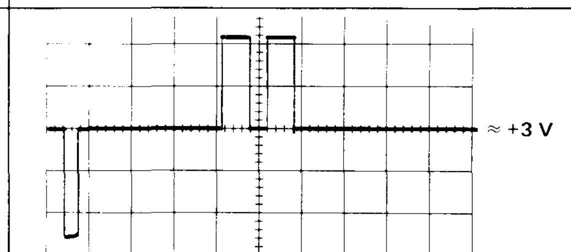
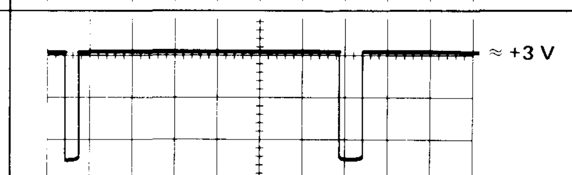
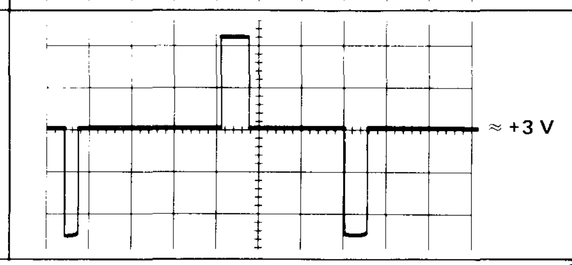
Typical output waveforms of the five possible input conditions that can occur are shown in Figure 3-21. When time-slot 1 occurs, a store command is given to all of the memories. If the plug-in units encoded data for column 1, 2, 3, 4, or 10 during time-slot 1, the appropriate memory (or memories) is set. Notice that row 3 information from the Row Decoder must also be present at pin 16 for data to be stored in the memory of U3401.

If data was encoded during time-slot 1, a negative-going output is produced at pin 7 while the memories are being set. This negative-going pulse is connected to the base of Q3414 in the Display-Skip Generator to produce a Display-Skip output. Since the information encoded during time-slot 1 was only provided to set the memories and not intended to be displayed on the crt at this time, the Display-Skip output prevents a readout display during this time-slot.

During time-slot 5, a memory within U3401 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 Q3419 to add one unit of current at the input of the Column Decoder. This produces a zero after the character displayed during time-slot 4. During time-slot 6, another memory within U3401 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 0 in the crt display.

Finally, another memory within U3401 is interrogated during time-slot 8 to obtain information on whether the prefix should be changed, or left at the value that was encoded. If data has been encoded that calls for a shift in prefix, a negative-going output level is produced at pin 7. This negative level subtracts one unit of column current from the data at the input to the Column Decoder. Notice on the Character Selection Matrix of Figure 3-14 that when row 4 is programmed, a reduction of one column results in a one-column shift of the prefix. For example, with the 100 μV program shown in Figure 3-19, if the data received from the plug-in unit called for a shift in prefix, the crt readout would be changed to 1 mV (zeros deleted by program; see Encoding the Data).

The 100 microamperes of quiescent current through R3409 provided by Q3419 (see Display-Skip Generator) allows the prefix to be shifted from m (100 microamperes of column current, column 1) to no prefix (0 column current, column 0) 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.

INPUT PIN OF U2232 ACTIVATED	COMMAND	TIME-SLOTS
14	IDENTIFY	
12	ADD ONE ZERO	
13	ADD TWO ZEROS	
10	DECREASE PREFIX	
11	DECREASE PREFIX AND ADD ONE ZERO	

C1195-36

Figure 3-21. Typical output waveforms for Zeros Logic and Memory stage operation (at pin 7 of U3401).

Another feature of the Zeros Logic and Memory is the Identify function. If 10 units of column current are encoded by the plug-in unit along with row 3 during time-slot 1, the Zeros Logic and Memory produces a negative-going output pulse at pin 1 to switch the Column Data Switch and Row Data Switch to the ninth channel. Then, time-slot pulses 2 through 8 encode an output current through resistors R241 and R248 for column data and R251 and R258 for row data. This provides the current necessary to display the word IDENTIFY in the word position allotted to the channel that originated the Identify command. After completing this word, the Column Data Switch and Row Data Switch continue with the next word in the sequence.

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

CHARACTER GENERATOR

The Character Generator stage consists of five similar integrated circuits (U3461, U3463, U3465, U3467, U3469), which generate the X (horizonal) and Y (vertical) outputs at pins 16 and 1, respectively, to produce the character display on the crt. Each integrated circuit can produce 10 individual characters; U3461 (designated "Numerals") can produce the numerals 0 through 9 shown in row 1 of the Character Selection Matrix (Fig. 3-14). Integrated circuit U3463 can produce the symbols shown in row 2 of the Character Selection Matrix and U3465 produces the prefixes and some letters, used as prefixes, shown in row 4. Integrated circuits U3467 and U3469 produce the remaining letters shown in rows 5 and 6 of the Character Selection Matrix.

All the Character Generator stages receive the Column Digital Data from the Column Decoder U3418 in parallel. However, only one of the Character Generators receives row data at a particular time and only the stage receiving this row data is activated. For example, if column 2 is encoded, the five character Generators are enabled so that a 1, >, μ, V, or an N can be produced. If row 4 has been encoded at the same time, only the Prefix Character Generator U3465 will produce an output to result in a μ being displayed. The activated Character Generator provides current output for the Format Generator to produce the selected character on the crt. In a similar manner, any of the characters shown in the Character Selection Matrix can be displayed by correct addressing of the row and column.

DECIMAL POINT LOGIC AND CHARACTER POSITION COUNTER

Decimal Point Logic and Character Position Counter U3470 performs two functions. The first function is to add a staircase current to the X (horizontal) signal to space the characters horizontally on the crt. After each character is generated, the negative-going edge of the Ready signal at pin 5 advances the Character Position Counter. This produces a current step output at pin 3 which, when added to the X signal, causes the next character to be displayed one character space to the right. This stage can also be advanced when a Space instruction is encoded so a space is left between the displayed characters on the crt. Row 10 information from the Row Decoder is connected to pin 4 of U3470. 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, because the Character Generators are not activated.

Time-slot pulses 1, 2, and 3 are also connected to pin 4 of U2260 through VR3470, VR3471, and VR3472 respectively, and R3470 and R3473. This configuration adds a space to the displayed word during time-slots 1, 2, and 3 even if information is not encoded for display during these time-slots. With this feature, the information displayed during time-slot 4 (scaling data) always starts in the fourth character position whether data has been displayed in the previous time-slots or not. Therefore, the resultant crt display does not shift position as normal-invert or cal-uncal information is encoded. The Word Trigger pulse connected to pin 8 resets the Character Position Counter to the first character position at the end of each word.

The Decimal Point Logic portion of this stage allows decimal points to be added to the crt display. With the Standard Readout Format, row 7, encoded coincident with columns 3 through 7, addresses a decimal at one of the five locations identified in row 7 of the Character Selection Matrix (Fig. 3-14). This instruction refers to the decimal point location in relation to the total number of characters possible in one word (see Fig. 3-22). For example, column 3 encoded with row 7 during time-slot 1 places a decimal point in location number 3. As shown in Figure 3-22, this displays a decimal point after the third character that can be displayed on the crt. (The first three time-slots produce a space whether data is encoded or not; see previous paragraph.)

When decimal-point data is encoded, the crt is unblanked so a readout display is presented. Because row 7 does not activate any of the five Character Generators, the crt beam is deflected vertically by the application of row-7 data to the Y input of the Format Generator through R3477. This places the decimal point between the characters along the bottom line of the readout word. After the decimal point is produced in the addressed location, the crt beam returns to the location indicated by the Character Position Counter to produce the remainder of the display.

FORMAT GENERATOR

The X- and Y-deflection signals produced by the Character Generator stage are connected to pins 2 and 7, respectively, of the Format Generator. The Channel Address Code from the Channel Counter is also connected to pins 1, 8, and 15 of this stage. The Channel Address Code directs the Format Generator to add current to the X and Y signals to deflect the crt beam to the area of the crt associated with the plug-in channel that originated the information (see Fig. 3-12). The Channel Address Code and the resultant word positions are shown in Table 3-3, in the Channel Counter part of this discussion. The Ready signal at pin 13 (coincident with the X/Y Inhibit Command output) activates this stage when a character is to be displayed on the crt. The ratio of resistor R3468 to R3480 determines the horizontal and vertical size of the displayed characters. The character position current from the Decimal Point Logic and Character Position Counter stage is added to the X (horizontal) input signal to space the characters horizontally on the crt (see previous discussion).

Y-Output

The Y-output signal at pin 6 of Format Generator U3480 is connected to the Y-Output amplifier, Q3486 and Q3493. This stage provides a low-impedance load for the Format Generator while providing isolation between the Readout System and the driven circuits. Vertical Separation adjustment R3491 changes the gain of this stage to control the vertical separation between the readout words displayed at the top and bottom of the graticule area.

X-Output

The X-Output amplifier Q3489 and Q3499 operates like the Y-Output amplifier, to provide the horizontal deflection from the readout signal available at pin 4 of U3480. The gain of this stage is fixed by the values of the resistors in the circuit.

Display Sequence. Figure 3-23 shows a flow chart for the Readout System. This chart illustrates the sequence of events that occurs in the Readout System each time a character is generated and displayed on the crt.

7

SIGNALS OUT

The Signals Out circuit provides the +SAWTOOTH and +GATE signals to the front panel. These output signals are samples of signals from the time base.

Diagram 7, a schematic of the Signals Out circuit, is shown in Section 8 (Diagrams and Circuit Board Illustrations) of this manual. Gray shaded lines divide the circuitry into major stages. Subheadings in the following discussion use the stage names to further identify portions of the circuitry on diagram 7.

+SAWTOOTH AMPLIFIER

The sawtooth signal from the time base is connected to the Sawtooth Amplifier stage through series resistor R91 (see Diagram 3).

Transistors Q1943-Q1942-Q1946 form an inverting feedback amplifier. Gain of the stage is about 2, as determined by the ratio of feedback resistor R1944 to the input resistance (made up of R1940 and R91 on diagram 3.)

+GATE AMPLIFIER

The +GATE signal originates in the time base. Before a gate occurs, Q1934 is biased off and Q1938 is conducting; its collector potential is low enough to turn off Q1928. When a gate signal occurs, it is coupled to the base of Q1934, causing it to conduct and thereby

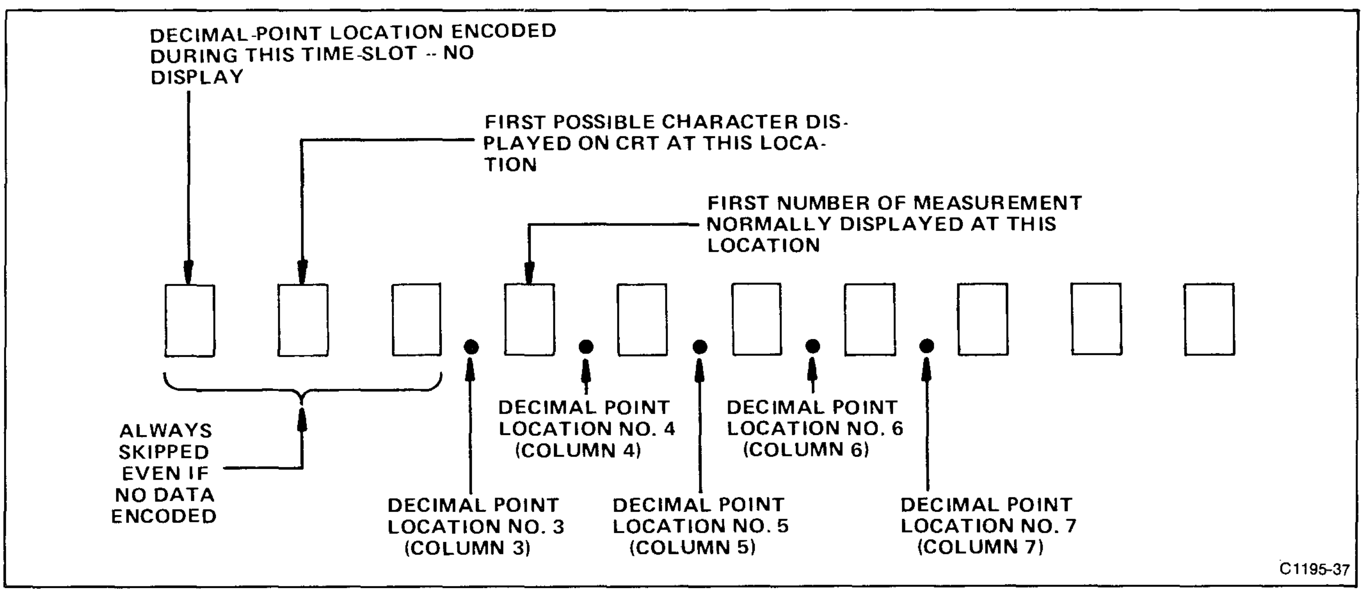


Figure 3-22. Readout word relating 10 possible character locations to the decimal point instructions that can be encoded; and the resultant crt display.

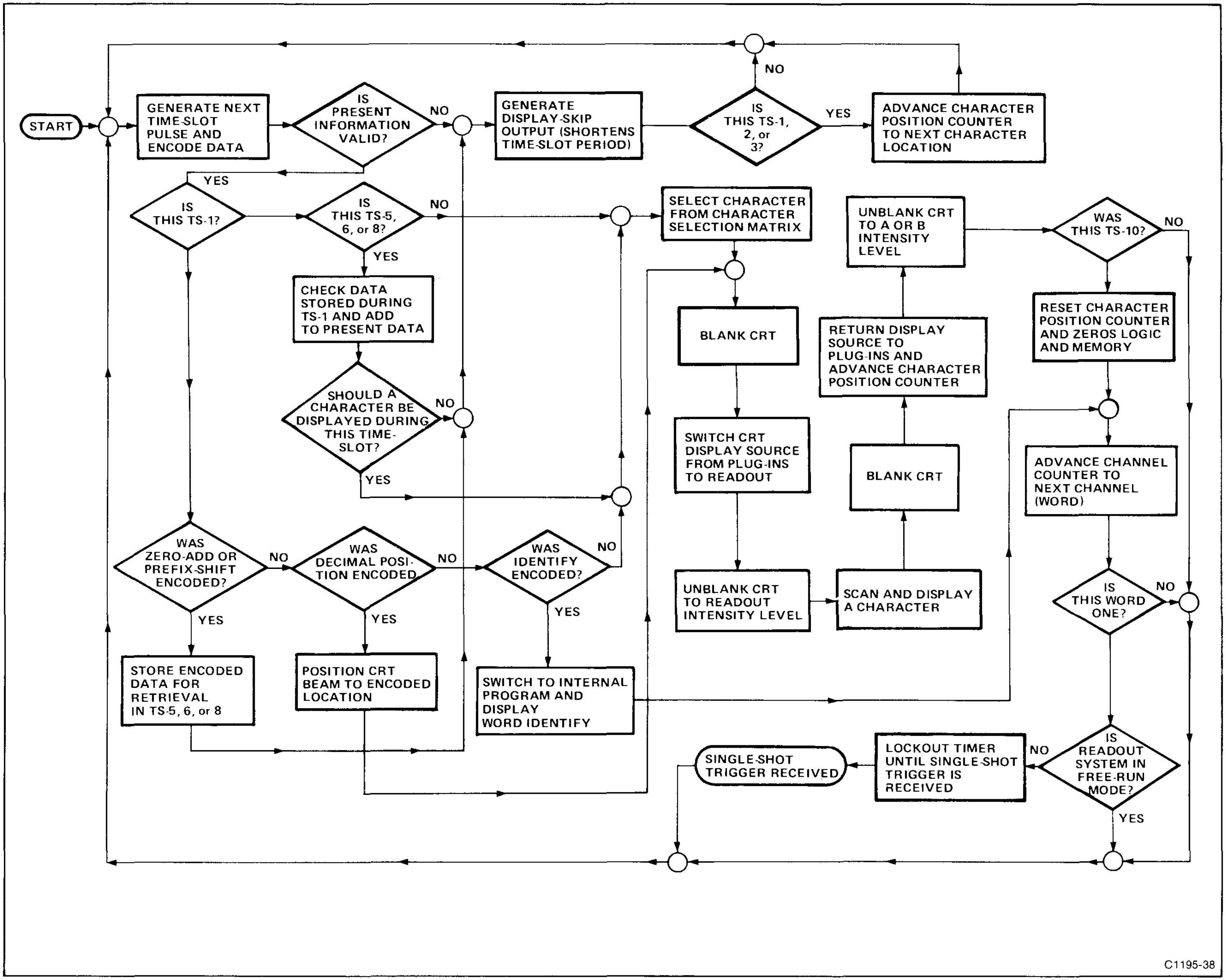


Figure 3-23. Flow chart for character generation by the Readout System.

cutting off Q1938. The current through R1911 now flows through Q1928 to produce the + GATE signal. In pulsed mode, the signal at the the collector of Q1934 drives the Graticule Illumination stage or the readout system.

GRATICULE ILLUMINATION

Variable resistor R1900 (GRAT ILLUM) determines the brightness of the graticule lights (except when in the PULSED position) by controlling the output of the graticule light supply (see Low-Voltage Regulators, diagram 15). Variable resistor R1902 (PRESET) determines the brighness of the graticule lights when the GRAT ILLUM control is set to PULSED. In the PULSED mode, the graticule lights are gated on for approximately 0.5 second. Programmable unijunction transistor Q1908, in conjunction with Q1910, generates the pulse to turn on the graticule lights. A negative signal (from the MAN pushbutton, the +Gate or from an external input) will cause Q1908 to conduct and start discharging C1908. At this time, Q1910 turns off, which allows R1902 to control the output of the graticule light supply. Capacitor C1908 discharges until Q1908 cannot maintain conduction. As Q1908 turns off C1908 begins to charge positive until the zener voltage of VR1910 is reached which turns on Q1910; its collector then goes negative to turn the graticule light supply off.

When in the PULSED mode and operating from the +GATE source, the graticule lights will turn on momentarily at the trailing edge of the +Gate (end of each sweep).

8

VERTICAL CHANNEL SWITCH

The Vertical Channel Switch circuit selects the vertical deflection signal from the output of the LEFT and/or RIGHT Vertical plug-in compartment(s) for display on the crt.

Schematic diagram 8, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, shows the Vertical Channel Switch. Gray shaded lines divide the circuitry into major stages. Sub-headings in the following discussion use the stage names to further identify portions of the circuitry on diagram 8.

CHANNEL SWITCH

The vertical deflection signal from the left and right vertical plug-in units is either terminated within the stage or coupled through the stage as determined by the Vertical Channel Selector stage. The Channel Switch stage is made up primarily of integrated circuit U668. Input pins 7 and 9 provide a differential input for the signal from the right vertical plug-in unit. Input pins 17 and 19 provide a differential input for the signal from the left vertical plug-in unit. The differential output signal at pins 3 and 13 is connected to J694 and J592, respectively.

Components U682, Q682, Q676, and Q672 supply standing current to U668 and maintain the output common-mode dc level at +8.5 volts for all Channel Switch modes. The common-mode level at pins 3 and 13 of U668 is sensed by R559-R659 and compared with a reference level set by divider R680-R681. Assume, for example that pin 2 of U682 is lower than pin 3, indicating an output level below 8.5 volts. The pin 6 output of U682 will be driven positive and current will flow in R683. This current must be supplied from the +15 V supply via R682, thereby lowering Q682's base voltage and increasing its the collector current. Transistor Q676 operates as a common-base amplifier and passes along the increased collector current to pin 3a of U668. This increases the output common-mode level and brings U682 into balance. The voltage at pin 3a of U668 depends on the Channel Switch mode: in Left, Right, Alt, or Chop modes, pin 3a is at +10.5V; in Add mode it is +12.5 V; when X-Y Inhibit is high, pin 3a is +8.5 volts. In all modes the current supplied by Q676 is 160 milliamperes plus or minus small variations required to keep the output level at +8.5 volts.

VERTICAL CHANNEL SELECTOR

The Vertical Channel Selector interfaces the Channel Switch, U668, to the logic signals arriving from the Main Interface. The Channel Switch stage requires two pairs of complementing control voltages; one pair for each channel. The high control voltage is +4.0 V, the complementing low voltage is +3.5 V. To select a channel, the high level must be applied to the On input of U668 (pin 2 for Left, and pin 12 for RIGHT VERTICAL MODE selector positions) and the low level must appear at the Off input (pin 1 for Left, and pin 11 for Right VERTICAL MODE selector positions). To inhibit a channel the control voltages are reversed.

When the VERTICAL MODE selector is set to LEFT the Display Right Command line, entering on P680 pin 6, is set low (-0.6 V), the Add line (P680 pin 5) is low (0 V) and, normally, X-Y Inhibit is low (-0.6 V). Transistors Q652, Q658 and Q558 are turned on; Q656 and Q556 are off. The result is that pins 1 and 12 of U668 are pulled down to +3.5 V but pins 2 and 11 are pulled down only to +4.0 V. Consequently, the Left Vert channel is turned on while the Right Vert channel is turned off. Signals appearing at J602 and J603 are amplified and fed to the outputs at J592 and J694. Similarly, if Display Right is high (+1 V), the Right Vert channel is turned on and the Left Vert channel is turned off. Signals from the Right Vert channel are amplified and fed to the outputs. Left Vert channel signals are terminated in U668.

When the VERTICAL MODE selector is set to either ALT or CHOP, the Display Right Command signal line switches between the low and high levels at a rate determined by either the Chop Counter or Vertical Binary stages (see Logic description diagram 4). This action displays the signal from the left vertical unit when the Display Right signal line is low and displays the signal from the right vertical unit when the signal line is high.

When Add vertical mode operation is selected, the Add signal line is high, and the Display Right Signal is low. This allows both the right and left vertical signals to pass to the output of U668. The signals from both vertical units are algebraically added and the resultant signal determines the vertical deflection. The X-Y Inhibit command has absolute control over the output of the Channel Switch stage. Quiescently, this signal is low; however when the Readout System is ready to display information on the crt, this level goes high, to block the signals from both vertical units.

When the X-Y Inhibit line is high (+1 V) Q652 is turned off. Current in R653 now flows via CR552 and CR654, lowering the base voltage of Q556 by one diode drop, and that of Q658 by two diode drops. This ensures that Q558 and Q656 are turned on regardless of the state of the Display Right Command or Add lines.

RIGHT AND LEFT CHANNEL FEEDBESIDE

The operation of the Left and Right Channel Feedbeside stages is identical. Only the Right Channel Feedbeside is described here.

The Feedbeside stage compensates for low-frequency imperfections in the frequency response of the Channel Switch stage, U668. Self-heating of the transistor base-emitter junctions of some transistors within U668 causes the low-frequency gain to exceed the midband gain. To correct this, a portion of the input signal is picked off through R502 and R504 and applied to U508. This differential signal is converted to a single-ended signal and distributed into four RC networks with different time constants. Variable components R512, R515, R520, R525, R530, and C538 are adjusted to provide an accumulated waveform. This waveform is converted to a paraphase signal by U538, Q542 and Q548, and injected into U668 via pins 6 and 4, where it is subtracted from the signal entering U668 at pins 7 and 9. Proper adjustment results in flat-frequency response and optimum transient response at the output.

9

VERTICAL AMPLIFIER

The Vertical Amplifier circuit provides final amplification for the vertical signal received from delay-line DL592 (shown on diagram 8) before it is applied to the crt vertical deflector. In addition, a low-frequency signal to provide the crt scale factor readout is accepted at the Y Readout input. The vertical portion of the Beamfinder function is also handled in the Vertical Amplifier.

Diagram 9, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, is a schematic diagram of the Vertical Amplifier. Gray shaded lines divide the schematic into major stages. Subheadings in the following discussion use the stage names to further identify portions of the circuitry on diagram 9.

DELAY-LINE COMPENSATION

Delay-line DL592 (diagram 8) delays the vertical signal approximately 51 nanoseconds to allow the horizontal circuits time to initiate a sweep before the vertical signal reaches the crt vertical deflector. This allows the instrument to display the triggering event when using internal triggering. The delay line is composed of a matched pair of 50 ohm coaxial cables. The signal from the delay lines is coupled on to the 50 Ω microstrip via J702 and J704. Transient response front-corner adjustment is provided by RLC network R705, C705 and parasitic inductance of C704.

Hybrid circuit U762 and its associated circuitry provides frequency compensation to offset delay line losses due to "skin-effect" in the cable. This compensation is achieved by attenuating the signal at low-frequencies approximately 4.8 dB. At high frequencies (above 1.5 gigahertz) the signal passes with little attenuation. Hybrid circuit U762 also terminates the delay line in its characteristic impedance (50 ohms) at frequencies greater than about 50 MHz. At dc U762 presents an impedance of 41 Ω to each cable; reverse termination of U668, Vertical Channel Switch, prevents standing waves below 50 MHz.

OUTPUT AMPLIFIER

The output amplifier consists of two thin-film, hybrid, wideband amplifiers, U842 and U862, and their associated bias circuitry. These amplifiers provide a voltage gain of approximately 4.5 each, resulting in an overall voltage gain of about 11 from J702 and J704 to the crt. All signal path interconnections between and within hybrids are made with 50-ohm strip transmission lines via the HYPCON system.

Integrated circuit U842 receives the delayed and compensated signal from U762 at pins 7 and 9. Variable resistor R830 provides vertical amplifier gain adjust by shunting the differential signal. Trimmer R836 is a transient response adjustment effective in the first 10 nanoseconds of the step response. The output of U842 is fed through level shifters VR852 and VR862 to U862. Bias current for U842 is supplied by Q892 and R893 through U862. Active devices Q892, U876B and associated circuitry operate as a power supply with (negative) output impedance of −25 ohms. This supply acts to maintain constant common-mode dc level at the input to U862 regardless of current demand from U842.

When pressed, the BEAMFINDER button changes the current source for U862 to provide the Beamfinder function. Normally, the current source for U862 comes from the +15 V supply through Q862 and R862. However, when the BEAMFINDER is pressed in it turns off Q862, leaving R862 as the only current source for U862. This limits the dynamic range of the stage by limiting its available current, so the display is compressed vertically within the crt graticule area.

Components Q878, VR878, and R878 clamp the output dc common-mode level to less than 44 V when the BEAMFINDER button is pressed.

The signal at the output of U862 (pins 17 and 19) is connected via a flexible coplanar transmission line to the crt vertical deflector neck pins. A distributed deflector is used in the crt for maximum bandwidth. The signal travels along the deflector at a velocity essentially the same as the velocity of the electron beam passing through the vertical deflector. This synchronism of the deflection signal and the electron beam reduces the loss in high-frequency sensitivity due to electron transit time through the deflector. After propagating along the deflector the signal exits the crt via a second flexible coplanar transmission line and terminates in U883. A double-terminated transmission-line system with a characteristic impedance of 200 ohms side-to-side is formed by the output of U862, the two flexible lines, the crt Vertical deflector, U883, and the crt vertical termination. Standing current for U862 is supplied from +50 V supply via U883 and the crt deflector transmission line system.

Bias levels for U862 are provided by U876A. Diode CR875 temperature-compensates the +23.9 V supply to maintain constant standing current in U862.

FEEDBESIDE

The Feedbeside stage compensates for low-frequency imperfections in the frequency response of the Output Amplifier stage, U842 and U862. Self-heating of the transistor base-emitter junction of some transistors in U842 and U862 cause the low-frequency gain to exceed the midband gain. To correct this, a portion of the input signal is picked off via the Delay Line Compensation stage and applied to U782. The paraphase signal is converted to a single-ended signal by U782 and distributed into six RC networks with different time constants. Resistors R785, R787, R791, R795, R801, R806, and C808 are adjusted to provide an accumulated waveform. This waveform is converted to a paraphase signal by U808, Q824, and Q814, and injected into U842 through pins 1 and 5, where it is subtracted from the signal entering U842 at pins 7 and 9. Proper adjustment of the seven RC components results in a flat frequency response and optimum transient response at the output of U862 (pins 17 and 19).

Diodes CR767 and CR777 improve the vertical amplifier overdrive recovery by limiting the amplitude of the feedbeside correction signals that exceed the dynamic range of the Output Amplifier. Thermistor RT813 adjusts the gain of the feedbeside amplifier to provide increased correction at high ambient temperature where transistor self-heating is aggravated.

AUXILIARY AMPLIFIER

The Auxiliary Amplifier is used to inject low-frequency (≤ 2 MHz) signals associated with crt scale-factor readout and alternate sweep switching into the vertical deflection system. Normally, the X-Y Inhibit signal entering on pin 8 of P789 is LO (−0.6 V), Q722 and Q712 are off, and Q732 is on. The Aux Y-Axis signal on pin 2 of of P790 is coupled through Q732 to the input of paraphase amplifier Q742 and Q752. Transistors Q748 and Q758 form a shunt-feedback amplifier with sufficient gain to drive the inputs of U762 (pins 5 and 11).

When the Readout system initiates a character display it sets the X-Y Inhibit logic level high (+1 V). Emitter follower Q718 turns Q722 on. The voltage on the collector of Q722 drops to zero, which turns Q732 off and turns Q712 on. The Aux Y-Axis signal is then blocked by Q732. Y Readout signals are inverted by U705. Readout centering is added to the composite readout signal and applied to the input of the paraphase amplifier via Q712. At the end of the character display period X-Y Inhibit returns to -0.6 V.

POWER SUPPLY SHUTDOWN

The Power Supply Shutdown stage monitors the 23.9 V supply. If this voltage drops significantly, indicating an overload condition, Q864 will turn on pulling the gate of Q873 positive to cause Q873 to turn on. This action overloads the +50 V power supply which in turn causes the high-efficiency power supply to shut down.

A drop in the +23.9 V supply may indicate an open connection or a short to ground in the crt deflector transmission line system (or supply). The latter case is particularly serious and may damage U862 even with the Power Supply Shutdown stage operating. For this reason care should be taken not to short or open the crt deflector connections when the power is on.

The Power Supply Shutdown circuit also accepts an input from the Horizontal Amplifier circuit (diagram 11) via a thermal cutout, from pin 10 of P782. This input is normally about +14.8 V but will decrease if a fault occurs in the Horizontal Amplifier or if the thermal cutout opens. The latter case indicates excessive temperature in the Horizontal and Vertical Amplifier circuits which will significantly reduce amplifier operating life. The thermal cutout will open at about +55° C ambient if the fan is operating properly or at +35° C ambient if the fan is disabled or totally blocked.

10

HORIZONTAL CHANNEL SWITCH

The Horizontal Channel Switch receives the output of the HORIZ plug-in unit and an X-Y Inhibit signal from the Readout System.

The Horizontal Channel Switch has switching capability that the R7103 does not need because it has only one horizontal channel.

Diagram 10, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual shows the Horizontal Channel Switch. Gray shaded lines divide the schematic into major stages. Subheadings in the following discussion use the stage names to further identify parts of the circuitry on diagram 10.

CHANNEL SWITCH

The Channel Switch consists mainly of U962. The differential horizontal signal from the HORIZ plug-in compartment is applied to pins 7 and 9. The Display B line is set permanently to -0.6 V, which turns Q924D on and turns Q924C off. The output of Q924D and C turn on the A channel of U962, and turn on Q924E. When turned on, Q924E inhibits the B channel of U962.

Integrated circuit U962 has a standing current of about 37 mA per channel. The standing current in channel A is the quiescent current drawn by current sinks Q992 and Q994, and by R998 and R999. This standing current flows out of pins 3 and 13, and becomes the standing current in U1018 (diagram 11), the Input Clamp. It is important that the current sink described above controls the standing current in the Channel Switch and the Input Clamp. The current comes from the +15 V supply (diagram 11) mainly via R1047, R1043, R1067, and R1063 at the stage output. Thus the current sink described above affects dc levels from the Channel Switch to the input of U1082.

A CHANNEL FEEDBESIDE

The A Channel Feedbeside circuit compensates for low-frequency imperfections in the frequency response of Channel Switch U962. Self-heating of the emitter-base junctions, of some transistors in U962, causes the low-frequency gain to appear greater than the midfrequency gain. To correct this, a portion of the input signal is picked off via R972 and R971 and applied to U974. The differential signal is converted to a single-ended signal and distributed to four resistor-capacitor (RC) networks of various time constants. Resistors R975, R980, R982, R985, and R988 are adjusted to provide an accumulated waveform. The accumulated waveform is converted to a paraphase signal by Q992 and Q994, then injected into U962 via pins 16 and 14, where it is subtracted from the signal entering U962 at pins 7 and 9. Proper adjustment results in a flat frequency-response and optimum transient-response at the output.

11

HORIZONTAL AMPLIFIER

The Horizontal Amplifier circuit amplifies the push-pull horizontal deflection signal from the plug-in unit installed in the horizontal compartment, and connects it to the horizontal deflection plates of the crt.

Diagram 11, in section 8 (Diagrams and Circuit Board Illustrations) of this manual, is a schematic diagram of the Horizontal Amplifer. Gray shaded lines divide the schematic into major stages. Subheadings in the following discussion use these stage names to identify parts of the circuitry on diagram 11.

READOUT POSITIONING

When readout is displayed, the X Readout signal is applied to the Horizontal Amplifier through P882. At the same time, a high on the X-Y Inhibit line causes Q1022 to conduct, turning Q1024 off. This action enables the horizontal readout center (R.O. CTR) adjustment R1025 to horizontally position the readout display on the crt.

OUTPUT AMPLIFIER

The Output Amplifier stage is a parallel path amplifier, having a fast path and a slow path. The fast path is a non-feedback amplifier, with 50 Ω impedance throughout, except at the output. The slow path is a feedback amplifier, used to correct thermal gain errors in the fast path, and to inject the readout signal.

Fast Path

The fast path consists primarily of U1082 (the driver) and U1094 (the output amplifier).

The differential signal is applied to pins 7 and 9 of U1082. The input is 50 Ω push-pull (100 Ω differential). The gain of U1082 is set by the HF Gain adjustment R1082 to provide a nominal current gain of about 3. The output of U1082 is applied to the input of U1094, the output stage. This stage has a 50 Ω push-pull input. Accordingly, the voltage gain through the driver will be about 3, because it has equal input and output resistances.

The output stage, U1094, has a current gain of about 3.3, and has a differential load impedance of 365 Ω. The voltage gain of the stage is then about 12 (the current gain times the resistance gain).

The crt has a distributed horizontal deflection structure with a differential impedance of about 365 Ω. The crt horizontal deflection structure is connected to the amplifier output and to the horizontal terminator resistor via the 365 Ω flexible transmission lines. The termination board (A2O) is adjustable to match the crt impedance.

Slow Path

The slow path is a feedback amplifier which is used to correct for thermal errors inherent in the fast path. The slow path can be considered to be an operational amplifier.

The slow path receives its input via R1043 and R1063, which pick off a fraction of the output signal from the Input Clamp stage. The input signal is amplified by Q1046 and Q1066 and injected into the operational amplifier summing nodes (base of Q1052 and Q1072). The output signal at the crt is picked off by a pair of 20 kilohm resistors within U1094. This signal is applied through R1034 and R1037 to the summing nodes. Any error signal at the summing nodes is amplified by the differential pair Q1052 and Q1072 and by the differential pair Q1058 and Q1078. The amplified signal is then injected into the fast path via pins 1 and 5 of U1082, to correct the signal applied to the crt.

The gain of the slow path is set with the LF Gain adjustment, R1062, independent of the fast path gain. The step response of the slow path is adjusted using the Delay adjustment C1036 and S.P. Damp R1073, the slow path damping adjustment.

Because the slow path is a feedback circuit, it can cause difficulties in locating problems in the output amplifier circuit. The feedback path can be disabled by removing Q1052 and Q1072, and shorting the emitter run to the collector run for each transistor on the circuit board. This can be done by inserting a U-shaped wire, the same diameter as the transistor leads, in the emitter and collector sockets. With the feedback path open, the amplifier will operate as before, with two exceptions. First, thermal errors will not be corrected; and second, readout is disabled since it is injected into the slow path. All dc voltages will remain essentially unchanged. This will simplify troubleshooting the Horizontal Amplifier.

INPUT CLAMP

The Input Clamp prevents the Output Amplifier stage from being overdriven. Signal limiting occurs in the Input Clamp stage when the + and − horizontal signal, applied to pins 5 and 8 of U1018, approaches a level which will overdrive U1094's input transistors. The Input Clamp requires about 75 milliamperes from pin 16 to pin 5 and from pin 13 to pin 8 for proper operation. This current is supplied by the Channel Switch stage on diagram 10. Pins 13 and 16 are normally about 7.0 volts, and pins 5 and 8 about +6.2 V.

The Clamp Adj, R1005, sets the voltage at pin 6 of U1018 about 0.3 volts more positive than pins 5 and 8. If a differential signal is applied to pins 5 and 8 of the Input Clamp stage, with pin 5 going negative and pin 8 going positive; clamping will occur when pin 5 goes negative enough to turn on the transistor inside U1018 whose emitter is tied to pin 5. The signal from pin 5 flows through the transistor to pin 13, effectively shunting the excess signal to the other side of the differential line. In a like manner, the other transistor causes clamping when pin 5 is positive going and pin 8 is negative going. Note that both transistors are never on at the same time.

The Input Clamp stage output common-mode voltage is sensed at pin 15 of U1018 and applied to U1006. This causes the voltage at pin 6 to track the common-mode voltage in the Input Clamp stage, so that the clamping point does not change as the common-mode voltage changes.

The Beamfinder input goes from 15 volts to ground when the BEAMFINDER button is pressed. This raises the voltage at pin 6 of U1018, which confines the horizontal signal to the crt screen.

12

INTENSITY LIMITER AND Z AXIS AMPLIFIER

Diagram 12, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, shows a schematic of the Intensity Limiter and Z-Axis Amplifier. Gray shaded lines divide the circuitry into major stages. Sub-headings in the following discussion use the stage names to further identify portions of the circuitry in diagram 12.

INTENSITY LIMITER

The gain of the microchannel plate is reduced in proportion to the logarithm of the charge output. In the area of sustained trace operation this gain reduction manifests itself as reduced writing speed. The Intensity Limiter stage limits the crt screen current and prevents long-term, on-screen trace operation. Even with the Intensity Limiter stage it is possible to incur distinguishable display gain loss, depending on the use of the instrument. For more information on proper usage see Reduction of Display Gain with Display Output Charge, in the Operating Instructions part of this manual.

The Screen I Sense output of the Anode Voltage Multiplier, U1700 (diagram 13) carries a current equal to the average screen current. Operational amplifier U1952, with feedback resistor R1951, converts this current to a voltage at the rate of 1 volt per microampere of average screen current. A divider string formed by R1952, R1959 and R1960 biases the inverting input of operational amplifier U1958B at 0.2 volt. When the average screen current is greater than 0.2 microampere the noninverting input of operational amplifier U1958B is more positive than +0.2 volt and its output, TP1962, goes positive. Via R1975, this turns on the LIMITED VIEWING TIME indicator, DS1970., Also, Q1974 is turned off, allowing C1971 to charge. In addition to this, the 3 hertz oscillator is started (timer U1968 oscillates at a frequency 3 hertz). When the output of operational amplifier U1958B goes positive, pin 4 of U1968 will go positive and start the oscillator.

Operational amplifier U1970 and C1971 form an integrator, integrating the current through R1958. This resistor is connected to the output of operational amplifier U1952 so that the current through R1958 is proportional to the screen current. The output of U1970 goes negative from ground. When the voltage reaches −10 volts timer U1986 starts. How fast the output reaches −10 volts depends on the average screen current. As will be seen later the average screen current cannot exceed 2 microamperes. At 2 μA of screen current, the output of the integrator will reach the −10 volt output level in about one minute. For below-average screen currents, Q1974 will be turned on to prevent the integrator from operating. At an average screen current of 25 nanoamperes the integrator reaches the −10 volt level in about 1 hour. If the output of the integrator has not reached the −10 volt level and the average screen current drops below 25 nanoamperes, Q1974 will turn on through R1974 to discharge C1971. This will give the integrator a fresh start when the screen current again exceeds the 25 nanoampere threshold.

When the output of U1970 reaches −10 V and pin 2 of timer U1986 reaches about +2 volts, the timing starts. The output of U1986, pin 3, goes high but returns low after 10 seconds when the timer has timed out. Capacitor C1985 sets the period of the timer.

Timer U1986 starts the following sequence of events: With pin 3 of U1986 low, diode CR1991 clamps the input of the red LED (DS1944) to ground. When U1986 pin 3 goes high the SHUTDOWN LED receives current from U1986 via R1969 and CR1993. It blinks at a 3 hertz rate to indicate that shutdown will occur in about 10 seconds.

Integrator capacitor C1971 is discharged through divider R1988 and R1989, and the base of Q1980 is held at +2.4 volts. If pin 3 of U1986 is low Q1982 conducts, and the collector voltage of Q1982 turns Q1978 off. When pin 3 of U1986 goes high Q1982 stops conducting and Q1978 turns on to discharge capacitor C1971, which allows the integrator a fresh start. The waveform at pin 3 of U1986 is differentiated by C1993 and inverted by Q1997. Flip-flop U1992 triggers on a positive-going pulse, so at the end of the 10-second timing interval U1992 is triggered and produces a high on the Z-Axis Off line.

This output goes high to cause the following to occur:

1. The Z-Axis Amplifier turns off.

2. The red LED is turned on steadily, to indicate that the Z-Axis Amplifier is shut down. Transistor Q1994 turns off when the Z-Axis Off signal goes high and the SHUTDOWN indicator is turned on from the +15 volt supply through R1994. U1970 applies a high to pin 2 of U1986 to inhibit the 10-second timer.

The Intensity Limiter stage can be reset several ways:

1. By pressing RESET button S1988 before shutdown occurs, or by reducing the display intensity so that the average screen current is less than 25 nanoamperes.

   If the RESET button is pressed before shutdown occurs, it shorts the base of Q1980 to ground, Q1982 turns off, and Q1978 conducts to discharge timing capacitor C1971.

   If the screen current is below 25 nanoamperes, the output of U1958B goes low and Q1974 conducts, discharging timing capacitor C1971 through R1974.

2. By pressing RESET button S1988 during the 10-second delay before shutdown (when the red SHUTDOWN indicator is flashing), or by reducing the intensity so that the average screen current is below 25 nanoampere.

   If the RESET button is pressed during the 10-second delay before shutdown occurs, the base of Q1980 is shorted to ground, Q1982 turns off, and Q1978 conducts to discharge timing capacitor C1971.

If the screen current goes below 25 nanoamperes during the 10-second delay before shutdown occurs, the output of operational amplifier U1958B goes low, the base of Q1998 is pulled low, Q1998 conducts and Q1999 is saturated. The saturation of Q1999 has the same effect as pressing the RESET button.

3. By pressing RESET button S1988 after shutdown occurs. During shutdown, Q1974 and Q1978 conduct, discharging timing capacitor C1971 through R1974, and resetting the 10-second timer.

   Also, flip-flop U1992 is reset and the Z-Axis Off signal goes low and turning the Z-Axis Amplifier back on.

4. By a low-logic level on the SINGLE SWEEP RESET input on the rear panel.

If the average screen current exceeds 2 microamperes the output of operational amplifier U1952 exceeds +2 volts. Because the noninverting input of U1958A is biased at +2 volts, its output will go positive and diode CR1963 will conduct. The current through Q1956 will increase and the voltage of the intensity reference at TP1956 will go positive from −10 volts. The intensity reference is connected to the INTENSITY control network (see Mode Switch and Calibrator, diagram 2). If this reference goes more positive the input drive to the Z-Axis logic is reduced. Therefore, the beam current of the crt is reduced which results in a lower average screen current. When this feedback loop reaches equilibrium, the voltage of the intensity reference is such that the average screen current equals 2 microamperes. Single-shot screen currents are not limited to 2 microamperes because the feedback loop has a long time constant.

When the intensity limiter is limiting the average screen current to 2 microamperes the output of U1958A is high, saturating Q1970. This causes the yellow LED to flash (indicates that the intensity is limited).

Figure 3-24 illustrates two operating conditions of the Intensity Limiter. The maximum viewing time (approximately 20 minutes) is shown in Figure 3-24A; this occurs with the minimum average screen current of 25 nanoamperes. The minimum viewing time (approximately 2 minutes) is shown in Figure 3-24B; this condition occurs when the intensity is limited to an average screen current of 2 microamperes.

Z-AXIS AMPLIFIER

The Z-Axis Amplifier stage controls the crt display intensity by varying the crt grid drive. The Logic circuit and the Readout System provide input signals to the Z-Axis Amplifier at J1606 and J1632 respectively.

The Z-Axis Amplifier consists of three stages; an impedance-matching stage, a preamplifier, and an output driver. The impedance-matching stage consists of Q1618 and Q1608. This stage isolates the Readout and Logic inputs from each other and terminates the input cables. The collector current from this stage is fed to the Auto Focus amplifier through R1606, which develops a voltage to drive the Z-Axis preamplifier. Transistor Q1626 limits the voltage drive to the preamplifier by clamping the output of Q1608 at a level by Clamp Level adjustment R1626.

The Z-Axis preamplifier provides a current drive for the output stage. The preamplifier is a transconductance amplifier which consists of Q1632, Q1648, and Q1652. Z-Axis Gain adjust R1637 sets the gain of this stage and is used to set the gain for the entire Z-Axis system. Adjustments R1635, C1635, and R1651 provide current peaking to the output stage for optimum transient response. The Z-Axis Level adjustment R1645 is used to adjust the Z-Axis baseline to the proper level. A Z-Axis Off signal from the Intensity Limiter disables the preamplifier by saturating Q1644.

The output driver is a shunt feedback stage with gain set by R1660. Q1658, Q1668, Q1666, and Q1676 form a direct coupled amplifier with a high open-loop gain; thus the input at the base of Q1658 is a virtual ground. These transistors can provide high- speed transitions in the negative-going direction only. Fast positive transitions are achieved by peaking the base of Q1676 via Q1664 and T1664. Capacitor C1663 adjusts the drive to Q1676 for optimum response. Transistor Q1672 provides collector voltage for Q1676. VR1671, R1677, CR1675, and CR1678 provide protection from high transient voltages.

AUTO FOCUS

The Auto Focus stage maintains optimum focus of the display over a range of sweep speeds. The crt needs focus correction only at high Z-Axis drive conditions. Consequently, the output of the Auto Focus amplifier is ac coupled to the focus grid. The collector current of Z-Axis impedance matching stage (Q1618 and Q1608), is fed to the input of the Auto focus amplifier, Q1603. The emitter voltage of Q1607 is −8.6 volts. At zero volts drive the collector current of Q1603 is maximum (8 milliamperes) which causes clamping diode CR1609 to conduct. At midrange Z-Axis drive the collector current of Q1603 drops to 6 milliamperes and the voltage at the anode of CR1609 is −8.0 volts which causes the clamping diode CR1609 to barely conduct. A Z-Axis drive greater than midrange will reverse-bias CR1609 and a negative-going signal will appear at the base of Q1617. The amplifier, consisting of Q1617 and Q1620, is noninverting and has a voltage gain of approximately four. The negative going signal at the collector of Q1620 is connected to emitter follower Q1629, then ac coupled through C1628 to the focus grid.

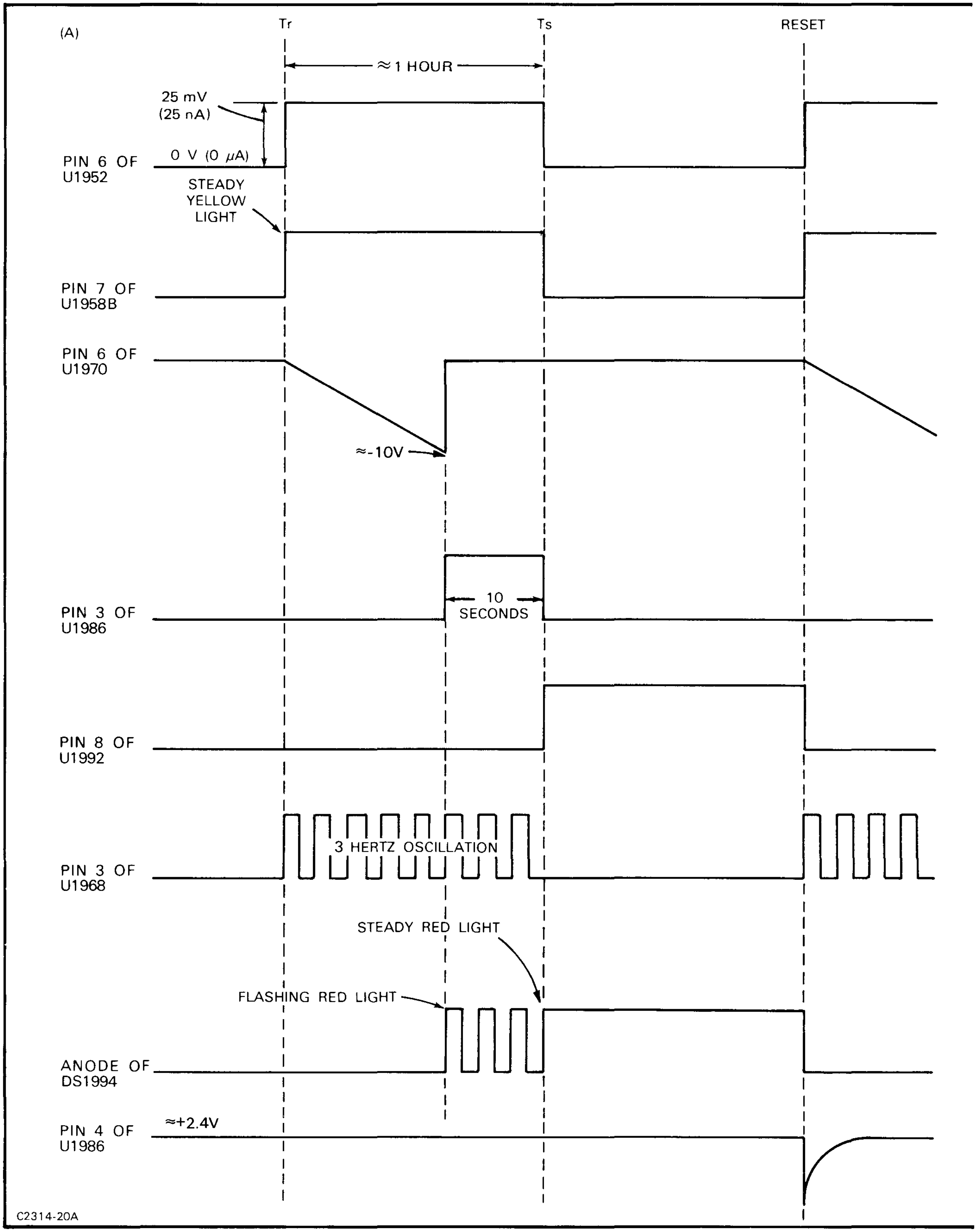


Figure 3-24. Theoretical timing diagrams for the Intensity Limiting stage.

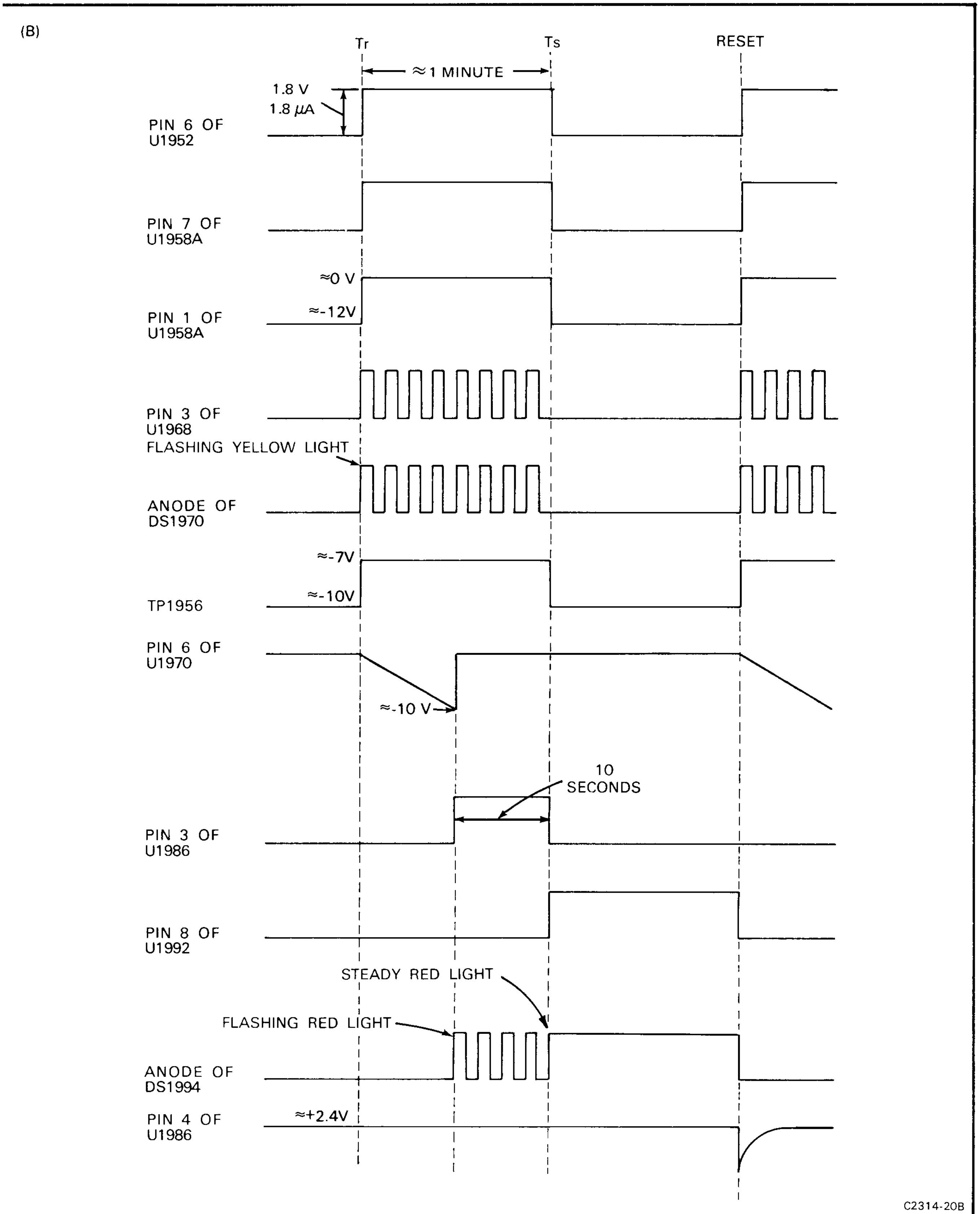


Figure 3-24 (cont). Theoretical timing diagrams for the Intensity Limiting stage.

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CRT CIRCUIT

Diagram 13, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, is a schematic diagram of the CRT Circuit. Gray shaded lines divide the circuitry into major stages. Subheadings in the following discussion use the stage names to further identify portions of the circuitry on diagram 13.

CONTROL GRID DC RESTORER

The Control Grid DC Restorer stage submerges the two low-voltage grid control signals to a large negative potential. These inputs are 1) the output signal from the Z-Axis amplifier, coupled through R1680 to the first input of the Control Grid DC Restorer stage, and 2) the crt grid bias (with its associated crt grid cut off warmup compensation circuit) coupled through R1748 to the second input of the Control Grid DC Restorer stage.

The Control Grid DC Restorer stage is current-driven from the square wave at T1770 pin 9 via R1788, R1789, R1812, and R1811. When the voltage at pin 9 of T1770 goes positive, CR1749 conducts at the voltage determined by the first input, the Z-Axis Amplifier output. This clamping action establishes the positive swing of the dc restorer drive. On the negative swing of T1770 diode CR1747 conducts at the voltage determined by the second input; the crt grid bias voltage. This clamping action establishes the negative swing of the dc restorer drive. The ac swing of the dc restorer is coupled from the low voltage section to the high voltage section by capacitor C1793. On the negative swing of the dc restorer drive, the high voltage end of C1793 is clamped to the -2400 volt supply by CR1794. On the positive swing of the dc restorer drive, CR1792 changes the high voltage end of C1792 to a voltage more positive than the -2400 volt supply by an amount equal to the sum of the absolute value of the voltages of the two inputs; the Z-Axis Amplifier output voltage level and the grid bias voltage level.

The crt cathode voltage is 135 volts more positive than the -2400 volt supply, as determined by the Cathode Supply Regulator stage. Therefore the grid is negative with respect to the cathode by 135 volts minus the sum of the absolute values of the voltages of the Z-Axis amplifier output voltage level and the crt grid bias voltage level. CRT Grid Bias adjustment R1746 is set with the Z-Axis amplifier output at the low level for the proper crt cutoff voltage. The CRT Grid Bias adjustment has a range of about 50 volts.

Cathode Supply Regulator

The Cathode Supply Regulator stage helps to protect the crt during turn-on of the instrument (see circuit description of the Grid Crow Bar circuit) and when a malfunction of the Control Grid DC Restorer stage occurs. In the case of a malfunction, the grid will become more negative than the cathode thereby turning the crt off.

Neon lamps DS1792 and DS1794 and the resistors in series with the diodes provide protection (voltage and current limiting) to the Control Grid DC Restorer stage during turn-on and turn-off, and short-circuit protection. Capacitor C1681 provides fast ac coupling between the Z-Axis Amplifier stage and the crt grid. The slower ac path is by way of R1680 and C1792.

FOCUS GRID DC RESTORER

The Focus Grid DC Restorer stage elevates the low voltage focus control to a high negative potential.

The Focus Grid DC Restorer stage is current-driven by the square wave at T1770 pin 9 via R1788, R1789, R1813 and R1814. When that voltage goes positive, CR1820 conducts at the voltage determined by the setting of FOCUS control R309. This clamping action establishes the positive swing of the Focus Grid DC Restorer drive. On the negative swing of T1770, CR1816 conducts at ground. This clamping action establishes the negative swing of the Focus Grid DC Restorer drive. The ac swing of the Focus Grid DC Restorer is coupled from the low voltage section to the high voltage section by C1819. On the positive swing of the Focus Grid DC Restorer drive signal, the high voltage end of C1819 is clamped to the Focus Preset adjustment voltage by CR1819. During the negative swing of the Focus Grid DC Restorer drive, CR1818 charges C1818 to a voltage more negative than the Focus Preset voltage by an amount equal to the voltage set by the FOCUS control.

Neon lamps DS1818, DS1819, and DS1820 and the resistors in series with the various diodes provide protection (voltage and current limiting) to the Focus Grid DC Restorer stage during turn-on and turn-off of the instrument, and short circuit protection.

The voltage from the FOCUS control passes through the BEAMFINDER switch. When the BEAMFINDER switch is pressed, it grounds the input to the Focus Grid DC Restorer, which defocuses the display.

GRID BIAS SUPPLY

The Grid Bias Supply is a 135-volt power supply connected between the crt cathode and the -2400 Volt Supply. The polarity is such that the cathode is at the more positive potential (-2365 volts). The purpose of the cathode supply is explained later in the Grid Crowbar circuit description.

The -2400 Volt Supply holds the current in the thick film high-voltage resistor R1802 constant at approximately

100 microamperes. The voltage developed across R1802C is 100 volts and is used as the voltage reference for the cathode supply. The comparator consisting of Q1835 and Q1838 requires both bases to be at the same potential. This condition is satisfied when there is 135 volts across the voltage divider of R1839 and R1840. If the voltage across the voltage divider R1839, R1840 is greater than 135 volts, the base voltage of Q1838 exceeds the base voltage of Q1835. Q1838 turns on harder, increasing the current in the series regulator Q1842. This reduces the current through the voltage divider R1839 and R1840 and lowers the voltage until it is 135 volts. The Grid Bias Supply furnishes current to the cathode, to the focus string, and to the resistor string which supplies the negative voltages to the scan expansion lens. Protection neon lamps DS1842, DS1844, and DS1846 limit the maximum voltage across the supply.

MICROCHANNEL PLATE SUPPLY

The MCP (Microchannel Plate) Supply receives a 25-kilohertz square-wave signal of about 54 volts peak from the Converter/Rectifiers circuit (diagram 14). If pin 1 of the transformer T1708 were grounded, the transformer would step this voltage up to 625 volts peak. Components C1711, CR1710, CR1711 and C1710 form a voltage doubler to develop 1250 volts dc at TP1775.

Assume that by some means the collector of Q1708 is held at a +20 volt level. The 25-kilohertz square-wave signal is clipped by diode CR1708 to a maximum of +20.6 volts and clipped by diode CR1707 to a minimum of −0.6 volt at the cathode of diode CR1707. With the circuit in equilibrium, the average current in capacitor C1707 must be zero. This is reached when C1707 is charged to 10 volts. This means that a 25-kilohertz square-wave signal of 10.6 volts peak is on pin 1 of transformer T1708. This voltage is subtracted from the 54 volt peak drive at pin 2 of T1708, so the primary of the transformer is driven by a voltage of 43.4 volts peak. The dc output voltage is then reduced to about 1000 volts.

Components U1714A and Q1708 regulate the dc output voltage of T1708. Pin 2 of U1714A is at ground potential and is the current summing point for the regulator. If there is zero current in R1722 and R1719, pin 2 of U1714A can be only at ground potential, when the dc output voltage at TP1775 is +562.5 volts. If pin 2 is above ground, the output of operational amplifier U1714A will go negative, turning off Q1708. This will charge C1708 more positive and reduce the primary drive of the transformer. This will result in a reduced dc output voltage at TP1775 until the voltage on pin 2 of U1714A returns to ground. Resistor R1722 carries the Intensity Sense current developed by the MCP Intensity Tracking stage on the Logic Schematic, diagram 4.

The Intensity Sense current varies between 0 and 50 microamperes depending on the setting of the INTENSITY Control, and gives the MCP Supply voltage a maximum increase of 375 volts. The higher the voltage across the MCP the greater the gain of the MCP (electrons out for electrons in) which results in a brighter crt display (this is needed at faster sweep speeds to obtain writing rate). MCP Gain adjustment R1720 sets the output voltage at TP1775; its range is 300 volts.

MCP Gain Adjustment R1720 controls the writing speed of the instrument. At the factory this adjustment is set so that a single shot, 1 gigahertz sine wave with an amplitude of 7.5 divisions is visible when photographed using type 107 3000 ASA Polaroid film (camera setting is f 1.9 at a reduction ratio of 1:0.85). If the MCP output voltage is set higher both the visual and photographic writing rate increase, however a background scintillation of the MCP may appear on photographs. This effect randomly covers the photographs with small bright spots.

Depending on instrument use, increased MCP output voltage may reduce the display gain. Refer to: Reduction of Display Gain With Display Output Charge in the Operating Instructions section of this manual.

When the INTENSITY control is turned clockwise, the MCP output voltage increases to produce a brighter crt display. This causes the Readout display to be brighter, which is undesirable. IC U1714B prevents this. When the Int Sense current increases from 0 to 50 microamperes, the voltage at pin 5 of U1714B increases from 0 to 1 volt. The voltage at the emitter of Q1724 follows this voltage at pin 5 of U1714B. Therefore, the collector current of Q1724 (Aux Readout Intensity current) increases from 0 to approximately 0.25 milliampere. Aux Readout Intensity current is subtracted from the Readout Intensity current to reduce the readout intensity current while the MCP output voltage increases. This results in a readout display of constant intensity.

Anode Voltage Multiplier

Positive accelerating potential for the crt anode is supplied by the five-times voltage multiplier U1700. The voltage applied to the input of U1700 from the high voltage secondary of T1770 is about 2500 volts peak-to-peak. This results in an output voltage of about 12.5 kilovolts at the crt anode. The output resistance of this supply is about 100 megohms and may be subject to meter loading when measured.

GRID BIAS

The Grid Bias stage provides a dc reference voltage for the Control Grid DC Restorer. This reference level is adjustable by means of CRT Grid Bias adjustment R1746, which sets the grid cutoff voltage of the crt. Te grid cutoff voltage drifts during warmup of the instrument; U1736 and Q1742 compensate for this drift.

Initially, at instrument turn-on, pin 6 of U1736 is at +7.5 V and pin 2 is slightly negative. This negative voltage at U1736 pin 2 causes pin 6 to try to go positive, which charges capacitor C1736. Transistor Q1742 conducts, making the crt grid bias more positive by the voltage developed across R1747. After 15 minutes, the voltage at TP1736 approaches +13.5 V, which turns off Q1742 and allows Q1748 to control the crt grid bias.

When the instrument is turned off capacitor C1736 discharges with the same time constant (diode CR1736 prevents a fast discharge). If, after a few minutes the instrument is turned on again, less warmup compensation is required.

-2400 VOLT SUPPLY

Components C1750, CR1762, CR1763, and C1764 form a voltage doubler. A 1250-volt peak square wave is applied to the input of this doubler. If the voltage at the collector of Q1784 is near ground, the dc voltage at TP1844 will be about -2500 volts. Components U1802 and Q1784 regulate the -2400 Volt Supply. Under nominal conditions, the voltage at TP1784 is about +100 volts. Diodes CR1776 and CR1778 alternately clip the waveform at pin 7 of the secondary winding of T1770 between the +100 volt level and ground level. The voltage across the secondary of T1770 is 1250 volts peak. With the waveform at pin 7, the voltage at pin 9 switches between 1250 and -1150 volts. This charges C1750 to 1250 volts and C1764 (at TP1844) to -2400 volts. To maintain equilibrium the average current through C1778 must be zero. During one half of the cycle CR1778 conducts and draws current through C1778; during the other half CR1776 conducts, and CR1778 is turned off. The collector current from Q1784 that flows through C1778 is such that the total average current in C1778 equals zero. The voltage at TP1784 can be pulled down only by Q1784. Zener diode VR1784 limits the voltage at this point to a maximum of 200 volts. This would also happen if transistor Q1784 were removed.

Pin 3 of the operational amplifier U1802 is at ground potential; it is the current summing point. If the current in R1804 and R1806 is zero, pin 3 can be at ground potential only if the current in thick-film high voltage resistor R1802A, R1802B and R1802C is 100 microamperes. This produces a voltage of -2400 volts at TP1844 (100 μA × 24 Megohms=2400 V). If the voltage at TP1844 is slightly more positive than -2400 volts, pin 3 of U1802 will be above ground, the output (pin 6) will go more positive, Q1784 will turn on harder and conduct more current to charge capacitor C1778 less positive. The voltage at TP1784 will drop and as a result the -2400 Volt Supply will return to -2400 volts dc. Regulation by this path is slow (several cycles of the 25 kilohertz square wave are required to make a correction), and C1786 provides for faster regulation. When Q1784 is turned on hard, current flows through C1786 and pulls down the -2400 Volt Supply.

The -2265 Adjust, R1805, sets the dc high voltage. Divider network R1800, R1803, R1804 and thermistor RT1804 vary the -2400 Volt Supply with changes in temperature. This means that the velocity of the electron beam through the vertical and horizontal crt deflectors changes, which in turn changes the vertical and horizontal deflection sensitivity. The change in deflection sensitivity compensates for gain change with temperature in the vertical and horizontal amplifiers.

A regulated 2400 volt supply (TP1754) is generated for use by the scan expansion lens. The -2400 Volt Supply regulator also regulates the +2400 volt supply, but for slow changes only, as described in the circuit description of the -2400 Volt Supply. Under nominal conditions for the -2400 Volt Supply regulator, the collector of Q1784 is at 100 volts and the voltage at pin 9 of the high voltage transformer (T1770) switches at a 25 kilohertz rate, between 1250 volts and -1150 volts resulting in -2400 volts dc at the output of the -2400 Volt Supply. The voltage at the anode of CR1762 switches between 0 volt and -2400 volts and is the input to the +2400 supply voltage doubler (C1752, CR1752, CR1753, and C1754) causing the output at TP1754 to be +2400 volts dc. The scan expansion lens requires a voltage lower than +2400 volts. Because the lens draws zero current, a resistive divider can be used to lower voltage. Capacitors C1756 and C1880 filter the scan expansion lens voltage.

A voltage doubler produces semi-regulated +105 volts for use by the Z-Axis Amplifier. The input signal to transformer T1770 is connected to the voltage doubler formed by C1770, CR1772, CR1771 and C1774 to generate +105 volts dc at R1771.

If it is overloaded, the +105-volt supply will develop a negative voltage across R1774. If the + or -2400-volt supply is overloaded, a negative voltage will develop across R1776. The Fault Sense line is connected through P1785, pin 8, to the voltage Fault Sense input of U75, in the power supply. This is a high impedance point, and when pin 2 of U75 is pulled 100 millivolts negative or positive, U75 will shut down the power supply. Under overload conditions of the above mentioned supplies, either diode CR1774 or CR1775 will turn on and shut down the power supply.

High-Voltage Transformer

High-Voltage Transformer T1770 provides pre-regulated voltages for the +2400 volt and -2400 volt high-voltage supplies, and 6.3 volts rms for the crt heater. The crt heater is elevated to the cathode potential through R1848. The high-voltage winding of T1770 also provides the drive to the Anode Voltage Multiplier, Focus-Grid DC Restorer, and the Control-Grid DC Restorer stage.

GRID CROWBAR

The Grid Crowbar stage prevents the crt grid from becoming more positive than the cathode during turn-on of the instrument. This action is needed to protect the crt cathode while the cathode and grid voltages are settling. The grid voltage is forced more negative than the cathode by connecting the -2400 Volt Supply voltage to the crt grid through VR1688, Q1687, DS1687 and R1688 (while Q1687 is on) which is primarily determined by C1687 and R1687. Initially, C1687 has no charge. When the instrument power is turned on C1687 receives charging current from the -2400 Volt Supply through the emitter-base junction of Q1687 and R1685. Transistor Q1687 remains on as long as the charging current through R1685 is large enough to cause VR1688 to conduct.

CRT

The R7103 crt is a high resolution, high frequency, micro-channel plate crt. Transformer T1770 has a secondary winding that supplies 6.3 volts to the crt heater. The crt heater is held at the cathode potential through R1848 and DS1848. The conventional oxide structured cathode is held at -2265 volts. The Z-Axis Amplifier provides a maximum of 55 volts unblanking to the grid.

An ion trap is incorporated into the first anode. Gas ions which might normally damage the cathode are drawn from the anode and deposited on a gas absorbing surface. The demagnification lens which works in conjunction with the primary focus lens, is operated at the cathode potential.

Stigmator adjustment R1894 is connected to the stigmator lens and used to adjust the axis of astigmatism for optimum spot symmetry. The primary focus lens is connected to the output of the Focus Grid DC Restorer stage, which contains Focus Preset adjustment R1825. At high voltage Z-Axis drive a focus correction is required. Capacitor C1628 (Auto Focus Stage on diagram 12) couples the focus grid voltage drive to the output of the Auto Focus Amplifier. The front-panel screwdriver adjustment ASTIG (R313) applies a voltage to the astigmatism lens. The front panel astigmatism and focus controls are used together to obtain best overall focus.

The vertical and horizontal deflectors are traveling wave deflectors. They are helical transmission line deflectors where the velocity of the input signal along the helical conductors is the speed of light. The phase velocity along the length of the helix is matched to the crt electron-beam velocity as it propagates along the helix. The impedance of the vertical deflector is 200 ohms, the deflection factor is 1 volt-per-division and the bandwidth is about 3 gigahertz. The deflector is silver plated to minimize skin-effect losses. The impedance of the horizontal deflector is 365 ohms, the deflection factor is 2 volts/division, and the bandwidth is about 1.5 gigahertz. The connections to the vertical and horizontal deflectors are made via carefully spaced neck pins. The vertical deflector also employs stripline lead-in wires between the deflector and the neck pins. Both deflectors use external termination resistors.

The R7103 crt uses a scan expansion lens. Without this lens, the crt would have to be over seven feet in length to obtain the desired scan size and deflector sensitivities. This lens operates as a strong positive lens in the vertical axis and causes the beam to cross over or invert the vertical deflection to produce a vertical scan expansion of 4.5 times. In the horizontal axis the lens is a negative lens, which enhances the deflection of the beam. The horizontal scan is expanded 4 times. Seven potentials are required to operate the lens. The voltages are adjustable, differentially absolutely. The adjustments on diagram 13 are labeled for their primary function, and they have secondary functions.

Vertical Linearity adjustments R1853 and R1856 align the overall vertical linearity of the crt display. Vertical Linearity adjustments R1854 and R1855 correct any vertical imbalance. Geometry adjustments R1863 and R1866 set the crt vertical geometry. Vertical Keystone adjustments R1864 and R1865 align the vertical keystone effect of the crt. Horizontal Sensitivity adjustments R1873 and R1876 set the horizontal deflection factor. Horizontal Linearity adjustments R1874 and R1875 are set to minimize horizontal nonlinearity or nonuniform bowing of vertical lines.

The input of the microchannel plate (MCP) is held at ground potential and the output is connected to a variable positive supply to provide bias for the MCP. The higher the bias across the MCP, the higher the gain or electron multiplication. The MCP is the basis for the R7103's high writing rate.

The MCP bias is adjusted with the INTENSITY control. The bias across the MCP is held constant at INTENSITY settings below about midrange, but increases linearly from midrange to the fully clockwise position. Adjustment R1720 (MCP Gain) on the High Voltage Board also adjusts the MCP output voltage. At the factory this adjustment is set to achieve a photographic writing speed of 20 cm/nanosecond using a standard camera (f 1.9 lens) and standard film (Polaroid Type 107; 3000 ASA).

If the MCP output voltage adjustment is set high the visual and photographic writing speeds will increase, however, on photographs a background scintillation may appear. At a high MCP bias setting, the channels being excited by stray electrons can have an electron-multiplication factor high enough to become visible on photographs. Depending on instrument use, increased

MCP output voltage may reduce the display gain. Refer to Reduction of Display Gain With Display Output Charge in the Operating Instructions section of this manual. The MCP is located about 0.3 cm from an aluminized screen with standard P31 phosphor crt's. About 11.5 kilovolts is applied across this gap to accelerate the electrons exiting the MCP.

The orthogonality coil, wound on the crt neck at the exit of the vertical deflector, allows for correction of rotational alignment errors between the deflection axis and scan expansion lens. In addition to the orthogonality coil, a trace rotation coil is wound on the envelope of the glass ceramic interface.

14

CONVERTER/RECTIFIERS

The Converter/Rectifiers circuit provides the operating power for the R7103 from an ac line-voltage source. This circuit includes a LINE VOLTAGE SELECTOR located on the rear panel. Figure 3-25 shows a detailed block diagram of the Converter/Rectifiers circuit. Diagram 14, in Section 8 (Diagrams and Circuit Board Illustrations) of this manual, is a schematic of the Converter/Rectifier circuit. Gray shaded lines divide the circuitry into major stages. Sub-headings in the following discussion use the stage names to further identify portions of the circuitry on diagram 14.

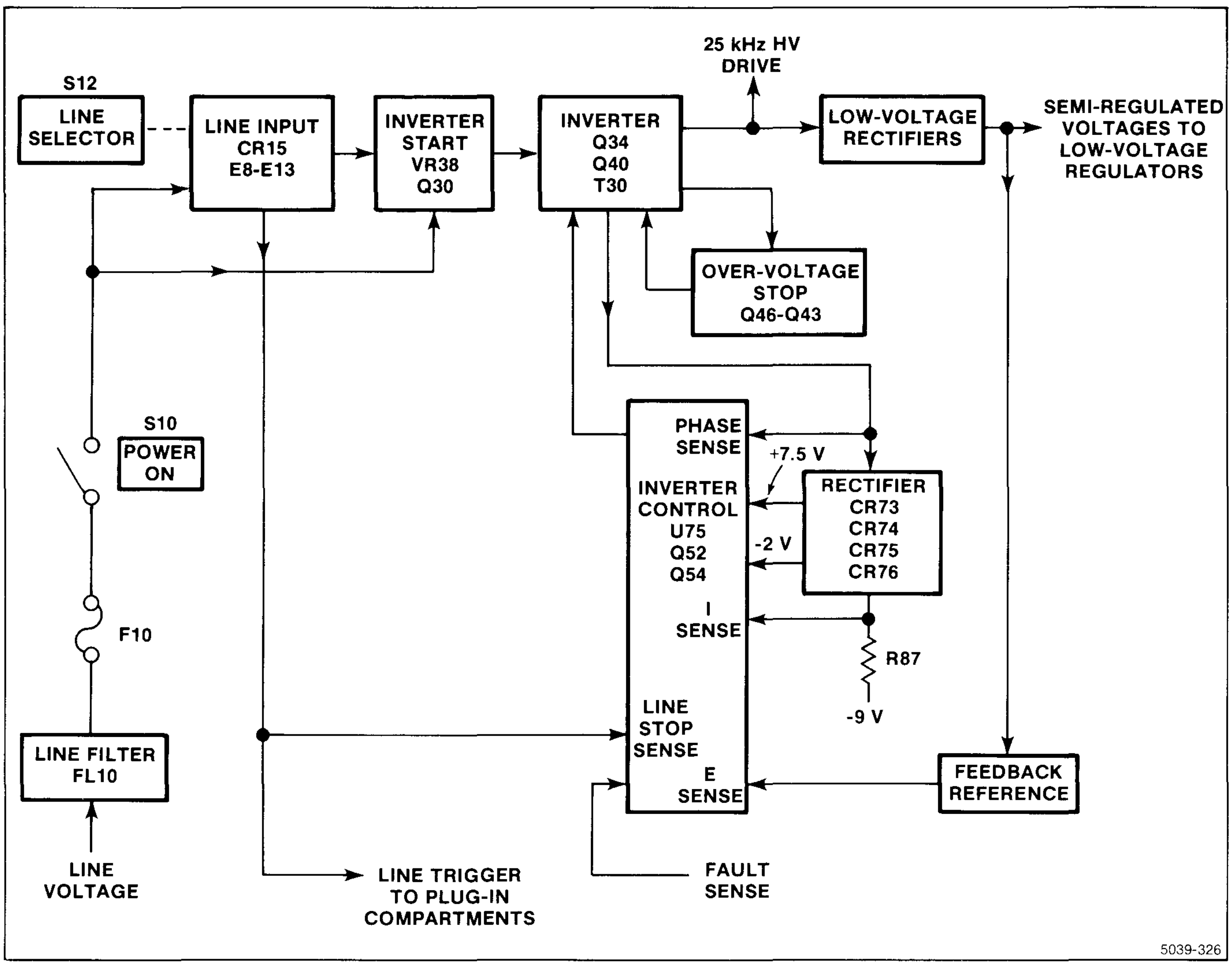

Figure 3-25. Detailed block diagram of Converter/Rectifier circuit.

LINE INPUT

Power is applied through line filter FL10, line fuse F10 and POWER switch S10. The line filter keeps power-line interference from entering the instrument, and keeps the approximate 25-kilohertz Inverter signal from entering the power line. Components R5, C5, and C6 suppress reverse-recovery transients of CR15.

The LINE VOLTAGE SELECTOR, S12, allows the R7103 to operate from a 115- or 230-volt nominal line voltage source. In the 115-volt position, rectifier CR15 operates as a full-wave doubler with energy-storage capacitors C16 and C17, so the voltage across the two capacitors in series will be the approximate peak-to-peak value of the line voltage. For 230-volt operation, CR15 is connected as a bridge rectifier, and the voltage across C16 and C17 will be the approximate peak value of the line voltage. Thus, the dc voltage applied to the Inverter stage is about the same for either 115- or 230-volt operation.

Thermistors RT12 and RT13 limit the surge current when the power supply is first turned on. After the instrument is in operation, the resistance of the thermistors decreases so that they have little effect on the circuit. When the instrument is turned off, the Inverter Control stage turns off the Inverter, which prevents it from discharging C16 and C17; C16 and C17 discharge slowly through R21 to allow for thermistor thermal-recovery time. This ensures sufficient thermistor resistance to limit the turn-on surge current to a safe level. Because C16 and C17 discharge slowly, dangerous potentials exist in the power supply for several minutes after the POWER switch is turned OFF. The presence of voltage in the circuit is indicated by the relaxation oscillator R19, C19 and DS19. Neon bulb DS19 will blink until the potential across C16 and C17 drops to about 80 volts.

Spark-gap electrodes E8 and E13 are surge-voltage protectors. When the LINE VOLTAGE SELECTOR is in the 115-volt position, only E8 is connected across the line input. If a peak voltage greater than 230 volts is present on the line, E8 will conduct and quickly open line fuse F10 to interrupt the input power before the instrument can be damaged. In the 230 volt position, E8 and E13 are connected in series across the line input to provide protection for peak voltages greater than 460 volts.

Transformer T8 provides a sample of the line voltage to the plug-in connectors for triggering at line frequencies. This line frequency signal is also connected to the Inverter Control stage to sense when line voltage is present.

INVERTER START NETWORK

Components R10 and C42 provide a turn-on path between the input line and the negative side of line-input filter capacitor C17. Capacitor C42 charges on each cycle of the input line voltage. When the charge on C42 reaches about 33 volts, Zener diode VR38 turns on, which causes Q30, the programmable unijunction transistor, to fire. This provides base drive to turn on Q40 through C39. When Q40 turns on, it shock-excites series-resonant network L37 and C37 to generate a damped oscillation. This damped oscillation provides the drive necessary to start the Inverter switching action. After the Inverter is operating, the recurrent waveform at the collector of Q40 keeps C42 discharged through CR49, thus disabling the Inverter Start network while the instrument is on.

INVERTER

The Inverter stage converts the dc voltage across C16 and C17 to a sine-wave current to drive power transformer T110. Once the Inverter has been started by the Inverter Start Network, transformer T30 provides feedback to the bases of Q34 and Q40 to sustain oscillation. These transistors operate at a forced beta of 4 due to the turns ratio of T30. Also, T30 provides a 60:1 turn ratio center-tapped winding for pre-regulation and fault protection shut-down. The Inverter Control stage short circuits one-half of this winding to either delay the turn-on of Q34 and Q40 or to stop their switching action.

The switching action of Q34 and Q40 generates a square-wave voltage with an amplitude approximately equal to the dc voltage at the input to this stage. The square-wave voltage at the emitter of Q34 supplies the drive necessary to maintain a sine-wave current in the series-resonant network of L37 and C37. Diodes CR34 and CR41 provide paths for series-resonant current when Q34 and Q40 are held off for pre-regulation.

To aid in understanding circuit operation, Figure 3-26A shows a representation of the Inverter stage as a switch. The three possible states of the Inverter are depicted by the three possible switch positions: Q34 is on in position (a); Q40 is on in position (c); or both transistors are off, for pre-regulation, in position (b). In the composite current waveform of Figure 3-26B, the relative phase and amplitude of each component of I_T is shown for periods T_a, T_b, and T_c corresponding to the three switch positions. Figure 3-26C and Figure 3-26D show the relationship of the Inverter voltage and primary winding voltages with respect to the current waveform.

The normal sequence of operation is as follows: assume that the voltage at point X is more positive than the negative supply voltage and that Q40 has just turned on. The current labeled I_4 in Figures 3-26A and 3-26B flows as the voltage at point W goes negative. Point X goes toward the negative supply voltage as C37 charges through L37. The voltage across the primaries of T110 and T35 at point Y produces a voltage at the secondary of T35 that is sensed by the Inverter Control IC, U75

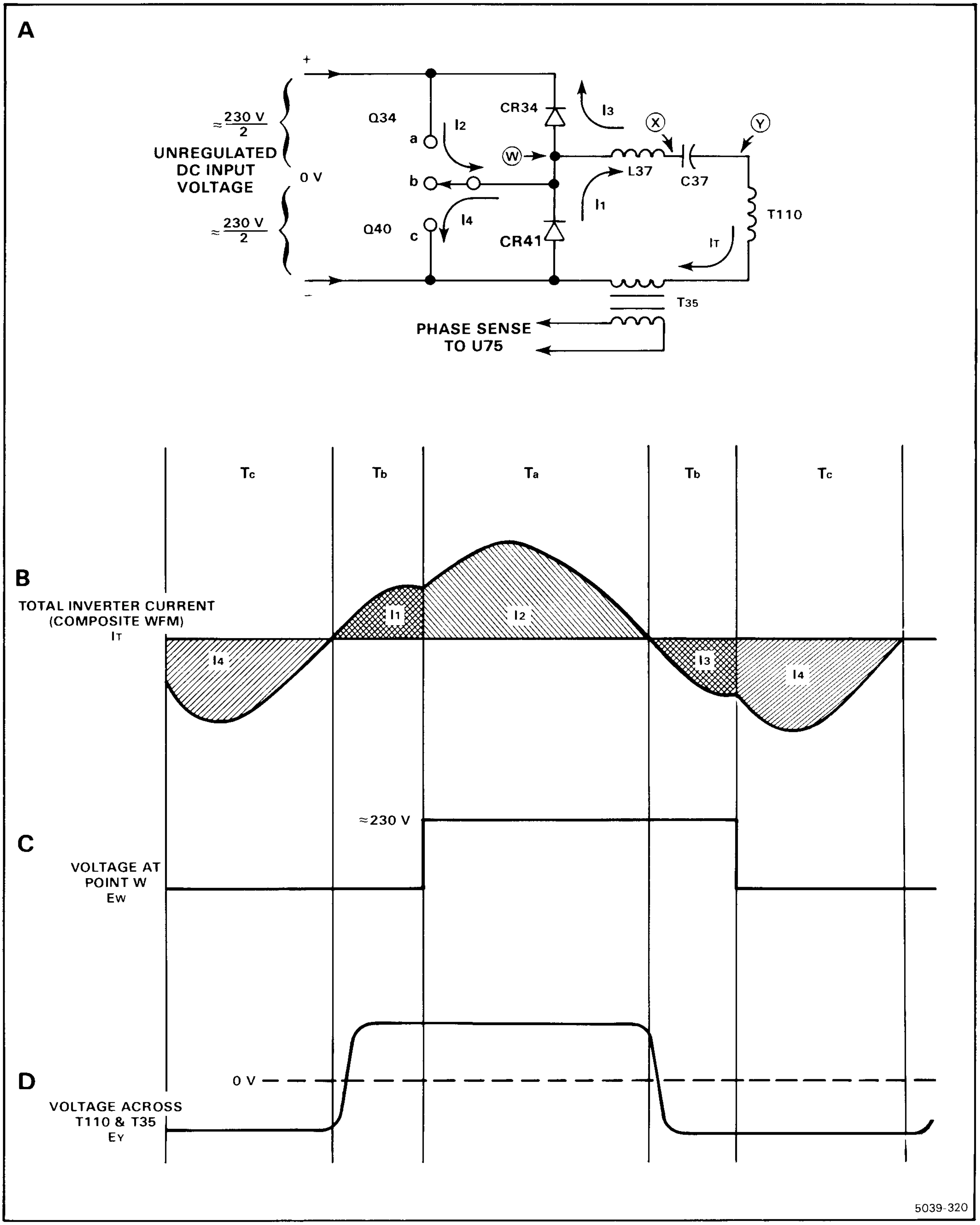

Figure 3-26. (A) Representation of Inverter stage. Idealized waveforms of (B) total Inverter current, I_T, (C) Voltage across CR41 and (D) Voltage across primaries of T110 and T35.

(see Fig. 3-26D). When this voltage changes phase from negative to positive, Q40 is held off (turned off) by U75. Due to the inductive action of L37, current continues to flow through the Inverter circuit, pulling the voltage at point W below the negative supply voltage. This forward-biases CR41, which now conducts I_1 (Figures 3-26A and 3-26B). After a predetermined time, the Inverter Control IC, U75, allows Q34 to turn on and conduct the current labeled I_2. Now that Q34 is conducting, the voltage at point X charges toward the positive supply voltage through L37. Again, voltage phase change is sensed at the secondary of T35, by U75, as previously described. Transistor Q34 is held off at this time, and I_3 flows because the inductive action of L37 pulls the anode of CR34 to a voltage greater than the positive supply voltage. After a time set by the Inverter Control stage, Q40 conducts I_4, and the cycle repeats.

OVER-VOLTAGE STOP

Whenever the voltage across the primary of T110 exceeds a safe level, the Over-Voltage Stop stage shuts down the Inverter to protect Inverter components from damage. For example, this stage activates whenever the normal voltage regulating path through Q52 and T30 is inoperative.

Capacitor C43 charges through R44 and CR38 to the peak voltage across the primary of T110. If this voltage exceeds a safe level, Q45 conducts to cause Q43 and Q46 to turn on. When Q46 turns on, the base-drive winding of T30 is short-circuited, which stops the Inverter. Because Q43 is turned on, C42 (in the Inverter Start network) is prevented from charging and from firing Q30; this prevents the Inverter from starting. Transistors Q45 and Q43 continue to conduct until C43 has discharged sufficiently, through R45, to turn Q45 off. At this point, Q43 and Q46 will turn off and the Inverter will start on the next positive half cycle of the line.

INVERTER CONTROL

The Inverter Control stage, which is principally U75, provides pre-regulation and fault protection functions. For pre-regulation purposes, U75 varies the hold-off time (T_b, in Fig. 3-26B) of the Inverter switching transistors.

Under normal operating conditions, only the voltage sense (E Sense) input at pin 15 controls the hold-off time. However, various fault conditions can affect hold-off time or stop the Inverter operation altogether. The operation of individual functions of the Inverter Control stage is described in the following discussion.

Pre-Regulator

The pre-regulator operation of U75 maintains constant voltage at the outputs of the Low-Voltage Rectifiers stage. It also provides constant peak-to-peak voltage to the High-Voltage Power Supply in the CRT Circuit (diagram 13).

Transformer T35 provides Inverter phase information and power to U75. The phase information is connected to pins 10 and 11 through C77 and C78. Bridge rectifier CR73, CR74, CR75 and CR76, provides positive and negative operating voltages to U75. A shunt regulator in U75 maintains the +7.5 volts at pin 6. The −2 volt (nominal) supply connected to pin 7 is unregulated. Zener diode VR72 provides protection against open circuit conduction (if U75 is removed) and normally does not conduct.

Pin 15 is the voltage sensing (E Sense) point of the pre-regulator circuit. Zero volts at pin 15 indicates proper regulation. Zener diode VR88 provides a stable reference voltage for sensing resistors R93, R95, R86 and R87. Variable resistor R93, in this divider, adjusts the ratio of the divider to adjust the output of the +108 volt supply. Outputs of the other supplies are determined by the turns ratio of T110.

Integrated circuit U75 regulates the Inverter by varying the hold-off time of the switching transistors, Q34 and Q40. A variable pulse-width monostable multivibrator in U75 is triggered at pins 10 and 11 whenever the Inverter current changes direction. The pulse width holds off the Inverter by turning on Q52 through pin 9 of U75, thus shorting out the base drive to Q34 and Q40. The pulse width, and therefore holdoff, is controlled by a ramp at U75 pin 12. If the voltage at the E Sense input, pin 15, is too low, the ramp is not allowed to rise very high and the pulse width and holdoff are short. As the E Sense voltage rises, the ramp is allowed to rise to a higher voltage level, increasing the holdoff time.

Fault Protection

The fault protection portions of U75 provide protection for the power supply components due to short circuits, turn-on surge currents, and other malfunctions. When a fault is detected at the Fault Sense input (pin 2) or I Sense input (pin 13), a current from the Fault Holdoff Time output (pin 1) charges C64. If the detected fault lasts longer than about 10 milliseconds, C64 will charge positive enough to initiate a positive output at pin 8. This output turns on Q54 and Q52, which turns off the Inverter. The Inverter will remain off while C54 discharges through R54, keeping Q54 and Q52 turned on. The Inverter restarts in roughly 500 milliseconds when the current through R54 is insufficient to keep Q54 and Q52 turned on. When the inverter restarts, C54 is recharged through CR59 and R59. This cycle repeats until the fault is corrected, with the Inverter on for about 10 milliseconds, and off for about 500 milliseconds.

Inverter Current Limiter

The inverter current limiter protects the Inverter components from damage due to excessive current or short circuits. Operation of this stage is similar to the pre-regulator (voltage regulation). The inverter current limiter takes control of the Inverter hold-off time whenever pin 13 starts to go negative. Transformer T35 provides a current step-down. The current is rectified and flows through R84, the current-sensing resistor. The voltage across R84 is negative and proportional to the Inverter current. The I Sense input at pin 13 U75 is normally held positive through divider R81, R82 and R83. The Inverter Current Limiter takes control of regulation when pin 13 reaches near zero volts. Peak Inverter current is limited to about 5 amperes. If the voltage at pin 13 remains near zero for more than about 10 milliseconds, pin 8 will go positive to turn off the Inverter.

Fault Sense

The fault sense portion of U75 provides overload protection for supplies on the Low-Voltage Regulators schematic (diagram 15), and other supplies throughout the instrument. Resistive networks from supplies are connected to the Fault Sense input at pin 2 of U75. During normal operation, the voltage at the Fault Sense input remains near zero. If one of the inputs changes sufficiently to cause this voltage level to vary 200 millivolts (positive or negative) for more than 10 milliseconds, a positive output at pin 8 of U75 stops the Inverter.

Line Stop

The line stop portion of U75 stops the Inverter when the POWER switch, on the front panel, is turned OFF. The Line Stop stage will also stop the Inverter if the ac line voltage falls below a minimum value.

The line-frequency signal from transformer T8 is connected to pin 4, the Line Stop Sense input of U75. During normal operation, the line-frequency signal causes the Line Stop Timer terminal (pin 3) to periodically discharge to ground. When the line-frequency signal is interrupted or falls below a minimum value, C67 will charge to approximately +0.7 volts causing the Line Stop stage to produce a positive output at pin 8 of U75 which stops the Inverter.

LOW-VOLTAGE RECTIFIERS

The Low-Voltage Rectifiers stage rectifies the square-wave ac voltages from T110 to the dc levels used for all regulated supplies in this instrument.

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LOW-VOLTAGE REGULATORS

The Low-Voltage Regulators convert semi-regulated voltages from the Converter/Rectifiers circuit (diagram 14) to stabilized low-ripple output voltages. The regulators are series type, using the +50 volt supply as a reference.

A schematic diagram of the Low-Voltage Regulators circuit is shown on diagram 15, in Section 8, Diagrams and Circuit Board Illustrations. Gray shaded lines divide the circuitry into major stages. Subheadings in the following discussion use these stage names to further identify the components and portions of the circuitry shown on diagram 15.

Operational Amplifier Power Supplies. The operational amplifiers used to regulate the +50, +15, +5, −50, and −15 volt supplies require that four special voltages be generated for their operation:

1. The +22 volt supply is generated from the semi-regulated +54 volt supply by reference zener diode VR32 and Q34.
2. The −22 volt supply is generated from the semi-regulated −54 volt supply by reference zener diode VR36 and Q38.
3. The +5.6 volt supply is generated from the semi-regulated +17 volt supply by zener diode VR152.
4. The −5.6 volt supply is generated from the semi-regulated −17 volt supply by zener diode VR156.

+50 V REGULATOR

Semi-regulated +54 volts from the Converter/Rectifiers circuit (diagram 14) is the unregulated voltage source for this supply. Differential amplifier U15 compares the feedback voltage at pin 2 against the reference voltage at pin 3. The error output at pin 6 of U15 reflects a difference between these two inputs. Zener diode VR12 sets a reference level of about +9 volts at U15 pin 3. A sample of the +50-volt output is connected to U15 pin 2 via divider network R16, R15 and R14. Variable resistor R15 in this divider sets the output level of this supply. Notice that the feedback voltage of this divider is obtained from a line labeled +50 VS (sense). If the feedback voltages were obtained at the supply, the voltage at the load would not stay constant, due to the resistance of the interconnecting cable between the supply and its load. The sense configuration overcomes this problem by sensing the voltage at the load. Because the current in the sense line is small and constant, the load voltage is held constant regardless of the load current.

Regulation of voltage occurs as follows: If the +50 V output decreases (becomes less positive) due to an increase in load or a decrease in input voltage (as a result of line-voltage change or ripple), the voltage across divider R16, R15 and R14 decreases also. This results in a less positive level, at pin 2 of U15, than that established by zener diode VR12 at pin 3 of U15. This decreases the current through CR15 and VR17 causing an increase in current through the base-emitter junction of Q28. This results in increased conduction of Q28, the +50 volt series regulator. The load current increases, therefore the voltage across the load also increases (becomes more positive) sufficiently to balance the input into differential amplifier U15. The +50 V Adj, R15, sets the output level of this supply.

Current limiting is provided for the +50 volt supply if excessive current is demanded from the supply. All current from the +50 volt supply must flow through R28. Under normal operation, there is insufficient voltage drop across R28 to turn Q22 off. However, when excessive current is demanded from the +50 volt series regulator (Q28) due to a short circuit or similar malfunction at the output of this supply, the voltage drop across R28 increases and begins to turn off Q22. The reduced collector current of Q22 results in a reduction of current through Q28. This current-limiting protects Q28 from damage due to excessive power dissipation.

Several protection diodes are also included in this circuit. Diode CR28 prevents the output of this supply from going more negative than about −0.6 volt if it is shorted to a negative supply. Zener diode VR10 and diode CR10 supply a turn-on voltage for U15 to start the +50 volt supply when the instrument is first turned on. As soon as the +50 volt supply turns on, CR10 stops conducting.

−15 V REGULATOR

Basic operation of all stages in the −15 Regulator is the same as for the +50 Regulator. The reference level for this supply is established through R82 at pin 5 of U84B. The divider ratio of R80 and R81 sets a level of zero volts at pin 6 of U84B. The level on the +50 VS (sense) line is held stable by the +50 volt supply. Any change at the output of the −15 volt supply appears at pin 6 of U84B as an error signal. The output voltage is regulated in the same manner as described for the +50 volt supply. Diode CR96 keeps the output of this supply from going more positive than about +0.6 volt if it is shorted to one of the more positive supplies. Operational amplifier U84A provides current limiting for Q94 by monitoring the voltage drop across R95. When too much current is demanded from the supply, the increased voltage drop across R95 allows U84A to turn Q88 off, reducing the current through Q94.

+5 V REGULATOR

The operation of the +5 V Regulator is basically the same as described for the previous supply regulators. Error voltage is provided through R131 to pin 2 of U114A, and pin 3 is referenced to the +50 VS (sense) line. The divider ratio of R113 and R114 is 10:1, so pin 3 of U114A is at +5 volts when the supply is operating normally. 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 pin 2 of U114A as an error signal. The output voltage is regulated in the manner described previously for the +50 volt supply. Diode CR132 limits the output of this supply to about −0.6 volt, if it is shorted to one of the negative supplies.

The +5 volt current limiting, accomplished by U114B, protects the supply from excessive output current damage. With normal supply current through R133 and R134, the voltage drop across this parallel resistance biases Q118 on. If the current through R133 and R134 increases above a safe level, pin 7 of U114B reduces the forward bias current to Q118. Now, the base current of Q122 is reduced which decreases the voltage on the base of Q126. This limits the conduction of Q126 to a safe current level.

+15 V REGULATOR

The +15 V Regulator regulates in the same manner as the +50 volt supply; current limiting operates in the manner described for the +5 volt supply. Error feedback voltage to pin 2 of U64A is provided through R69. Pin 3 of U64A is referenced to the +50 VS (sense) line. The divider ratio of R61 and R62 sets pin 3 of U64A at +15 volts. Any change in the output level of the +15 volt supply appears at pin 2 of U64A as an error signal. This results in an opposite change at the output, pin 1 of U64A, which is conveyed to the +15 volt series regulator transistor Q74, through CR64 and Q68, to correct the error in the output voltage of the supply. Diode CR76 limits the output of this supply to about −0.6 volt if it is shorted to one of the negative supplies.

−50 V REGULATOR

The −50 V Regulator operates basically the same as the +50 volt supply; current limiting operates in a manner similar to that described for the +50 volt supply. Error voltage to pin 2 of U45 is provided by divider R45-R46 and is referenced to the −50 VS (sense) line. The divider ratio of R45 and R46 sets the level at pin 2 of U45 at zero volts when the output of this supply is correct. Protection diode CR58 limits the output voltage of this supply to +0.6 volt should the supply be shorted to a positive supply.

GRATICULE LIGHT SUPPLY

The Graticule Light Supply provides power for the graticule lights. The front-panel GRAT ILLUM potentiometer controls the output of this supply to set the brightness of the graticule lights. Transistors Q144, Q148 and diode CR148 form a voltage-following current buffer. The output voltage at the collector of Q148 follows the voltage set at the base of Q144 by the divider made up of R142, R141, R143 and the front-panel GRAT ILLUM control on diagram 7. Resistor R148 limits the output current from this supply to protect Q148 from damage due to a short circuit.

MAINTENANCE

This section of the manual contains information for performing preventive maintenance, troubleshooting, and corrective maintenance for the R7103 Oscilloscope.

PREVENTIVE MAINTENANCE

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

CABINET PANEL REMOVAL

WARNING

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

The top and bottom cabinet panels provide protection from operating potentials present within the instrument. In addition, they reduce radiation of electromagnetic interference from the instrument. Screws retain the cabinet panels. To remove the panels, remove the screws and lift the panels off. Operate the instrument with the panels in place to protect the interior from dust.

CLEANING

The R7103 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path which may result in instrument failure. The side panels reduce the amount of dust reaching the interior of the instrument. Operation without the panels in place necessitates more frequent cleaning.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Exercise care when cleaning Hypcon connectors; see cleaning instructions under Hypcon Connectors in this section. Use a nonresidue type of cleaner, preferably isopropyl alcohol or totally denatured ethyl alcohol. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

EXTERIOR

Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small brush. The brush is also 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. Do not use abrasive cleaners.

CRT

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

The crt mesh filter can be cleaned as follows:

1. Hold the mesh filter in a vertical position and brush it 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 it 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

Cleaning the interior of the instrument should only be occasionally necessary. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in^2. Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components.

CAUTION

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

The high-voltage circuits should receive special attention. Excessive dirt in this area may cause high-voltage arcing and result in improper instrument operation.

VISUAL INSPECTION

The R7103 should be inspected occasionally for such defects as broken connections, 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 parts are found. Overheating usually indicates other trouble in the instrument; therefore, correcting the cause of overheating is important to prevent recurrence of the damage.

SEMICONDUCTOR CHECKS

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

PERIODIC ELECTRICAL ADJUSTMENT

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

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting of the R7103 Oscilloscope. Information in other sections of this manual should be used with the following data to aid in locating a defective component. An understanding of the circuit operation is helpful in locating troubles. See Section 3, Theory of Operation, for this information.

TROUBLESHOOTING AIDS

DIAGRAMS

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

CIRCUIT BOARD ILLUSTRATIONS

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

TROUBLESHOOTING CHART (also see p.7)

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

ADJUSTMENT AND TEST POINT LOCATIONS

To aid in locating test points and adjustable components called out in the various sections of the Checks and Adjustment procedures, the Adjustment and Test Point Locations pullout pages are provided in Section 8, Diagrams and Circuit Board Illustrations.

COMPONENT COLOR CODING

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

The values of common disc capacitors and small electrolytics are marked on the side of the component body.

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

SEMICONDUCTOR LEAD CONFIGURATIONS

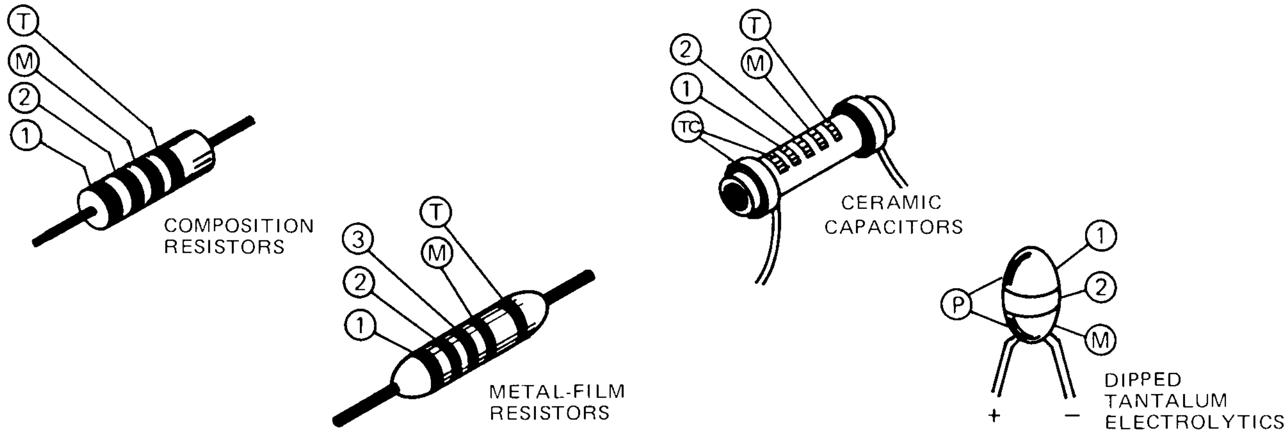
Lead configurations for semiconductor devices used in the R7103 Oscilloscope are shown in Figure 4-2.

MULTI-PIN CONNECTORS

Pin 1 on multi-pin connectors is designated with a triangle. A triangle, dot or square printed on circuit boards denotes pin 1. When a connection is made to a circuit board, the orientation of the triangle on the multi-pin holder is determined by the index (triangle, dot or square) printed on the circuit board (see Fig. 4-3). Some multi-pin connectors are keyed with a plastic pin that protrudes through a hole on the circuit board. Proper mating with the multi-pin connector and the pin(s) on the circuit board cannot be accomplished unless this pin is aligned with the hole on the circuit board.

Some multi-pin connectors are equipped with a locking mechanism to more readily secure the connector to the circuit board. To remove these connectors, grasp the connector body and pull perpendicular to the circuit board. They should not be removed by pulling on the wire leads; this causes the locking mechanism to clamp onto the circuit board pins.

COLOR CODE



(1) (2) and (3) - 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.
(M) - MULTIPLIER (T) - TOLERANCE;
(TC) - TEMPERATURE COEFFICIENT.

(T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;
(P) - POLARITY AND VOLTAGE RATING

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

5039-401

Figure 4-1. Color codes for resistors and capacitors.

NOTE

LEAD CONFIGURATIONS AND CASE STYLES ARE TYPICAL, BUT MAY VARY DUE TO VENDOR CHANGES OR INSTRUMENT MODIFICATIONS.

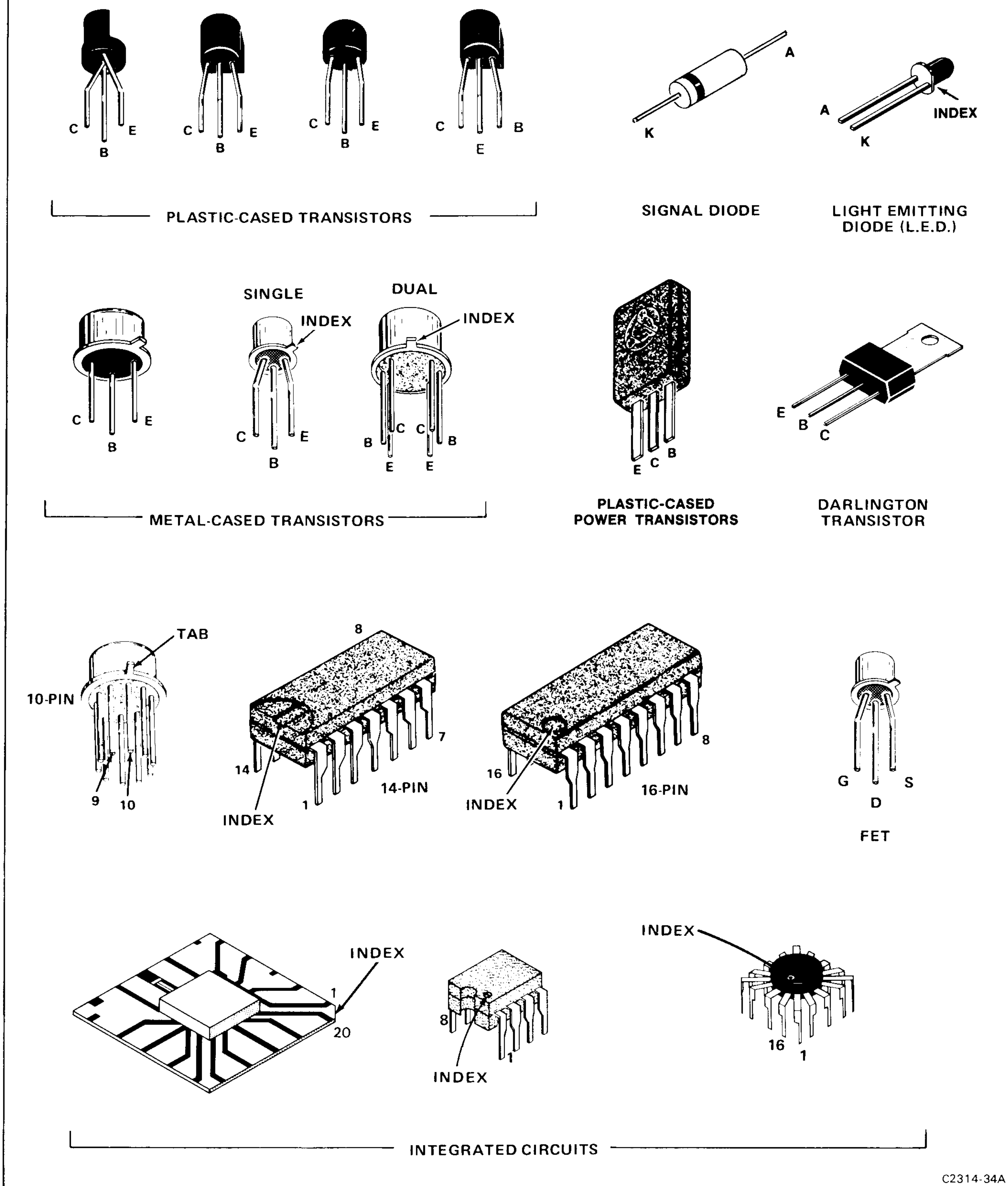


Figure 4-2. Semiconductor lead configurations.

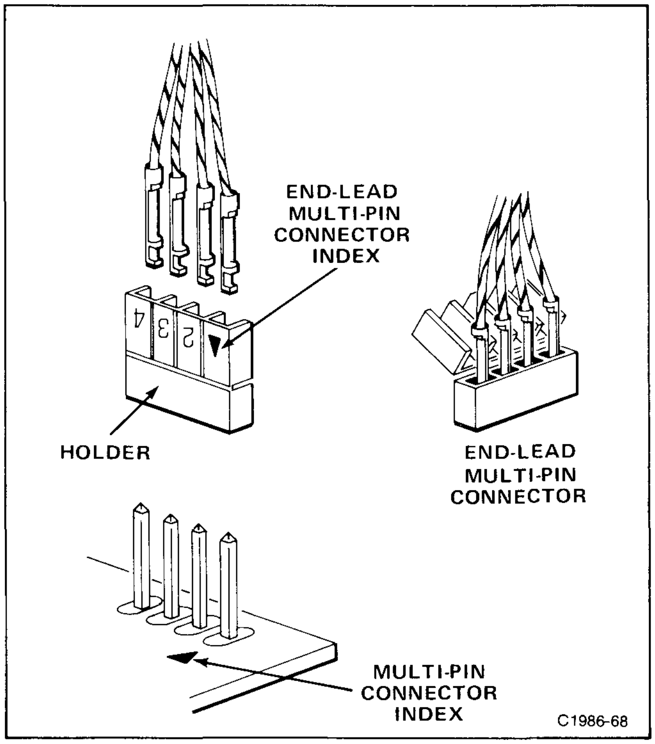


Figure 4-3. Orientation of multi-pin connectors.

TROUBLESHOOTING EQUIPMENT

The following equipment is useful for troubleshooting the 7103 Oscilloscope mainframe:

1. Transistor Tester

   Description: Dynamic-type tester.

   Purpose: Test semiconductors.

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

2. Digital Multimeter

   Description: 10 megohm input impedance and 0 to 1 kilovolt range, ac and dc; ohmmeter, accuracy, within 0.1%. Test probes must be insulated to prevent accidental shorting.

   Purpose: Check voltages and resistances.

   Recommended type: TEKTRONIX DM 501A Digital Multimeter.

3. Test Oscilloscope

   Description: Frequency response, dc to 100 megahertz minimum; deflection factor, 5 millivolts to 5 volts/division and 1 milliampere to 1 ampere/division. A 10X, 10-megohm voltage probe should be used to reduce circuit loading for voltage measurements. For current waveforms, use a Tektronix P6021 Current Probe with passive termination, or the equivalent.

   Purpose: Check operating waveforms.

   Recommended type: Refer to the Tektronix Products catalog for applicable oscilloscope system.

4. Variable Autotransformer

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

   Purpose: Vary input line voltage when troubleshooting the power supply.

   Recommended type: General Radio W10MT3W Variac Autotransformer.

5. Isolation Transformer

   Description: 1:1 turns ratio, 500 volt-amperes minimum, 50-60 cycle. Must have three-wire power cord, plug, and receptacle with ground connection carried through from input to output.

   Purpose: To isolate R7103 from line potential when troubleshooting power supply.

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

TROUBLESHOOTING TECHNIQUES

This troubleshooting procedure is arranged to check the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation, and adjustment. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, replace it following the replacement procedures given under Corrective Maintenance.

1. CHECK CONTROL SETTINGS

Incorrect control settings can indicate a nonexistent trouble. If there is any question about the correct function or operation of any control on the R7103, refer to Section 2, Operating Instructions.

2. CHECK ASSOCIATED EQUIPMENT

Before proceeding with troubleshooting, check that the equipment used with this instrument is operating correctly. Also, check that the input signals are properly connected and that the interconnecting cables are not defective. Check the line-voltage source.

3. VISUAL CHECK

Visually check that portion of the instrument in which the trouble is located. Many troubles can be found by visible indications, such as unsoldered connections, loose cable connections, broken wires, damaged circuit boards, and damaged components.

4. CHECK INSTRUMENT ADJUSTMENT

Check the electrical adjustment of this instrument, or of the affected circuit if the trouble appears in one circuit. The apparent trouble may only be a result of misadjustment. Complete adjustment instructions are given in Section 5, Checks and Adjustments.

5. ISOLATE TROUBLE TO A CIRCUIT

To isolate trouble to a particular circuit, note the trouble symptom. The symptom often identifies the circuit where the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by taking voltage and waveform measurements. Also check for the correct output signals at the front- and rear-panel output connectors with a test oscilloscope. If the signal is correct, the circuit is working correctly up to that point. For example, correct sawtooth output indicates that the time base and sawtooth output portion of the Output Signals circuit is operating correctly. If a malfunction in the Readout System is suspected of causing trouble to appear in the Z-Axis Amplifier, Vertical Amplifier, or Horizontal Amplifier circuits, the trouble can be localized by removing the Readout System circuit board. This board can be removed without significantly affecting the operation of other circuits in the instrument.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. However, a defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits. If incorrect operation of the power supplies is suspected, refer to Troubleshooting the High-Efficiency Power Supply, later in this section.

The Troubleshooting Chart, in Section 8, Diagrams and Circuit Board Illustrations, is a guide for locating defective circuits. Start at the top of the chart and perform the checks given on the left side of the page until a step is found that does not produce the indicated results. Further checks, or the circuit in which the trouble is probably located, are listed to the right of the step. This chart does not include checks for all possible defects; use steps 6 and 7 in such cases.

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 voltages or waveforms in the circuit. Typical voltages and waveforms are given in Section 8, Diagrams and Circuit Board Illustrations.

NOTE

Voltages and waveforms given in Section 8, Diagrams and Circuit Board Illustrations, are not absolute and may vary slightly among R7103 Oscilloscopes. To obtain operating conditions similar to those used to take these readings, see the appropriate schematic.

7. CHECK INDIVIDUAL COMPONENTS

The following procedures describe methods of checking individual components in the R7103. Components which are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

WARNING

To avoid electric-shock hazard, always disconnect the R7103 from the power source before removing or replacing components.

Fuses

Check fuses for continuity with an ohmmeter.

Transistors

A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been previously checked). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

Integrated Circuits

Integrated circuits (ICs) can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit operation is essential to troubleshooting circuits using ICs. In addition, operating waveforms, logic levels, and other operating information for the ICs are given in Section 3, Theory of Operation and Section 8, Diagrams and Circuit Board Illustrations. Use care when checking voltages and waveforms around the ICs so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the in-line, multi-pin ICs is with an IC test clip. This device also doubles as an IC-extraction tool.

Diodes

A diode can be checked for open or short circuits by measuring the resistance between terminals with an ohmmeter on a scale having a low internal source current, such as the R X 1k scale. The resistance should be very high in one direction and very low when the meter leads are reversed.

CAUTION

When checking diodes, do not use an ohmmeter scale that has a high internal current, because high currents may damage diodes.

Resistors

Check the resistors with an ohmmeter. Resistor tolerances are given in Section 7, Replaceable Electrical Parts. Normally, resistors need not be replaced unless the measured value varies widely from the specified value.

Capacitors

A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking that the capacitor does not pass ac signals.

8. REPAIR AND ADJUST THE CIRCUIT

If any defective parts are located, follow the replacement procedures given under Component Replacement in this section. Check the performance of any circuit that has been repaired or that has had any electrical components replaced. Adjustment of the circuit may be necessary.

TROUBLESHOOTING THE HIGH-EFFICIENCY POWER SUPPLY

GENERAL

The following information is provided to facilitate troubleshooting the high-efficiency power supply. Information in other sections of this manual should be used in conjunction with this procedure to aid in locating a defective component. An understanding of the circuit operation is valuable in locating troubles. See Section 3, Theory of Operation, for this information. Specifications for the troubleshooting equipment mentioned in this procedure are given earlier in this section under Troubleshooting Equipment.

WARNING

Use extreme caution when troubleshooting the power supply due to the line voltage and the high-voltage/high-current potentials present.

When a fault condition occurs which is of insufficient magnitude to open the line fuse, protection circuitry will cause the inverter to operate in a pulse mode. In pulse mode the inverter will turn on for a short period of time, and then turn off for a longer period of time. This cycle repeats until the malfunction is corrected. This pulse mode causes either a "ticking" or a "chirping" sound. Whenever either of these sounds is heard, turn off the R7103 and proceed with the Preliminary Procedure, which follows.

PRELIMINARY PROCEDURE

WARNING

To avoid electric shock, always disconnect the instrument from the power source before removing or replacing components or plug-in units.

1. Remove all plug-in units from the mainframe.

2. Set the CONTROL ILLUMINATION switch on the rear panel to the Off position, and the GRAT ILLUM switch on the front panel to the fully counterclockwise position.

3. Remove the power supply from the mainframe following the procedure given later in the Corrective Maintenance part of this section under Removing and Replacing Parts.

4. Connect the power-cord plug of the R7103 to the output of a variable autotransformer set for 115 volts. Connect the autotransformer to an isolation transformer and plug the isolation transformer into a 115-volt power source.

5. Push the R7103 POWER button in (to turn the instrument on) and note the trouble symptoms.

6. Turn the R7103 off and proceed to the appropriate step in the Troubleshooting Procedure as indicated by the Trouble Symptoms column in Table 4-1.

TROUBLESHOOTING PROCEDURE

Step A: Check Line Fuse

To check the line fuse, proceed as follows:

1. Check the line fuse (F10), which is located on the rear panel of the power-supply, for continuity and proper rating as given in Section 7, Replaceable Electrical Parts.

2. If the line fuse is open, replace it with a new fuse of proper rating.

Step B: Isolate Malfunction from the Mainframe Circuitry

To isolate the malfunction proceed as follows:

WARNING

Use extreme caution when troubleshooting the power supply to avoid electric shock. Stored dc potentials on the A23-Inverter circuit board remain long after the instrument is disconnected from the power source. Verify that the power-cord plug is disconnected and that the line storage capacitors (A23C16 and A23C17) are completely discharged before attempting any repairs or resistance measurements. (A warning-indicator neon bulb, located on the A23-Inverter Board, flashes when this stored voltage exceeds about 80 volts. However, simply because the neon bulb is not flashing does not mean that the capacitors are fully discharged.)

1. Check the voltage at the collector of A17Q864 on the Vertical Amplifier Board. This voltage should be close to ground potential. If it is more positive than +1 V, there is probably a fault in the Vertical or Horizontal Amplifier or in the Chassis Mounted Thermal Cutout switch, S70 (shown on diagram 9).

TABLE 4-1
Recommended Power Supply Troubleshooting Sequence

Trouble Symptom	Procedure	Proceed to Troubleshooting Step:
R7103 inoperative; no pulse mode.	1. Check line fuse.	A
R7103 inoperative; no pulse mode; line fuse open.	1. Check line input circuit.	D
	2. Check LV rectifier circuit.	H
	3. Check inverter circuit.	G
R7103 inoperative; no pulse mode; line fuse normal.	1. Check inverter circuit.	G
R7103 operating in the pulse mode.	1a. Check +50 V Power Supply Shutdown circuit on A17 Vertical Amplifier Board, diagram 9.	B
	1b. Isolate malfunction from the mainframe circuitry.	B
	2. Check pre-regulated power supplies.	C
	3. Check crt and high-voltage circuits.	E
	4. Check inverter control circuit.	F
	5. Check inverter circuit.	G

2. Remove the R7103 power-cord plug from the power source.

3. Remove the protective cover from the power supply following the procedure under Access to Components in the Power Supply. This is located in this section under Removing and Replacing Parts.

4. Manually discharge the line storage capacitors using the procedure called Access to Components in the Power Supply. A two-step procedure at the end of this part describes the safest method of discharging A23C16 and A23C17.

5. Check the resistance of the power supplies at the test points given in Table 4-2. The Power Supply test points are located on the A25 Regulator Board; see Figure 8-25 in the Diagrams and Circuit Board Illustrations section.

NOTE

Connect the Common lead of the ohmmeter to ground when measuring power-supply resistance.

6. If any resistance reading is significantly lower than that listed, remove the electrical connections between the mainframe and the power-supply. Disconnect P17, P82, and P83 on the A25 Regulator Board. This isolates the circuitry in the mainframe from the power supply. Recheck the resistance. If the readings remain low, the malfunction is located within the mainframe circuits. If the readings increase to normal or above, the malfunction is in the power supplies.

7. Replace all electrical connections which were disconnected in part 6.

Step C: Check the Pre-Regulated Power Supplies

To check the pre-regulated power supplies, proceed as follows:

1. Connect a 10X voltage probe from the test oscilloscope to resistor R84 on the A24 Control Rectifier Board. (Refer to Access to Components in the Power Supply for access to the A24 Control Rectifier Board, and see the component locator, opposite diagram 14 in Section 8, Diagrams and Circuit Board Illustrations, for the location of A24R84.) Set the test oscilloscope vertical deflection factor as necessary for an on-screen display; set the Time/Div to 2 ms.

2. Set the variable autotransformer to 115 volts. Connect the R7103 power-cord plug to the variable autotransformer; turn on the R7103.

TABLE 4-2
Typical Power-Supply Resistance

Power Supply	Test Point*	Ohmmeter Scale	Typical Resistance Readout
+50 V	TP891	2k	≥1.05 kΩ
+15 V	TP893	2k	≈0.115 kΩ
+5 V	TP895	2k	≈0.005 kΩ
−15 V	TP897	2k	≈0.19 kΩ
−5 V	TP899	2k	≥0.59 kΩ

***See schematic diagram 9.**

TABLE 4-3
Burst Voltage Test Points

Pre-Regulated Power Supply	Test Point Located on A24 Control Rectifier Board
+108 V	TP126
+54 V	Pin 4 of P52
+17 V	Pin 6 of P52
−17 V	Pin 2 of P52
+8 V	Pin 7 of P50
−54 V	Pin 3 of P52
+5 V Lights	Pin 10 of P82 on A25 Regulator Board

3. Compare the waveform on the test oscilloscope to those shown in Figure 4-4. If the waveform resembles that of Figure 4-4A, proceed to Step E of this procedure. If it resembles that of Figure 4-4B, proceed with part 4 of this step.

4. Disconnect the 10X voltage probe from A24R84. Set the test oscilloscope vertical coupling to dc and the Time/Div to 10 ms.

5. Connect the 10X probe to each power supply at the Burst Voltage Test Points given in Table 4-3. (To locate the Burst Voltage Test Points, refer to the component locator for the A24 Control Rectifier Board, which is shown on diagram 14 in Section 8, Diagrams and Circuit Board Illustrations.) Note the polarity, amplitude, and shape of the waveform present at each test point. (Adjust the vertical deflection factor of the test oscilloscope as necessary to maintain an on-screen display.)

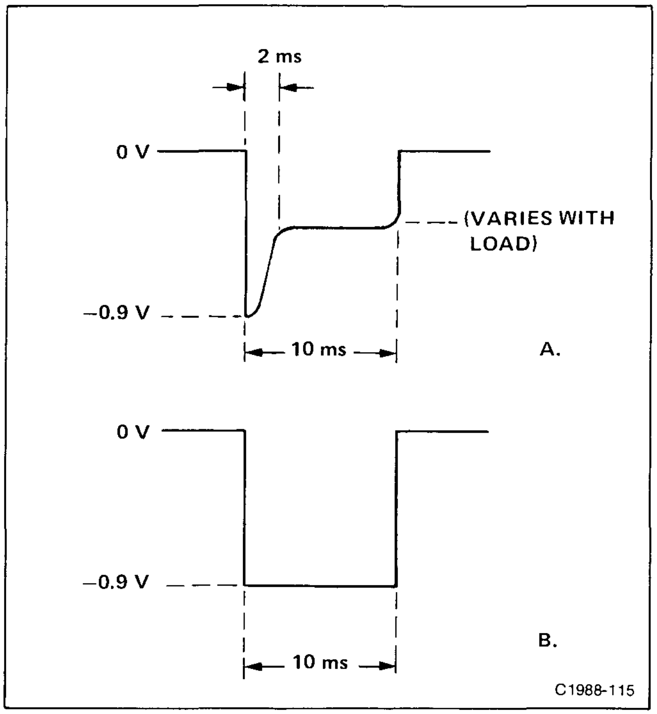


Figure 4-4. Current sensing waveform at A24R84 showing: A. Power supplies not in current limit operation. B. Power supplies in current limit operation.

NOTE

Look for a power supply output whose burst voltage is very low in relation to the specified supply voltage.

6. When a low supply voltage is found, disconnect the R7103 from the power source and discharge the line storage capacitors following the procedure given under Access to Components in the Power Supply. Check for shorted components in the suspected power supply; also check the filter capacitors for leakage.

Step D: Check Line Input Circuit

To check the input circuit, proceed as follows:

1. Disconnect the R7103 from the variable autotransformer and discharge the line storage capacitors as described under Access to Components in the Power Supply.

2. Replace the line fuse.

3. Check diode bridge CR15 on the A23 Inverter Board and the associated line input circuit for a shorted component. If the circuit appears normal, connect the power cord to the variable autotransformer.

4. Connect a test probe from the digital multimeter to one of the screws used to discharge A23C16 and A23C17 (see Fig. 4-11). Connect the other test lead to ground. Set the variable autotransformer to 20 volts and turn the R7103 on.

5. Check for a multimeter reading of about 27 V dc. Move the probe tip to the other capacitor screw. Check for a dc voltage which is equal and opposite in polarity from the previous voltage. (This checks the condition of the line storage capacitors.)

Step E: Check Crt and High-Voltage Circuit

To check the crt circuitry, proceed as follows:

1. Disconnect the R7103 from the power source and discharge the line storage capacitors following the procedure given under Access to Components in the Power Supply.

2. Remove multi-lead cable P40 from the A24 Control Rectifier board.

3. Set the variable autotransformer for 115 volts. Connect the R7103 power-cord plug to the variable autotransformer; turn the R7103 on.

4. Check for stable operation (no pulse mode) of the power supplies. If the power supplies operate properly, a crt failure or malfunction in the high-voltage circuitry is indicated.

Step F: Check the Inverter Control Circuit

To check the inverter control circuit, proceed as follows:

1. Disconnect the R7103 from the power source and discharge the line storage capacitors as described in Access to Components in the Power Supply, later in this section.

2. Remove Q54 from the A24 Control Rectifier Board.

3. Connect the R7103 power-cord plug to the variable autotransformer. Turn the R7103 on and apply 115 volts from the variable autotransformer. If the power supplies stabilize, check the inverter control circuit for a malfunction. If the R7103 continues in pulse mode, proceed to part 4 of this step.

4. Repeat part 1 of this step. Then remove Q52 from the A24 Control Rectifier Board.

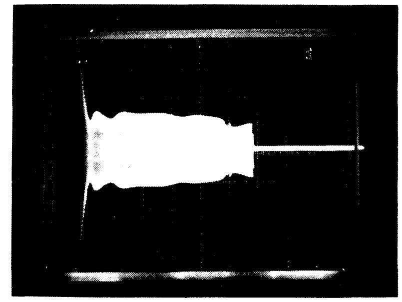
5. Set the variable autotransformer to 0 volts. Connect the R7103 power-cord plug to the variable

autotransformer. Turn the R7103 on. While monitoring the +108 V test point on the A25 Regulator Board with a voltmeter, slowly increase the output of the variable autotransformer until the voltmeter just reads +108 volts. (The 108-volt test point is accessible through the A12R93 Pre Reg Adj hole, marked R1293 on the panel, in the bottom of the Power Supply.)

NOTE

If the variable transformer output is increased past the point where the voltmeter just reaches a reading of +108 volts, the R7103 will switch to pulse mode.

6. If the power supplies stabilize, check A24U75 and the inverter control circuit for a malfunction. If the R7103 continues in the pulse mode, proceed to Step G of this procedure.



C1988-103

Figure 4-5. Current waveform at A23T30 showing burst operation at line voltage of about 60 V.

Step G: Check Inverter Circuit

To check the inverter circuit, proceed as follows:

1. Disconnect the R7103 power-cord plug from the power source and discharge the line storage capacitors following the procedure given under Access to Components in the Power Supply.

2. Remove Q34, Q40, CR34, and CR41 on the A23 Inverter Board and check the characteristics of each with a curve tracer. Install the checked or replaced components in the A23 Inverter Board. Replace the line fuse, if it is open.

3. If the faulty component was not found, check A23Q43, A23Q45 and A23VR45 with a curve tracer.

NOTE

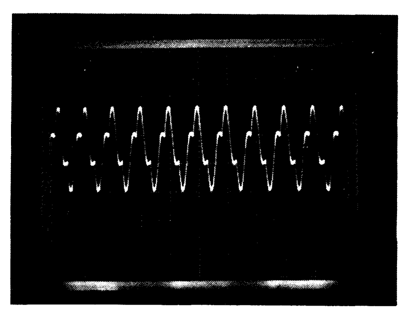
A shift in the zener voltage of A23VR45 can cause erratic operation of the inverter circuit.

4. If the R7103 continues in the pulse mode or keeps blowing line fuses, check the current waveform through T30 on the A23 Inverter Board. To do this, first repeat part 1 of this step. Then connect a current probe from the test oscilloscope to the gray lead that passes through toroid transformer T30. Set the test oscilloscope for a vertical deflection factor of about 1 volt/division and a horizontal sweep rate of 2 milliseconds/division. Connect the R7103 power-cord plug to the variable transformer which is set for 0 volt. Turn the R7103 on and slowly increase the variable autotransformer's output to about 60 volts. Check for a burst waveform on the test oscilloscope (similar to that shown in Fig. 4-5).

NOTE

The burst waveform indicates that the inverter circuit is attempting to start. If no burst waveform occurs, proceed to part 6; if a burst waveform is obtained, proceed to part 5.

5. If a burst waveform was obtained in part 4 above, check for stable inverter operation when the line input voltage is increased to about 85 volts. Figure 4-6 shows the current waveform at A23T30 for normal inverter operation at a line source of 115 volts. (NOTE: The test oscilloscope horizontal sweep rate has been changed to about 50 microseconds/division for Fig. 4-6.)



C1988-104

Figure 4-6. Current waveform at A23T30 for normal inverter operation at line voltage of 115 V.

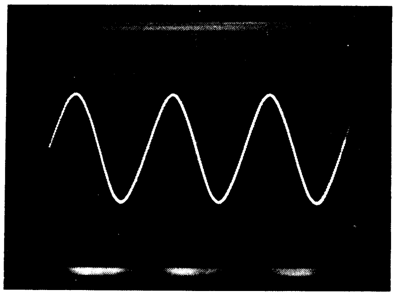


Figure 4-7. Waveform at TP34 on the Power-Supply Inverter board with the line voltage at about 20 V.

6. If no burst waveform occurred in part 4, repeat part 1 of this step. Then remove the current probe from the R7103 and the test oscilloscope. Connect a 10X voltage probe from the test oscilloscope to TP34 on the A23 Inverter Board (provided that access to that board has already been gained, remove the line inverter shield from the circuit board. TP34 is marked "TANK" on the A23 Inverter Board.) Set the variable autotransformer for 20 volts and check for a line-ripple waveform which is about dc centered (see Fig. 4-7). If the waveform is not centered check Q46, CR32, CR40, CR249, and CR45 on the A23 Inverter Board for shorts or leakage.

Step H: Check LV Rectifier Circuit

1. Disconnect the R7103 power-cord plug from the power source and discharge the line storage capacitors in the power supply, following the procedure given under "Access to Components in the Power Supply." Inspect the A24 Control Rectifier Board and connecting cables for shorts and damaged components.

2. Remove dual diode CR151 from the A24 Control Rectifier Board and check with a curve tracer. Reinstall tested or replaced parts, making certain that the case is not shorted to the heat sink.

3. Lift one lead each of CR140, CR141, CR142, and CR143 on the A24 Control Rectifier Board and check with a curve tracer. Reconnect tested or replaced parts.

4. Lift one leg each of CR130, CR131, CR132, CR133, CR150, and CR153 on the A24 Control Rectifier Board and check with a curve tracer. Reconnect tested or replaced parts.

5. Check the electrolytic capacitors which filter the supplies, including A24C154 (under the board) for short circuits.

TROUBLESHOOTING THE CRT AND ASSOCIATED CIRCUITRY

The following information is provided to facilitate troubleshooting the crt connections and associated circuitry, and is designed to prevent unnecessary crt replacement. Information in Section 3, Theory of Operation, should be used in conjunction with this procedure to aid in locating troubles.

WARNING

Extreme caution must be used when troubleshooting the crt and associated circuitry due to the high voltage present in this area of the instrument.

CRT DISPLAY SYMPTOM CHECKOUT PROCEDURE

Perform the following procedure to determine the display symptoms associated with a crt circuit failure. Then proceed to the appropriate step in the CRT Circuit Troubleshooting Procedure as indicated by the Trouble Symptom column of Table 4-4.

Preliminary Setup:

1. Set the R7103 front-panel controls as follows:

POWER	OFF
INTENSITY	Counterclockwise
FOCUS	Midrange
READOUT	OFF
VERTICAL MODE	RIGHT
BEAMFINDER	Pushbutton in

2. Connect the R7103 to a power source that meets the voltage and frequency requirements of the instrument.

3. Install a Tektronix 7A-series amplifier in the RIGHT VERT compartment.

4. Install a Tektronix 7B-series time-base in the HORIZ compartment and set it to 1 ms/div. Set triggering controls for a free-running sweep.

TABLE 4-4
Recommended CRT Circuitry Troubleshooting Sequence

Trouble Symptom	Recommended Procedure	Proceed to Step:
1. Bright display; no response with INTENSITY controls.	1. Check CRT Grid; pin 3.	R
	2. Check Grid Bias Supply circuit.	E
	3. Check Control Grid DC Restorer circuit.	G
	4. Check Z-Axis Amplifier circuit.	I
2. No waveform or readout display.	1. Check Anode Voltage Multiplier output.	A
	2. Check CRT Heater supply.	B,T
	3. Check Microchannel Plate Supply circuit.	C
	4. Check −2400 Volt Supply circuit.	D
	5. Check Grid Bias Supply circuit.	E
	6. Check Z-Axis Amplifier circuit.	I
	7. Check Intensity Limiter circuit.	J
	8. Check Grid Crowbar circuit.	F
	9. Check Control Grid DC Restorer circuit.	G
	10. Check CRT First Anode, Second Section	P
3. No waveform display; readout display only.	1. Check Intensity Limiter circuit.	J
4. Display only at sweep speeds below 5 μs/div.	1. Check CRT Grid, pin 3.	R
5. Dim display.	1. Check Microchannel Plate Supply circuit.	C
	2. Check Grid Crowbar circuit.	F
	3. Check Z-Axis Amplifier circuit.	I
	4. Check Intensity Limiter circuit.	J
	5. Check Grid Bias Supply circuit.	E
	6. Check Anode Voltage Multiplier output.	A
	7. Check First Anode, First Section.	U
6. Display intensity varies during warmup.	1. Check Grid Bias circuit.	L
7. Geometry or linearity unsatisfactory.	1. Check CRT Scan Expansion Lens.	O
8. Focusing problems; charging phenomena may be observed.	1. Check Focus Grid DC Restorer circuit.	H
	2. Check following CRT pin connections:	
	a. Astigmatism, pin 10.	X
	b. Stigmator, pin 11.	V
	c. First Anode, First Section, pin 7.	U
	d. D1-D2 Shield, P1813-pin 5.	W
	e. Focus Electrode, pin 4.	Q
	f. Spot Demagnification Lens, pin 5.	Y
	g. Cathode, pin 2.	S
	h. Isolation Shield, P1813-pin 6.	N
9. Waveform and readout displays do not focus simultaneously.	1. Check Auto Focus circuit.	K
10. Low writing rate.	1. Check Microchannel Plate Supply circuit.	C
	2. Check Grid Bias Supply circuit.	E
	3. Check Anode Multiplier circuit.	A
11. Unacceptable background scintillation appears in photographs.	1. Check Microchannel Plate Supply circuit.	C
12. Display present with background glow.	1. Check CRT Exit Electrode.	M

5. Press the POWER switch to the On (locked in) position. If a trace appears on the crt, turn the POWER switch Off and disconnect P1702 (crt heater). See Trouble Symptom #1 in Table 4-4.

6. Rotate the INTENSITY and READOUT INTENSITY controls clockwise to about midrange.

   a. If no display appears on the crt, turn the POWER switch Off and disconnect P1702 (crt heater). Refer to Trouble Symptom #2 in Table 4-4.

   b. If only the readout portion of the display appears on the crt, refer to Trouble Symptom #3 in Table 4-4.

   c. If the intensity of the displayed trace appears to change during warmup, refer to Trouble Symptom #6 in Table 4-4.

   d. If the displayed trace appears dim with the INTENSITY control set fully clockwise, refer to Trouble Symptom #5 in Table 4-4.

7. Set the time base to 5 μs/div. Adjust the INTENSITY control for a visible display. Set the time base to 2 ns/div. If the display disappears and cannot be obtained with the INTENSITY control, refer to Trouble Symptom #4 in Table 4-4.

8. Rotate the INTENSITY control. If a charging phenomena appears on the display, refer to Trouble Symptom #8 in Table 4-4.

9. Perform the Geometry procedure in Section 5, Checks and Adjustments. If the crt geometry or linearity is unsatisfactory, refer to Trouble Symptom #7 in Table 4-4.

10. Perform the Photographic Writing-Rate procedure in Section 5, Checks and Adjustments.

   a. If the waveform and readout display focuses at different positions of the FOCUS control, refer to Trouble Symptom #9 in Table 4-4.

   b. If the photographic writing rate is unsatisfactory, refer to Trouble Symptom #10 in Table 4-4.

   c. If the photograph indicates background scintillation, refer to Trouble Symptom #11 in Table 4-4.

CRT CIRCUIT TROUBLESHOOTING PROCEDURE

Step A: Check Anode Voltage Multiplier

1. Check that the anode lead is properly installed.

2. Turn the INTENSITY controls counterclockwise.

3. Turn the instrument off, disconnect the anode lead. Watch for an arc while you short the anode lead to the chassis. An arc indicates that the Anode Voltage Multiplier is at least partially working.

NOTE

If the crt anode is open, the screen capacitance will not be charged and an arc will not be drawn when the anode is discharged to ground.

4. Turn the instrument on and measure the anode voltage. The voltage should measure approximately 12.5 kV.

NOTE

The output impedance of the anode supply is 100 MΩ. When measuring the anode voltage the loading of the voltmeter should be taken into account. Due to the 100 MΩ output impedance, the Anode Voltage Multiplier is short-proof.

5. Check the input voltage to the Anode Voltage Multiplier at A22R1750. This should be a square-wave signal roughly centered about ground with an amplitude of 2500 volts peak-to-peak and a frequency of approximately 25 kHz. If this voltage is correct, turn the instrument off and remove the A22 High Voltage board (see Fig. 8-1 in the Diagrams and Circuit Board Locators section for the board location). Check to see if the input and ground leads of the A22V1700 Anode Voltage Multiplier are connected.

6. Replace the A22 High Voltage Board.

Step B: Check CRT Heater Supply

1. Check for loose connections to the crt. Then check to see if the heater glows.

WARNING

Potential shock hazard exists when measuring the heater supply. The heater supply is elevated to −2265 volts.

2. Disconnect harmonica P1702 and measure the heater voltage with a true rms voltmeter. The voltage should be 6.3 volts rms; frequency about 25 kHz. If a low reading of the supply is obtained, the high voltage transformer may be defective.

3. Turn the instrument off. Check for continuity between pins 1 and 2 of P1702, and between pins 1 and 14 of the crt.

Step C: Check Microchannel Plate (MCP) Supply

WARNING

Potential shock hazard exists: the MCP voltage can be as high as +1200 volts.

1. Visually check for loose connections on the High Voltage Board. (See Fig. 8-1 in the Diagrams and Circuit Board Locations section for board location.)

2. Turn the INTENSITY control counterclockwise. Measure the MCP output voltage at A22TP1775 and note the reading.

3. Turn A22R1720 (MCP Gain) clockwise. The voltage reading should be about 860 volts. Turn A22R1720 counterclockwise. The voltage reading should be about 460 volts. Reset A22R1720 to the voltage reading noted in part 2.

   a. If the MCP voltage at A22TP1775 is low, ground A22TP1707 and again note the MCP voltage reading. If the voltage now reads about 1250 volts: check components A22Q1708, A22U1714A, A22CR1707, A22CR1708, A22C1707 and A22C1708. If the voltage is still low, check components A22CR1710, A22CR1711, A22C1710, and A22C1711.

   NOTE

   With A22TP1707 grounded, the voltage at the secondary of the MCP transformer should be a square wave of about 625 volts peak.

   Remove the ground from A22TP1707.

4. Remove the plug-in unit from the horizontal compartment. Turn the INTENSITY control fully clockwise. The MCP output voltage (at A22TP1775) should increase by about 350 volts.

5. If the MCP voltage measurements are correct, check for a loose connection to the microchannel plate at the crt (P1819, pins 3 and 7). This can be done without removing the crt by connecting a DVM across resistors A22R1725 and A22R1726 and checking for about 10 volts. Typically, the voltage reading is around 10 volts, corresponding to a current of 50 μA. If no current flows, remove the crt and check for open connections.

Step D: Check -2400 Volt Supply

WARNING

To avoid electric shock, use extreme caution when troubleshooting the -2400 Volt Supply.

1. Check the voltage at TP1844 on the A22 High Voltage board.

   a. If the reading is -2400 volts, within 5 volts, the supply is operating properly.

   b. If the reading is more than 5 volts from -2400 volts, check the cathode supply at A22TP1846 for -2265 volts. If necessary, adjust A22R1805 (-2265 V Adjust) to -2265 volts. If the adjustment has no effect, check the high-voltage regulator A22Q1784 (see below). If the adjustment has some effect but fails to obtain -2265 volts at A22TP1846, the Grid Bias Supply may not be functioning properly. See Step E: Check Grid Bias Supply.)

   c. If the reading is near ground, check:

      (1) For a 2500 volt (p-p) square-wave signal at the junction A22R1750 and pin 9 of A22T1770 with the other end of the winding pin 7) held near ground. If the appropriate signal is not obtained, check diodes A22CR1776, A22CR1778, and A22VR1784.

      (2) Check the voltage doubler by removing regulator transistor A22Q1784. The dc voltage at A22TP1844 should be approximately -2300 volts. If not, check diodes A22CR1762, A22CR1763 and capacitors A22C1750 and A22C1764.

      (3) Check the regulator transistor A22Q1784 and zener diode A22VR1784. With transistor A22Q1784 removed, the voltage at A22TP1784 should be 200 volts dc.

      (4) Check operational amplifier U1802.

      (5) Check the -2265 Adjust, A22R1805. Remove the regulator transistor A22Q1784 and connect a DVM to A22TP1806. Moving A22R1805 throughout its range should cause a dc voltage change of about 200 mV. Check for shorted or opened resistors if the 200 mV change is not obtained.

      (6) Check the thick-film high-voltage resistor A22R1802.

Step E: Check Grid Bias Supply

WARNING

Potential shock hazard exists when measuring the Grid Bias Supply; the DVM is elevated to -2400 volts.

1. Place a voltmeter between A22TP1846 (−2265 volts) and A22TP1844 (−2400 volts). Check for a reading of 137 volts, within 5 volts.

   a. If the voltage is low (approximately 60 to 70 volts), check A22Q1838, A22Q1842, and A22C1846 for short circuits. Then check A22Q1835 for an open junction.

   b. If the voltage is high (approximately 200 volts), check A22Q1842 and A22Q1838 for an open junction.

   c. If the voltage is more than 5 volts from 175 volts, check transistors A22Q1835, A22Q1838, and A22Q1842 on a curve tracer. Check capacitor A22C1846 for leakage by lifting one end of the capacitor from the circuit board and remeasuring the Grid Bias Supply voltage.

Step F: Check Grid Crowbar Circuit

WARNING

Potential shock hazard exists when working on the Grid Crowbar circuit since it is elevated to −2400 volts.

1. Remove transistor A21Q1687 and check for a display. If a display is obtained, check A21Q1687 on a curve tracer. If a display is not obtained, check A21C1687 for leakage.

CAUTION

To ensure crt cathode protection, check the Grid Crowbar circuit for proper operation.

Step G: Check Control Grid DC Restorer

WARNING

Turn instrument power off before attempting to service high-voltage circuits.

1. Set the time base for a 20 μs/div, free-running sweep.

2. Check that the waveform at the junction of A22R1811 and A22CR1747 is similar to that shown in Figure 4-8.

NOTE

A typical waveform at this junction is a square wave with a frequency of about 25 kHz. The positive level should not exceed +50 volts and the negative level should be more positive than −50 volts.

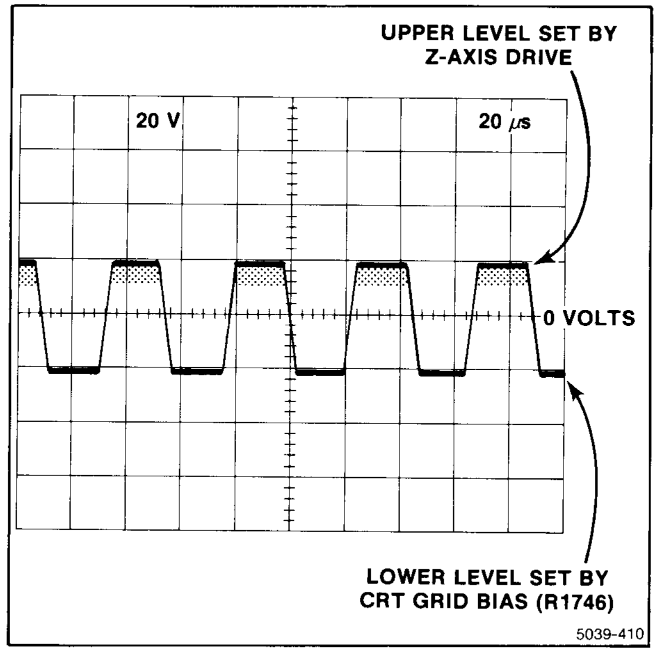


Figure 4-8. Typical waveform at junction of R1811 and CR1747 on the A22 High Voltage Board.

If the waveform is not like that of Figure 4-8, check the Z-Axis Amplifier by advancing the INTENSITY setting; the positive level of the square wave should also rise until the Intensity Limiter limits the Z-Axis drive. Then check the Grid Bias circuit by changing the setting of CRT Grid Bias adjustment R1746; the negative level of the square wave should also change.

a. If the square wave appears normal, but the display is bright and not subject to the INTENSITY control, check for an open crt grid.

b. If the positive level of the square wave exceeds +50 volts and the display is bright regardless of the INTENSITY control, the low-frequency signal from the Z-Axis Amplifier is disconnected from the Control Grid DC Restorer. Check diode A22CR1749 for an open, then check for loose connections.

c. If the negative level of the square wave is more negative than −50 volts and the display is bright regardless of the INTENSITY control, the Grid Bias circuit is disconnected from the Control Grid DC Restorer. Check A22CR1747 for an open.

d. If the square wave appears normal, but no display can be obtained, check A22CR1792, A22CR1794, and A22C1793 for an open.

e. If the waveform is a dc level which varies with the

Z-Axis Amplifier output and no display can be obtained, check A22CR1794 for a short.

f. If the square wave amplitude is about 10 to 20 volts and can be positioned with the CRT Grid Bias adjustment, A22R1746, but no display can be obtained, check A22CR1747 for a short.

g. If the square-wave amplitude is about 10 to 20 volts, and cannot be positioned with CRT Grid Bias adjustment or the INTENSITY control, and no display can be obtained, check A22CR1792 and CR1794 for a short.

h. If the square wave appears normal but the INTENSITY control has no effect on its positive level, check the Z-Axis Amplifier circuit.

i. If the square wave appears normal but a display can be obtained only with the INTENSITY control fully clockwise, the Grid Bias circuit is not functioning. Check A22Q1748 and A22Q1742.

j. If the waveform is not normal and no display can be obtained, the high-voltage transformer is not driving the Control Grid DC Restorer. Check the resistor string of A22R1811, A22R1812, A22R1788, and A22R1789.

Step H: Check Focus Grid DC Restorer

WARNING

Turn instrument power off before attempting to service high voltage circuits.

1. Check that the waveform at the junction of R1814 and CR1816 is similar to that shown in Figure 4-9.

NOTE

A typical waveform is a square wave of about 25 kHz. The negative level should be -0.7 volt. The positive level is determined by the setting of the front-panel FOCUS control and can be anywhere between +0.7 volt and +50 volts.

a. If the negative level of the waveform is more negative than -50 volts, check diode A22CR1816 for an open.

b. If the positive level of the waveform exceeds +50 volts, check diode A22CR1820 for an open circuit.

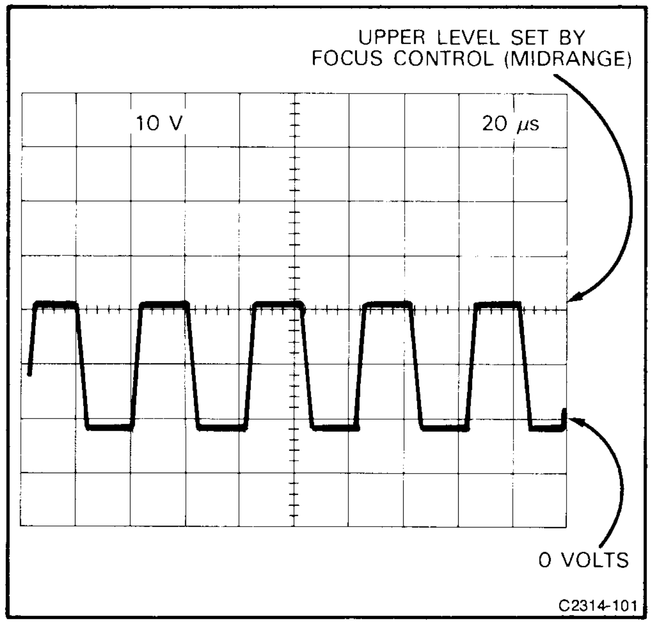


Figure 4-9. Typical waveform at junction of R1814 and CR1816 on the A22 High Voltage Board.

c. If the amplitude of the waveform is small and the FOCUS control has no effect on the positive level of the waveform, check A22CR1816 for a short circuit.

d. If the amplitude of the waveform is small and the FOCUS control can vary the positive level from 0 to +50 volts, check A22CR1820 for a short circuit.

e. If the waveform is not as shown in Figure 4-9 and the dc level is above ground with the FOCUS control at midrange, check diode CR1818 or CR1819 for a short.

f. If the waveform is not as shown in Figure 4-9, the Focus Grid DC Restorer may not be receiving drive signal from the high voltage transformer. Check resistors A22R1788, A22R1789, A22R1813, and A22R1814.

g. If the waveform appears normal but the display has focusing problems, check for an open crt focus electrode. Then check for proper adjustment of the Focus Preset and for defective resistors in the focus string. Check A22CR1819, A22CR1818, and A22C1819 for an open circuit.

NOTE

The focus-preset voltage, across A22C1820, ranges from about -1385 volts to -1560 volts as determined by the setting of the Focus Preset A22R1825.

Step I: Check Z-Axis Amplifier

1. Check A21TP1678, on the Z-Axis Board, for a waveform with a baseline at +8 volts, within 1 volt, and an amplitude of at least 55 volts above the baseline.

NOTE

To obtain maximum Z-Axis drive without engaging the Intensity Limiter, set the time-base Time/Division control fully clockwise and position the trace off the crt screen. Refer to Z-Axis and Display in Section 5, Checks and Adjustment, to properly adjust the Z-Axis Amplifier.

2. Check the dc voltage at A21TP1672. The voltage should be +75 volts, within 5%. If it is not, check transistor A21Q1672 and zener diode A21VR1671.

3. If the voltage at A21TP1672 is about +60 volts and the display intensity is high, check the voltage at the collector of A21Q1608: the baseline should be at +1.6 volts, and the signal amplitude should be about 700 mV.

   a. If the conditions in part 3 are met, check transistors A21Q1648, A21Q1668, and A21Q1676.

   b. If the conditions in part 3 are not met, check transistors A21Q1608 and A21Q1618 for a short.

4. If the voltage at A21TP1678 is at ground and no display can be obtained, the Intensity Limiter may be inhibiting the Z-Axis Amplifier by saturating A21Q1644, or A21Q1644 may be shorted. Check A21Q1644.

   a. If the baseline voltage at the collector of A21Q1608 is not at +1.6 volts and the signal amplitude is not about 700 mV, check A21Q1626, A21Q1608, A21Q1632, and A21Q1603.

   b. If the signal is correct, check transistors A21Q1668 and A21Q1644 for a short circuit.

Step J: Check Intensity Limiter

NOTE

When troubleshooting the Intensity Limiter circuit, flood the crt display with many cycles of a large amplitude sine wave.

1. If the Intensity Limiter is inhibiting the Z-Axis Amplifier, check the Z-Axis Off signal at A1TP1992 (on the A1 Front-Panel Board) On a properly operating instrument the signal level at A1TP1992 is +120 mV; on an instrument which is shut-down the signal level is +3.4 volts.

   a. If the signal at A1TP1992 is +120 mV, the fault is in the Z-Axis Amplifier. (Refer to Step I: Check Z-Axis Amplifier.)

   b. If the reading is +3.4 volts, check pin 2 of A1U1992 (the flip-flop may not be receiving a reset). Check A1U1992 by replacing it.

2. Check that operational amplifier A1U1952 converts the average screen current to a dc voltage at a rate of 1 μA/volt. With the INTENSITY control turned fully counterclockwise, the voltage at A1TP1952 should be zero volts; it should increase as the INTENSITY control is advanced. If this does not occur, check the Screen I Sense connection to the Anode Voltage Multiplier. (When the INTENSITY control is advanced, a negative voltage should be measured at pin 8 of A1P1904. If zero volts is measured here, either the connection is open or the Anode Voltage Multiplier is defective.) Also check A1U1952.

3. Turn the INTENSITY control clockwise until the LIMITED VIEWING TIME indicator turns on steadily, and observe that this occurs when the voltage at A1TP1952 is approximately +0.2 volt dc (0.2 μA of average screen current).

   a. If the condition in part 3 is not met, check that the voltage at pin 6 of A1U1958B is +0.2 volt dc. Measure the voltage at A1TP1962; with zero screen current the reading should be about −12 volts. When the INTENSITY control is advanced and the average screen current exceeds 0.2 μA, the reading should be about +12 volts. If the readings are much different, check operational amplifier A1U1958 by replacing it.

   b. If the condition in part 3 is not met, check for a loose connection to the LIMITED VIEWING TIME indicator (LED A1DS1970) Check A1DS1970.

   c. If the LIMITED VIEWING TIME indicator is on continuously (at zero screen current) and starts flashing at an average screen current above 0.2 μA, transistor A1Q1970 is shorted.

4. Advance the INTENSITY setting until the LIMITED VIEWING TIME indicator starts flashing, and observe that this occurs when the voltage at A1TP1952 is aproximately +2.0 volts dc, or 2 μA average screen current. If this does not occur, check the following:

a. Check 3 Hz Oscillator A1U1968; at zero screen current the voltage at A1TP1968 is about +12 volts, but will oscillate between ground and +12 volts when the INTENSITY control is advanced to the limited-viewing condition (LIMITED VIEWING TIME indicator is on steadily). If no oscillation occurs, check U1968 by replacing it.

b. The voltage at pin 2 of A1U1958A should be +2.0 volts dc.

c. Measure the voltage at A1TP1958. With zero screen current the reading should be at about −12 volts. When the INTENSITY control is advanced and the average screen current is 2 μA, the voltage reading should have increased to at least −8.0 volts dc. If the readings are much different, check operational amplifier A1U1958 by replacing it.

d. Check transistor A1Q1970 for conduction.

5. Advance the INTENSITY setting until the LIMITED VIEWING TIME indicator just starts to flash. Observe that further advance of the INTENSITY control does not increase the display intensity and that limiting is taking place. (With proper limiting, the voltage at A1TP1956 is −10.6 volts and increases towards ground when limiting occurs.) If this does not occur, check the following:

a. Check transistor A1Q1956 for a short circuit.

b. Check for proper connection of the Intensity Reference line (pin 4 of P1904) to diode A5CR319 on the A5 Mode Switch Board. (See Fig 8-1 for location of the A5 Mode Switch Board.)

c. Check A5CR319 for an open circuit.

6. Advance the INTENSITY setting until the LIMITED VIEWING TIME indicator flashes. Check that after approximately one minute the SHUTDOWN indicator starts to flash. If this does not occur:

a. Check integrator A1U1970. With zero screen current, the voltage at A1TP1970 should be at ground or moving toward ground. Observe that when the INTENSITY setting is advanced until the LIMITED VIEWING TIME indicator is on steadily, the voltage starts moving toward −10 Volts. If the INTENSITY control is further advanced, the voltage slew rate should increase. The slew rate is maximum when limiting occurs (LIMITED VIEWING TIME indicator is flashing) and should be about 5 volts/minute. If this does not occur, one of the following failures may have occurred:

(1) The base of A1Q1980 is held at ground by either a shorted RESET button or by a shorted or saturated A1Q1999.

(2) Transistor A1Q1982 is not conducting.

(3) Transistor A1Q1978 is shorted.

(4) Operational-amplifier A1U1970 is defective.

(5) Field-effect transistor (FET) A1Q1974 is not conducting. This causes the voltage at A1TP1970 to stop at about −2.0 or −3.0 volts instead of −10 volts.

(6) Capacitor A1C1971 is leaking. The symptoms are similar to those for an open FET. Press the RESET button, then advance the INTENSITY control until limiting occurs. After about one minute, the voltage at A1TP1970 should be −10 volts. If this differs significantly, replace A1C1971.

(7) Check the 10-second delay timer. The voltage at A1TP1986 should measure zero volts at zero screen current. When the INTENSITY setting is advanced and the output of the integrator has reached about −10 volts, the voltage at A1TP1986 should jump to about +3.6 volts. After about 10 seconds, the voltage should drop to ground level. If this does not occur, check A1U1986 by replacing it.

(8) Check SHUTDOWN LED A1DS1994 for loose connections or failure.

7. Advance the INTENSITY setting until limiting occurs, and wait approximately two minutes until the SHUTDOWN indicator starts flashing. After approximately 10 seconds, the indicator should be on steadily and the display should shut down. If this does not occur:

a. Check transistor A1Q1995. This transistor should momentarily go out of saturation when timer A1U1986 has timed out.

b. Check flip-flop A1U1992. The voltage at A1TP1992 should increase from 0.1 volt to about +3.4 volts when timer A1U1986 has timed out.

c. Check transistor A1Q1994.

d. Check for a loose connection of the Z-Axis Off line (pin 1 of A1P1904) to the Z-Axis Amplifier.

e. Check transistor A1Q1644.

8. When the instrument is shut down, the voltage at A1TP1992 is about +3.4 volts dc. If pressing the RESET button does not restore the display, check the following:

   a. Check the RESET switch. The voltage at the base of A1Q1980 should be +2.3 volts and should drop to +0.2 volt when the RESET button is pressed.

   b. Check flip-flop A1U1992 by replacing it.

9. With the SHUTDOWN indicator flashing, shutdown can be prevented by reducing the average screen current to below 0.2 μ A (LIMITED VIEWING TIME indicator off). If this does not occur, check the following:

   a. Transistors A1Q1998 and A1Q1999.

   b. Ten-second delay timer A1U1986, if it does not reset.

Step K: Check Auto Focus Amplifier

1. Check the dc voltage at the emitter of A21Q1607. The voltage should be about -8.5 volts. If the voltage reading differs by more than 0.2 volts, check transistor A21Q1607 and diode A21CR1607.

2. Obtain a full-drive crt display that is not intensity limited. The front-panel LIMITED VIEWING TIME indicator should not flash.

3. Check the auto-focus signals at the collector of A21Q1603. With the INTENSITY control fully counterclockwise, the signal is clamped by diode A21CR1609 to a voltage of -7.9 volts. At about midrange of the INTENSITY control, diode A21CR1609 ceases to conduct. With the INTENSITY control fully clockwise, the waveform at the collector of Q1603 should have an amplitude of 0.9 volt. If not, check transistor A21Q1603 and diode A21CR1609.

4. Check the auto-focus signal at A21TP1628. With the INTENSITY control fully clockwise, the amplitude of the signal should be about 7 volts (depending upon the focus gain adjustment). If not, check transistors A21Q1629, A21Q1620, and A21Q1617.

5. Check the connection to the crt focus electrode.

Step L: Check Grid Bias Compensation

1. Turn the instrument off and discharge capacitor C1736 on the A22 High Voltage Board.

2. Connect a DVM to A22TP1736 and turn the instrument on. The voltage should be approximately +7.1 volts and should increase to +12.5 volts in 10 minutes. If the voltage is different, check the following:

   a. Check operational amplifier A22U1736 by replacing it.

   b. Check A22CR1736.

   c. Check A22C1736 for leakage.

   d. Check A22Q1742.

Step M: Check CRT Exit Electrode

1. The best way to detect an open exit electrode is with a magnified sweep and maximum Z-Axis drive. The duty cycle should be such that the LIMITED VIEWING TIME indicator stays lit.

2. Move the trace vertically and horizontally and look for a background glow. This glow indicates an open exit electrode.

Step N: Check CRT Isolation Shield (A22P1813, Pin 6)

1. Obtain a focused display, then turn the instrument off and disconnect pin 6 of A22P1813.

2. Turn the instrument back on; if the isolation shield is open, the display will now be out of focus.

Step O: Check CRT Scan Expansion Lens (A22P1810, A22P1819 Pin 10)

WARNING

Turn the instrument off before attempting to service the A22 High Voltage Board.

NOTE

The scan-expansion lens is connected to seven different high potentials. Six are negative, one is positive. If any of these elements is floating, obtaining a focused display is still possible. In addition to a focused trace, the display can show geometry problems, linearity problems, and low vertical or horizontal gain.

Because the lens draws no current, detecting an open element is difficult. To detect an open connection to the Horizontal Bowing element, adjust Horizontal Bowing and observe that the display is not affected. This is the only case where the voltage varies on one element only; the other elements are adjusted in pairs.

1. To detect an open scan-expansion lens, lift the 160-ohm series resistors on the A22 High Voltage Board one at a time and look for a change in the display. No change in the display indicates an open connection.

Step P: Check CRT First Anode, Second Section (Pin 8, CRT Socket)

An open first anode, second section, will result in no display. Some display flashing may be observed as the INTENSITY control is advanced.

Step Q: Check CRT Focus Electrode (Pin 4, CRT Socket)

When the crt focus electrode is open, the display is very badly defocused and the FOCUS control has no effect.

Step R: Check CRT Grid (Pin 3, CRT Socket)

The display is always bright and the Z-Axis has no control when the crt grid is open. Check the connection to pin 3 of the crt.

Step S: Check CRT Cathode (Pin 2, CRT Socket)

With an open crt cathode, the display defocuses when the Z-Axis drive is changed.

Step T: Check CRT Heater (Pin 1 and 14, CRT Socket)

No display is obtained if the crt heater is open. Turn off the instrument and check for continuity between pins 1 and 2 of P1702, then between pins 1 and 14 of the crt socket.

Step U: Check First Anode (Pin 7, CRT Socket)

If the first anode is open, the display is badly defocused and dim. Charging can be observed when changing the Z-Axis drive. The first anode draws current. On the A22 High Voltage Board, at the junction of A22R1896 and A22R1897, a voltage waveform can be observed which is related to the Z-Axis drive. The front-panel +GATE waveform is useful for establishing a relationship to the Z-Axis drive.

Step V: Check CRT Stigmator (Pin 11, CRT Socket)

If the crt stigmator is open, the display cannot be focused. If the instrument has been off for a few minutes, then turned on with the INTENSITY control at about midrange, the display at first is severely defocused and then slowly changes to a defocused display. If adjusting R1894 on the A22 High Voltage Board has no effect on the display, the stigmator is open.

Step W: Check CRT D1-D2 Shield (Pin 5, A22P1813)

If the D1-D2 shield is open, the display cannot be focused and charging effects are not noticeable. The D1-D2 shield is open if adjusting R1891 on the A22 High Voltage Board has no effect on the display.

Step X: Check CRT Astigmatism (Pin 10, CRT Socket)

With an open crt astigmatism element the display cannot be focused, but charging may be observed. The front-panel ASTIG screwdriver adjustment has no effect. Turn the FOCUS control to midrange, slowly turn the INTENSITY control to about midrange. The trace initially is defocused, then goes into focus and defocuses again. If the instrument has been off for some time, turn the FOCUS and INTENSITY controls to midrange, and turn on the instrument. Initially the display is very badly defocused then slowly drifts into focus and finally defocuses again.

Step Y: Check Spot Demagnification Lens (Pin 5, CRT Socket)

If the crt spot demagnification lens is open, the display is badly defocused and the FOCUS control has no effect.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in the R7103 Oscilloscope mainframe are given here.

OBTAINING REPLACEMENT PARTS

All electrical and mechanical part replacements for the R7103 can be obtained through your Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE

When selecting replacement parts, remember that the physical size and shape of a component may affect its performance in the instrument. All replacement parts should be direct replacements unless you know that a different component will not adversely affect instrument performance.

Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured for Tektronix, Inc. to our specifications. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. To determine manufacturer of parts, refer to Parts List, Cross Index Mfr. Code Number to Manufacturer.

When ordering replacement parts from Tektronix, Inc., include the following information:

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

SOLDERING TECHNIQUES

WARNING

To avoid electric-shock hazard, and instrument damage 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.

The desoldering and removal of parts is especially critical and should be done only with a vacuum solder extractor; preferably, one approved by a Tektronix Inc. Service Center.

Use wire solder with rosin core, 63% tin, 37% lead. Contact your local Tektronix Inc. representative or field office for approved solders.

Several of the R7103 circuit boards are multilayer. Conductive paths between the top and bottom board layers may connect with one or more of inner layers. If this inner conductive path is broken (due mainly to poor soldering practices), the board is unusable and must be replaced. Damage can void warranty.

CAUTION

Only an experienced maintenance person, proficient in the use of vacuum type desoldering equipment, should attempt repair of any board in this instrument.

When soldering on circuit boards or small wiring, use only a 15-watt, pencil-type soldering iron. A higher wattage soldering iron can cause the etched circuit wiring to separate from the board base material, and melt the insulation from small wiring. Always keep the soldering-iron tip properly tinned to ensure the best heat transfer to the solder joint. Apply only enough heat to make a good solder joint. To protect heat-sensitive components, hold the component lead with a pair of long-noise pliers between the component body and the solder joint.

The following technique should be used to replace components on the circuit boards.

Touch the tip of the vacuum desoldering tool directly to the solder to be removed.

CAUTION

Excessive heat can cause the etched circuit wiring to separate from the board base material.

Never allow the solder extractor to remain on the board for more than three (3) seconds. Solder wick, spring-actuated or squeeze-bulb solder suckers, and heat blocks (for multi-pin components) must not be used. Damage can void warranty

NOTE

Some components are difficult to remove from the circuit boards due to a bend placed in each lead during machine insertion of the component. The bent leads held the component in position during a flow-solder manufacturing process which soldered all components at once. To make removal of machine inserted components easier, first remove the solder from the joint, then straighten the leads of the component on the back of the circuit board using a small screwdriver or pliers.

When removing multi-pin components i.e., IC's, do not heat adjacent conductors consecutively (see Fig. 4-10). Allow a moment for the circuit board to cool before heating the next pin.

Bend the leads of the replacement components to fit the holes in the circuit board. Insert the leads into the holes in the board, or as originally positioned.

Touch the iron to the connection and apply enough solder to make a firm solder joint.

Cut off any excess lead protruding through the board.

Clean the areas around the solder connection with a flux removing solvent. Be careful not to remove the information printed on the circuit board.

REMOVING AND REPLACING PARTS

WARNING

To avoid electric-shock hazard, always disconnect the instrument from the power source before removing or replacing components or plug-in units.

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

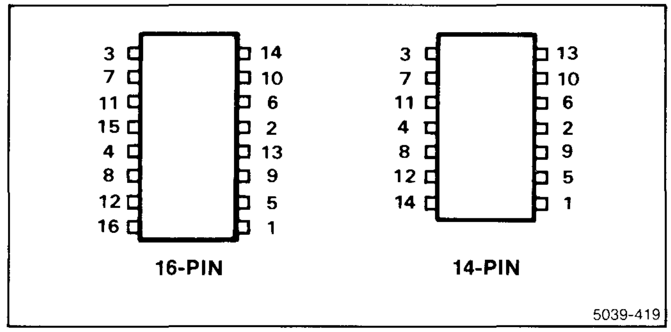


Figure 4-10. Recommended desoldering sequence.

HOW TO REMOVE THE POWER SUPPLY

The power supply can be removed from the rear of the R7103 for maintenance and troubleshooting. To remove the power supply from the mainframe, proceed as follows:

- Remove the four screws which hold the power supply to the rear frame of the instrument (see Fig. 4-11).
- Slide the power supply out of the mainframe until it can be set on the work surface (be sure to guide the interconnecting cables so they do not catch on other parts of the instrument).

The power supply remains electrically connected to the rest of the instrument in this position, allowing troubleshooting. If it is necessary to operate the R7103 with the power supply removed, we recommend that the power supply be secured to the instrument with spacers between the rear frame and the power supply.

To install the power supply into the mainframe, follow the removal procedure in reverse order. Be careful not to pinch the interconnecting cables. Be sure that all the securing screws are tight.

Access to Components in the Power Supply

To reach components inside the power supply for maintenance or repair, use the following procedure:

WARNING

Disconnect the R7103 from the power source and allow the line storage capacitors to discharge before removing the power supply cover. The line storage capacitors remain charged with high voltage dc for several minutes after the line power is disconnected unless they are manually discharged. A warning-indicator (neon bulb) located on the A23-Inverter board, flashes when this stored voltage exceeds about 80 volts. Do not remove the power supply cover while this light is flashing.

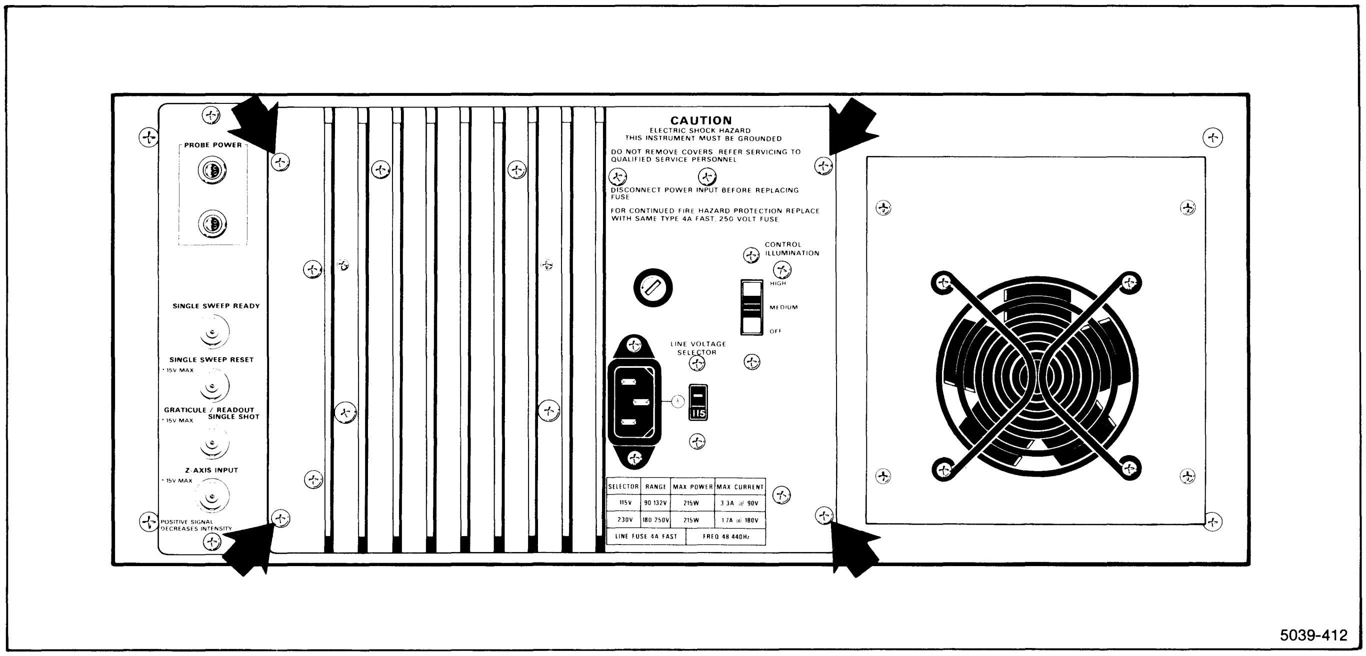


Figure 4-11. Screws that retain the Power Supply.

1. Remove the power supply as previously described.
2. Remove the four small screws that secure the cover to the rear heatsink.
3. Remove the nine screws that fasten the sides of the cover to the power-supply chassis.
4. Disconnect the two coaxial connectors from P1440 on A24 Control Rectifier Board.
5. Remove the cover from the power supply.
6. The power supply is now open for maintenance or repair. If the R7103 is to be operated with the cover removed, first reconnect the coaxial cables to the A24 Control Rectifier Board.
7. To replace the power-supply cover, follow the removal procedure in reverse order.

Before performing maintenance or taking resistance measurements in the power supply, manually discharge the line storage capacitors (A23C16 and A23C17) as follows:

- Remove the protective cover from the power supply as previously described.
- Apply a 1.5-kilohm, 2-watt, insulated resistor across the capacitor screws as shown in Figure 4-12.

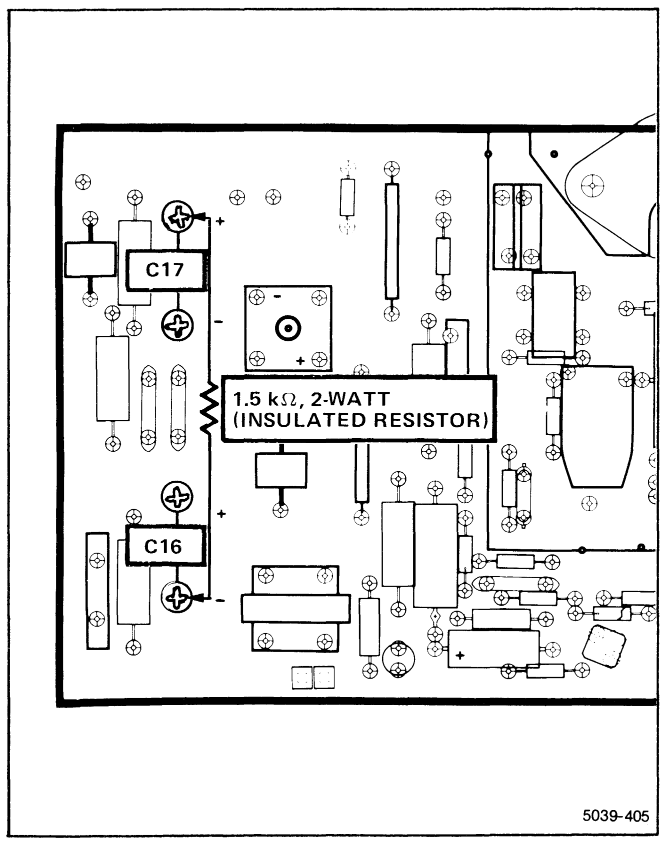


Figure 4-12. Location of terminals used to manually discharge C16 and C17.

HOW TO REMOVE THE CATHODE-RAY TUBE

NOTE

Before removing the cathode-ray tube (crt), be certain that removal is necessary: see CRT Troubleshooting Procedure.

Remove the crt as follows:

WARNING

The crt may retain a dangerous electrical charge. Before removing the crt, the anode must be fully discharged by shorting the anode lead from the crt to the chassis. Wait approximately ten minutes and again firmly short this lead to the chassis. Then remove the crt.

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

1. Remove the crt base-pin socket from the rear of the crt.

2. Loosen the two screws located above and below the crt base pins until the tension of the springs on these screws is released. Then, press in on the screws to be certain that the crt clamp inside the crt shield is loose.

3. Disconnect the two vertical deflection-plate connectors from the left side of the crt.

4. Disconnect the two horizontal deflection-plate connectors from the top of the crt.

5. Disconnect the crt anode lead from the jack located between the crt shield and the center bulkhead. Ground this lead to the chassis to dissipate any stored charge remaining in the crt.

6. Remove the plastic A22 High-Voltage Board shield on the bottom of the instrument.

7. Disconnect P1811, P1810 and P1813 from the A22 High-Voltage Board.

8. Remove the plastic mask which covers the crt bezel.

9. Remove the four screws that hold the crt bezel to the front panel. Remove the bezel while disconnecting the three-pin connector from the left rear of the bezel.

10. Remove the plastic faceplate protector, the graticule light assembly, and the faceplate mask. (The graticule light assembly need not be unsoldered from its leads.)

11. Hold one hand on the crt faceplate and gently push forward on the crt base with the other. Slowly pull the crt out from the front of the instrument while guiding the cable connected to P1811, P1810 and P1813, and the crt anode lead, through the holes in the crt shield.

HOW TO REPLACE THE CATHODE-RAY TUBE

Replace the cathode-ray tube (crt) as follows:

1. Insert the crt into the shield, guiding the crt anode plug and the cables connected to P1811, P1810 and P1813 through the holes in the crt shield and center bulkhead. Set the crt firmly against the front-panel casting.

2. Clean the crt faceplate, plastic faceplate protector, and the light filter with denatured alcohol.

3. Place the crt mask over the faceplate. Connect the multi-pin connector to the crt bezel (align the arrow on the connector with the arrow on the bezel).

4. Hold the faceplate protector in position and replace the crt bezel, graticule light assembly, light filter frame, and light filter. Check that the light filter is properly aligned, then firmly tighten the four screws.

5. Gently push forward on the crt base to ascertain that the crt is as far forward as possible. Then tighten the two screws beside the crt base until the springs on the screws are fully compressed.

6. Place the crt base-pin socket on the crt base pins.

7. Reconnect the crt anode plug.

8. Carefully reconnect all cables and crt neck-pin connectors.

9. Replace the plastic crt bezel mask.

NOTE

Replacing the crt will require that the R7103 be re-adjusted. Refer to Section 5, Checks and Adjustment.

CIRCUIT BOARDS

If a circuit board is damaged beyond repair, replace the entire board assembly. Part numbers for completely wired boards are given in Section 7, Replaceable Electrical Parts.

Most of the circuit boards in the R7103 are mounted on the chassis; pin connectors are used for electrical interconnection with chassis-mounted components and other circuit boards. Two boards plug onto the rear of the A6 Interface Board; feed-through connectors connect the plug-on boards to the A6 Interface Board.

Chassis-Mounted Boards

Remove and replace all chassis-mounted circuit boards as follows:

1. Disconnect all pin connectors attached to the board, or which connect the board to other parts of the instrument.

2. Remove the securing screws.

3. Remove the chassis-mounted board.

4. Replace chassis-mounted boards in the reverse order of removal. Match the index arrow on the multi-pin connectors to the corresponding arrow on the board. Correct location of the pin connectors is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

Plug-On Boards (A13 Logic Board, A14 Trigger Selector Board)

Remove and replace the plug-on boards as follows:

1. Remove the plug-in units to gain access to the screws that fasten the boards mounted on the rear of the A6 Interface Board.

2. Disconnect any end-lead coaxial connectors located on the front of the board, or those which pass across a portion of the board.

3. Remove the two electrical shields at the rear of the plug-in compartment as follows:

   a. Remove the single screws at the tops of the shields.

   b. Loosen, but do not remove, the two screws at the bottom of each shield.

   c. Pull the top of the shield outward, then move the shield up and off the two bottom screws.

4. Working through the plug-in compartment, loosen the screws (two for each board) that fasten the board(s) to the A6 Interface Board. See Figure 4-13. (The board-retaining screws are captive screws; loosen them enough to disengage them from the circuit board, but do not remove them from their parent assembly.)

5. Keep the board parallel to the A6 Interface board, then gently pull outward on its edges until the feed-through terminals are fully disengaged.

6. To replace a plug-on circuit board, position the board parallel to the A6 Interface Board so that all feed-through pins are properly aligned with their sockets.

7. Gently press the circuit board against the mounting surface. Be sure that all feed-through pins and sockets mate properly.

8. Uniformly tighten the securing screws (recommended torque: four to six inch-pounds).

9. Replace the two electrical shields. Be sure to put the tops of the shields behind the spring clips at the top of the plug-in compartment.

A5 Mode Switch Board

Remove or replace the A5 Mode Switch Board as follows:

CAUTION

Do not allow solder or solder flux to flow under printed circuit board switches. The printed circuit board is part of the switch contacts, and intermittent switch operation can occur if contamination enters the switch assembly.

1. Disconnect the pin connectors and remove the four screws that fasten the board to the chassis.

2. Remove the knobs, retaining nuts, and flat washers from the INTENSITY and FOCUS potentiometers.

NOTE

When removing wires from a circuit board, always tag the wire and the corresponding connection point on the circuit board.

3. Slide the board toward the rear of the instrument until the front-panel pushbuttons clear the chassis.

4. Lift the board from the instrument.

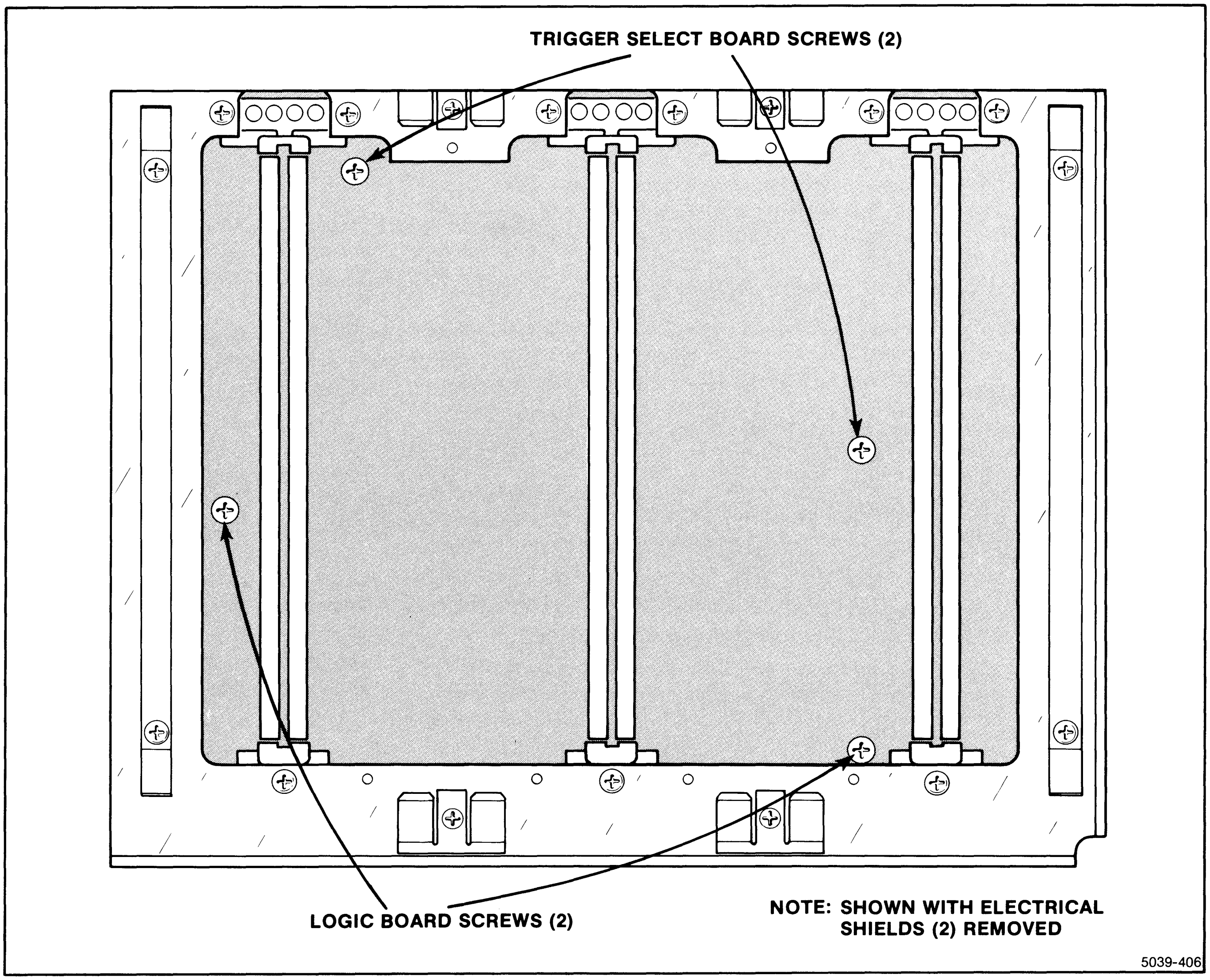


Figure 4-13. Screws that fasten the Plug-On Boards to the A6 Interface Board.

5. Replace the board by following the removal procedure in reverse order. Match the index arrows on the pin connectors to the correspondings arrow on the board. Correct location of the pin connectors is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

A6 Interface Board

Remove and replace the A6 Interface Board as follows:

1. Remove the plug-in units.

2. Disconnect all connectors from the A6 Interface Board. Note the location of the connectors so they can be correctly replaced.

3. Remove the nine screws which fasten the plug-in interface connectors to the chassis (see Fig. 4-14).

4. Slide the Main Interface Board assembly to the rear of the instrument and remove it through the top of the instrument.

5. Replace the A6 Interface Board in the reverse order of removal. Match the index arrow on the pin connectors to the corresponding arrow on the board. Correct location of the pin connectors is shown in the circuit board illustrations in Section 8, Diagrams and Circuit Board Illustrations.

A7/A8/A9/A10/A11/A12 Follower Boards

Follower circuit boards with four or six interface contacts are used in the plug-in interface connectors to provide optimum signal connections between the plug-in units and the R7103. Each Follower Board is held in place by a spring that permits the board to move back and forth in the interface connector to compensate for

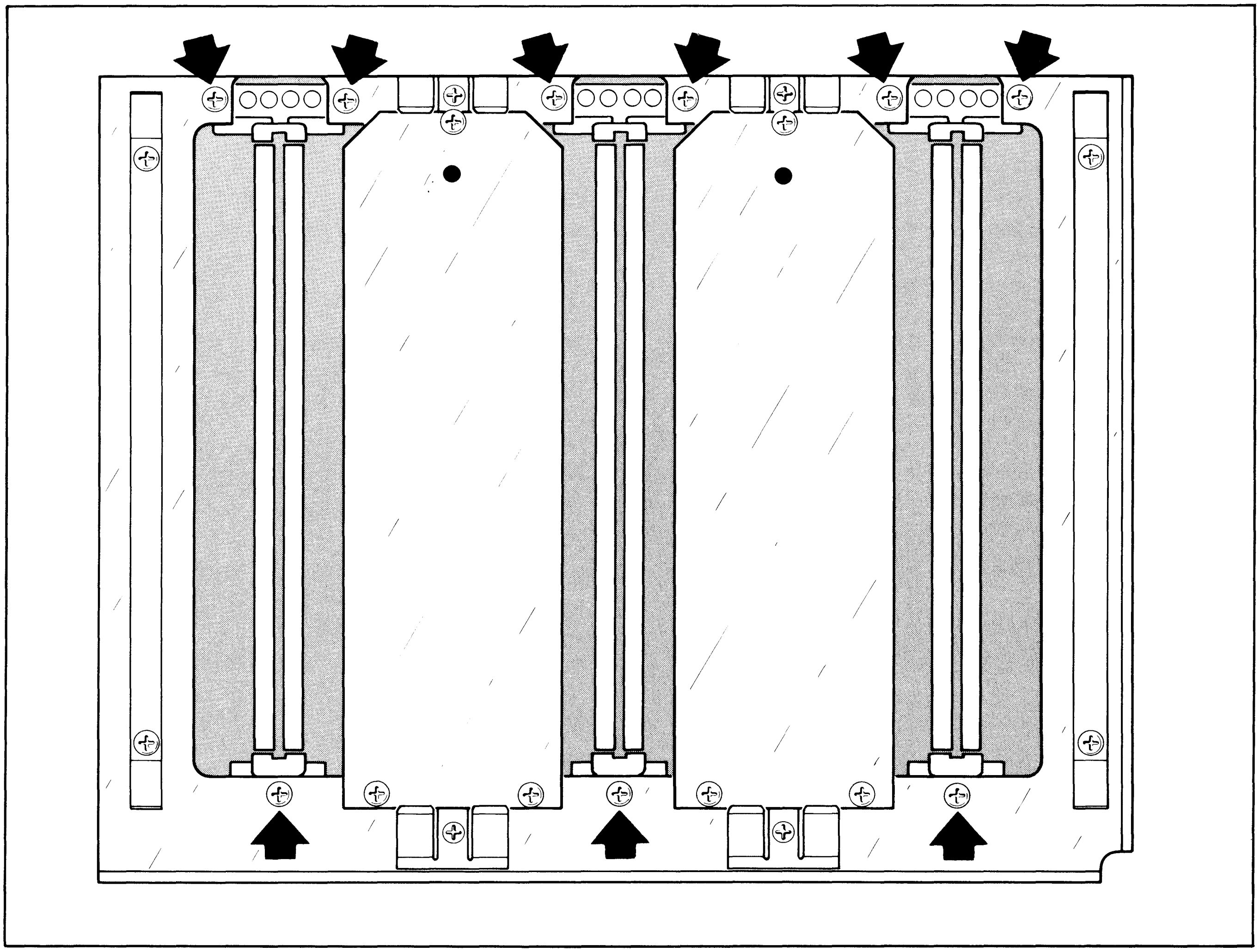


Figure 4-14. Screws that retain the A6 Interface Board.

length variances between plug-in units. If a contact on a Follower board is damaged, the entire board with contacts and interconnecting cables, is replaced as a unit.

Remove a Follower Board as follows:

1. Disconnect the R7103 from the power source and remove any plug-in units.

2. Remove the metal shields in front of the A6 Interface Board.

3. Disconnect the coaxial leads of the Follower Board from the A16 Vertical Channel Switch Board, and the A19 Horizontal Amplifier or A14 Trigger Selector Board. Note the location of the connectors so they may be correctly replaced.

4. Using long-nose pliers, disengage the spring from the Follower Board (spring is in front of A6 Interface Board).

5. Remove the Follower Board, with its interconnecting cables, from the rear of the interface connector, through the hole in the A6 Interface Board.

To replace a Follower Board, a folded length of very thin shim stock as wide as the Follower Board is required to compress the contacts while inserting the board into the interface connector. Proceed as follows:

1. Hold the Follower Board between the ends of the shim stock with the fold directly in front of the contacts. With the shim stock held against the sides of the board, the contacts on the sides of the board should be pressed together.

2. Insert the folded end of the shim stock (with the

Follower board) into the rear of the interface connector through the hole in the A6 Interface Board. When the Follower Board contacts are almost fully inserted into the connector, hold the board in place and remove the shim stock through the front of the interface connector while fully inserting the Follower Board.

3. Secure the Follower Board with the spring.

4. Reconnect the Follower Board coaxial cables to the A16 Vertical Channel Switch or A19 Horizontal Amplifier Board and the A14 Trigger Selector Board.

5. Replace the metal shields.

A25 Regulator Board

Remove and replace the A25 Regulator Board as follows:

1. Slide the power supply out of the instrument (see How to Remove the Power Supply, in this section).

2. Disconnect the multi-pin connectors from the board (two of the multi-pin connectors are self-locking; see the discussion on multi-pin connectors in this section). Note the location of the pin connectors so they may be correctly replaced.

NOTE

If the A25 Regulator Board is to be removed to allow access to other parts of the power supply, perform steps 3 and 4 only. If the board is to be removed from the instrument, proceed with the remaining steps of the procedure.

3. Remove the two screws located in the access holes under the A25 Regulator Board. These screws secure the chassis.

4. Remove the three screws securing the Regulator chassis to the rear heat sink. Remove the board with the chassis attached.

5. Remove the hardware securing the plastic-cased power transistors to the rear heatsink (see Fig. 4-15). Note the position of the lockwashers so they can be correctly replaced.

6. Remove the five securing screws and lift the board, with attached power transistors, from the chassis.

7. To replace the A25 Regulator Board, first apply a thin coat of silicone grease to the back (mounting surface) of each power transistor.

WARNING

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

8. Place the A25 Regulator Board on the chassis. Replace, but do not tighten, the securing screws.

9. Check that the power transistors are aligned with their mounting screws and that the insulating washers are in place between the transistor cases and the rear heatsink.

10. Secure the transistors with the mounting hardware. Do not over-tighten the nuts; recommended torque is four to six inch-pounds.

11. Tighten the screws holding the A25 Regulator board to the chassis.

12. Install the chassis on the power supply.

13. Connect the multi-pin connectors to the board. Match the index arrow on the pin connectors to the corresponding arrow on the board. Correct location of the pin connectors is shown in the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

14. Replace the power-supply in the instrument.

A24 Control Rectifier Board

An exploded-view drawing of the power supply is given in Section 9, Replaceable Mechanical Parts, at the rear of this manual. To remove the A24 Control Rectifier Board, use the following procedure:

1. Slide the power supply out of the instrument (see How to Remove the Power Supply, in this section).

2. Remove the A25 Regulator Board with attached chassis as described in A25 Regulator Board.

3. Remove the four screws that secure the power transformer to the bracket.

4. Remove the protective cover from the power supply (see Access to Components in the Power Supply, in this section).

5. Disconnect the multi-pin connectors, from the A24 Control Rectifier Board. Note the location of the pin connectors so they can be correctly replaced.

6. Remove the two plastic screws which hold the circuit-board shield to the A23 Inverter Board.

7. Unsolder the three power-transformer leads from the A23 Inverter Board. Remove the excess solder from the board pads with a vacuum-type desoldering tool.

8. Remove the five securing screws from the A24 Control Rectifier Board.

9. Lift the circuit board and attached power transformer from the instrument.

10. To replace the A24 Control Rectifier Board, use the removal procedure in reverse order. Match the index arrow on the pin connectors to the corresponding arrow on the board. Correct location of the pin connectors is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

A23 Inverter Board

An exploded-view drawing of the power supply is given in Section 9, Replaceable Mechanical Parts, at the rear of this manual. Remove and replace the power-supply A23 Inverter Board as follows:

WARNING

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

1. Slide the power supply out of the instrument (see How to Remove the Power Supply, in this section).

2. Remove the protective cover from the power supply (see Access to Components in the Power Supply, in this section).

3. Remove the A24 Control Rectifier Board using the following procedure.

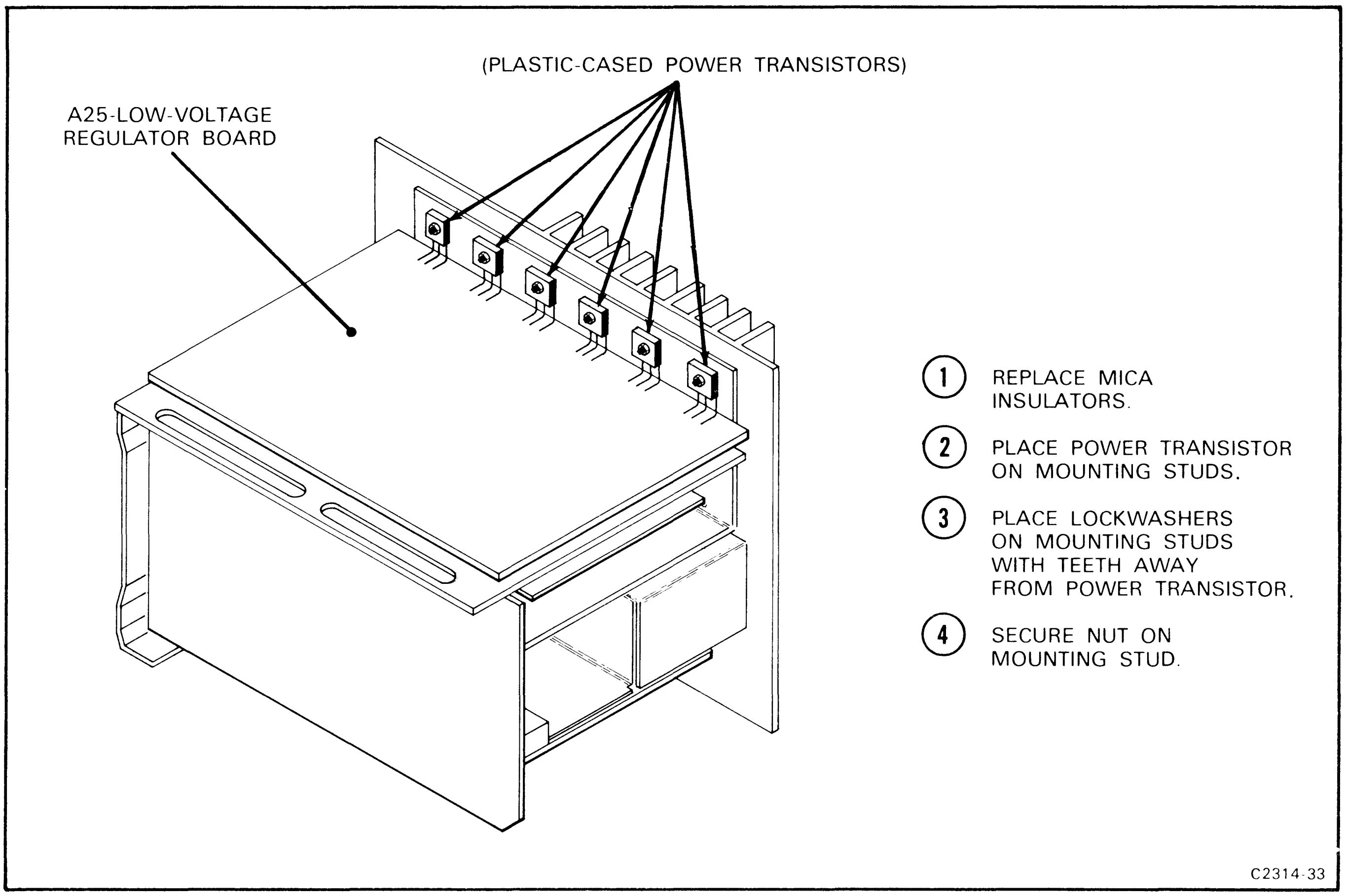


Figure 4-15. Correct placement of power transistors and their mounting hardware on rear heat sink.

4. Remove the three securing screws from the A23 Inverter Board.

5. Unsolder the line-input leads from the circuit board. Remove the excess solder from these circuit board pads with a vacuum-type desoldering tool.

6. Remove the two metal-cased power transistors by removing the securing nuts and pulling the transistors from their sockets.

7. Move the A23 Inverter Board away from the heat-sink shield until the transistor mounting studs clear the heatsink shield. Remove the board from the power unit.

8. To replace the A23 Inverter Board, follow the removal procedure in reverse order. Match the index arrow on the pin connectors to the corresponding arrow on the board. Correct location of the pin connectors is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

PLUG-IN INTERFACE CONNECTORS

The individual contacts of the plug-in interface connectors can be replaced. If several contacts are damaged, we recommend replacing the entire A6 Interface Board. An alternate solution is to have your local Tektronix Field Office repair or replace the damaged A6 Interface Board. Use the following procedure to remove and replace an individual contact of the plug-in interface connectors:

NOTE

The plug-in interface contacts which are mounted on the Follower circuit boards cannot be replaced. A Follower Board with contacts and interconnecting cables is replaced as a unit. See Circuit Boards.

1. Remove the A6 Interface Board from the instrument as previously described.

2. Snap the white plastic connector cover off the side of the damaged plug-in interface connector.

3. Unsolder and remove the damaged contact.

4. Install the replacement contact. Carefully position it to fit against the connector body.

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

6. Replace the A6 Interface Board.

DELAY LINE REMOVAL

The vertical delay line is carefully matched at the factory. Therefore, it is recommended that repair not be attempted in the field. Instead, contact your local Tektronix Field Office.

SEMICONDUCTORS

Semiconductors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the adjustment of the instrument. When semiconductors are replaced, check the operation of circuits which may be affected.

WARNING

To avoid electric shock hazard, always disconnect the R7103 from the power source before removing or replacing components.

Replacement semiconductors should be of the original type or a direct replacement. Lead configurations of the semiconductors used in this instrument are shown in Figure 4-2. Some plastic-cased transistors have lead configurations which differ from those shown. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for standard basing as used for metal-cased transistors. When removing soldered-on transistors, use a vacuum type desoldering tool to remove the solder from the circuit board pads. Transistors which have heat radiators or are mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease on both sides of the insulating washer when replacing these transistors.

WARNING

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

To replace one of the power transistors mounted on the heatsink at the rear of the power supply, first remove the mounting hardware. Then, unsolder and remove the defective transistor. When replacing the transistor, be sure to install the insulating washer between the transistor and the heatsink (use silicone grease as previously described). Tighten the mounting nut just tight enough to hold the transistor in place. Then solder the replacement transistor to the A25 Regulator Board.

An extracting tool should be used to remove in-line integrated circuits to prevent damaging the pins. This tool is available from Tektronix, Inc.; order Tektronix Part 003-0619-00. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the integrated circuit. Try to avoid disengaging one end from the socket before the other end.

Hypcon Connectors

The hypcon (HYbrid-Printed CONnector) connector is a precision-made connector designed to provide low-loss electrical and thermally efficient connection between the printed circuit board and hybrid integrated circuit. Figure 4-16 shows an exploded view of the hypcon connector. Use care when replacing the hybrid ICs not to touch the elastomer gold-plated contacts with the fingers or to use a cleaner which will degrade contact reliability. The hypcon connector and hybrid IC should be removed if it becomes necessary to use a cleaning solvent near the connector when replacing adjacent (within 1/2") circuit board components. IMPORTANT: Remove all traces of solder flux or foreign material contamination from the circuit board contact area before replacing the connector. Contamination usually takes place during the soldering and cleaning process. Even when the soldering is done carefully, flux, oil, or other contaminants can be carried under the connector during the cleaning operation. When the solvent evaporates, nonconductive contaminants may remain on or near the contact interfaces.

The cleaning process (either hand cleaning with a solvent or machine cleaning in an automatic detergent wash) is not recommended for boards containing hypcon connectors.

If a component near a hypcon connector must be replaced, the following steps are recommended:

1. Remove the hybrid IC and hypcon connector (see Disassembly and Removal instructions) before any soldering or cleaning and store in a dirt-free covered container. When several hybrids and hypcon connectors are to be removed, keep parts in sets and do not interchange parts between sets.

2. Hand soldering:

   a. Use small diameter solder (0.030"-0.040").

   b. Use low-wattage soldering irons (15-20 watts).

   c. Use care with solder amount and placement.

3. Remove solder flux and contact contamination with isopropyl alcohol or denatured ethyl alcohol.

4. Flush the hybrid and hypcon connector mounting area with isopropyl alcohol. Do not scrub with a cotton-tipped applicator, as cotton fibers will adhere to edges and surfaces of contact areas and cause open or intermittent connections. The elastomer should be examined under light for dust, hair, etc., before it is re-installed. If the etched circuit board surfaces require more cleaning, scrub with a soft rubber eraser and blow or vacuum clean while dusting surface with a small clean brush.

5. If the hybrid IC and elastomer contact holder are contaminated, clean the contact holder and hybrid by flushing or spraying with alcohol and oven dry at 50° C. Do not scrub with a cotton-tipped applicator or similar device. If the contact holder is excessively contaminated, replace it with a new one.

Two inch-pounds of torque should be applied to the mounting screws to secure the hypcon to the circuit board.

Make sure that the elastomer is properly seated in the contact holder before remounting the assembly to circuit board. Exercise care when mounting the frame-elastomer connector holder-hybrid IC assembly to the circuit board to prevent misalignment between the connector and board.

CAUTION

Because of close tolerances involved, special care must be taken to ensure correct index alignment of each hypcon part during reassembly. Failure to do so can result in a cracked hybrid substrate. See Figure 4-16A for index locations.

If your instrument contains both the flush and stepped type of hypcon connectors be careful not to mix the elastomer contact holders during reassembly. The flush hypcon connectors have green elastomer contact holders and the plastic frame is marked FLUSH. The stepped hypcons have neutral-colored elastomer contact holders with a slight ridge or step on the contact surface; the large frames are marked STEPPED. The registration pins on the stepped plastic frame are slightly longer than those on the flush frame. The elastomer contact holder in the small stepped connectors is indexed differently than the large connectors. Look for a small gold arrow in one corner of the holder instead of a flat corner. Match this corner arrow with the pointed corner of the plastic frame. Give close attention to this indexing, as it is easy to insert the elastomer contact holder incorrectly.

Differences also exist between the large flush and large stepped hypcon circuit board receptacles. Figure 4-16A

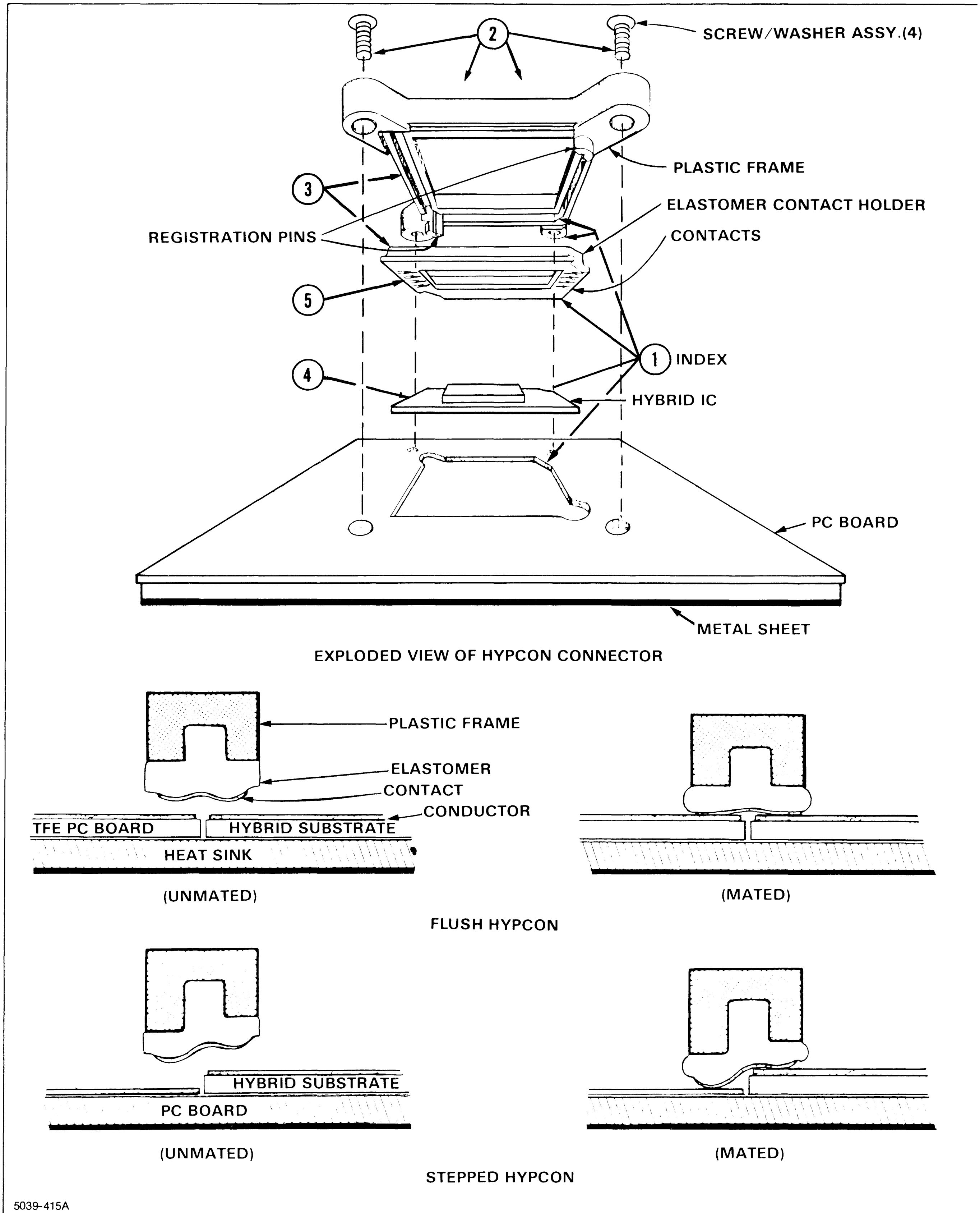


Figure 4-16. How to remove and replace the Hypcon assemblies.

DISASSEMBLY AND REMOVAL

(1) Note index on circuit board (arrow, triangle, or dot) and HYPCON plastic frame (pointed mounting ear).

(2) Unscrew and remove the 4 screw/washer assemblies. Where the HYPCON connector serves to heatsink the hybrid to the chassis, 2 of the 4 screws are longer. Note the location of the yellow tinted screws for proper replacement.

(3) Lift HYPCON connector from board.

(4) Note index location of hybrid and remove from board with tweezers.

(5) Note index location of elastomer contact holder and remove by grasping a corner of the contact holder with tweezers and lifting up. Do not touch the gold-plated contacts with your fingers.

REASSEMBLY AND REPLACEMENT

Grasp corner of elastomer contact holder with tweezers and place in plastic frame slot being careful to match the flat contact holder with the flat frame corner. Place a clean plastic envelope over finger and press with finger to seat contact holder into the frame. The contact holder must be evenly seated on all four sides.

Flush HYPCON: Match hybrid flat corner with board receptable flat corner and place hybrid in receptable. Match pointed mounting ear of HYPCON connector with flat corner of receptacle and guide registration pins into the board hold.

Stepped HYPCON: Using tweezers, match the hybrid corner index with the elastomer contact holder index and insert between the registration pins. Turn the assembly over, grasp the hybrid "hat" with the tweezers, and guide the registration pins into the board holes. Match the plastic frame pointed mounting ear with the circuit board arrow.

Insert mounting hardware and apply 2 inch-pounds of torque to secure the connector assembly.

5039-415B

Figure 4-16 (cont). How to remove and replace the Hypcon assemblies.

shows the cross-sectional differences which must be observed when working with an instrument that contains both types of hypcon connectors.

CAUTION

Damage to the elastomer contact holder can result if the connectors are not mated properly with the board receptacle.

When replacing the hybrid, insert it into the board opening, then position the hypcon connector in the board registration holes for perfect alignment. The outer portion of the hypcon frame should be flush with the circuit board before the four mounting screws are tightened. Avoid touching the hybrid and elastomer contact holder with your fingers; finger oils can degrade reliability.

A procedure for removal and replacement is included in Figure 4-16.

Hybrid substrate contact numbers 1 and 20 are printed on the substrate at the index corner. See Figure 4-2, semiconductor lead configurations.

INTERCONNECTING PINS

Two methods of interconnection are used in this instrument to electrically connect the circuit boards with other boards and components. When the interconnection is made with a coaxial cable, a special end-lead connector plugs into a socket on the board. Other interconnections are made with a pin soldered into the board. Two types of connectors are used for these interconnecting pins. If the connector is mounted on a plug-on circuit board, a special socket is soldered into the board. If the connector is on the end of a lead, an end-lead pin connector is used which mates with the interconnecting pin. The following information provides the removal and replacement procedure for the various types of interconnecting methods.

Coaxial-Type End-Lead Connectors

Replacement of the coaxial-type end-lead connectors requires special tools and techniques; only experienced maintenance personnel should attempt to remove or replace these connectors. We recommend that the damaged cable or wiring harness be replaced as a unit. For cable or wiring harness part numbers, see Section 9, Replaceable Mechanical Parts. An alternative solution is to refer the replacement of the defective connector to your local Tektronix Field Office or representative. Figure 4-17 gives an exploded view of a coaxial end-lead connector assembly.

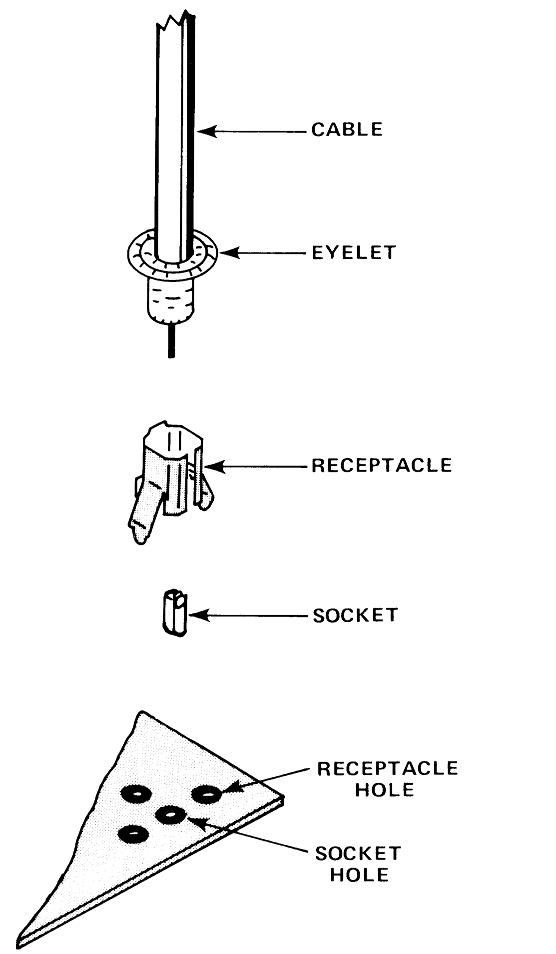


Figure 4-17. Coaxial end-lead connector assembly.

Circuit-Board Pins

A circuit-board pin replacement kit (including necessary tools, instructions, and replacement pins with attached ferrules) is available from Tektronix, Inc. Order Tektronix Part 040-0542-01. Replacing circuit-board pins on multi-layer boards is not recommended. (The multi-layer boards in this instrument are listed under Soldering Techniques in this section.)

To replace a damaged pin, first disconnect any pin connectors. Then unsolder the damaged pin and pull it from the board with a pair of pliers, leaving the ferrule (see Fig. 4-18) in the circuit board if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using an anti-static vacuum-type desoldering tool (see Soldering Techniques). Then press the replacement pin, with attached spare ferrule, into the circuit board.

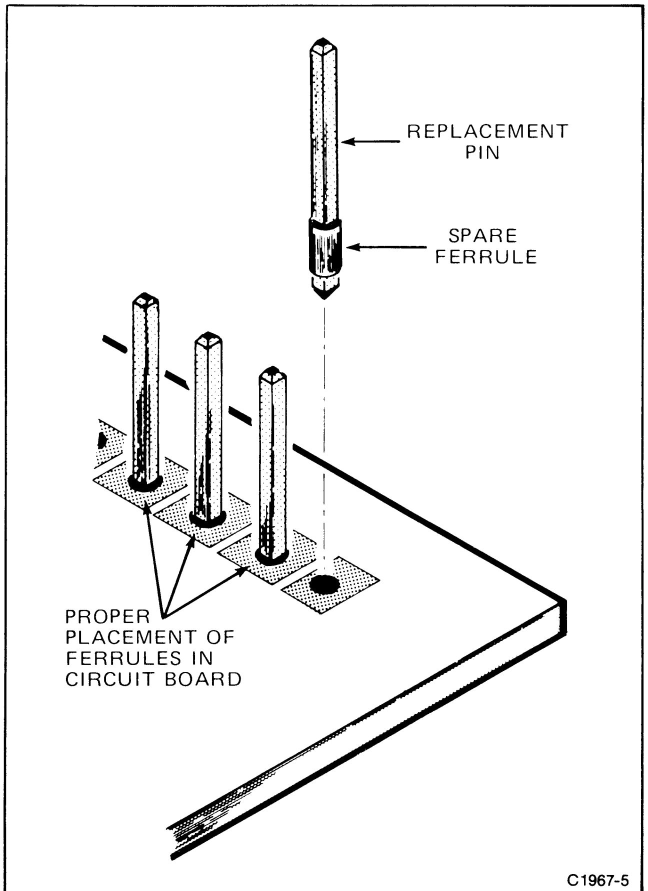


Figure 4-18. Exploded view of circuit-board pin and ferrule.

Position the replacement pin in the same manner as the original. Solder the pin to the circuit board on each side of the board. If the original pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

Circuit-Board Pin Sockets

The pin sockets on the circuit boards are soldered to the back of the board. To remove or replace one of these sockets, first unsolder the pin (use a vacuum-type desoldering tool to remove excess solder). Then straighten the tabs on the socket and remove the socket from the board. Place the new socket in the circuit board hole and press the tabs down against the board. Solder the tabs of the socket to the circuit board; be careful not to get solder inside the socket.

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 connecting points for spring-loaded probe tips, alligator clips, etc.

Multi-Pin Connectors

The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads. To remove or replace damaged multi-pin connectors, remove the old pin connector from the end of the lead and clamp the replacement connector to the lead.

NOTE

Some multi-pin connectors are equipped with a special locking mechanism. These connectors cannot be removed by pulling on the wire(s). To remove the connectors from the pin(s) grasp the plastic holder and pull.

To remove an individual wire from the holder, use a sharp pointed tool (such as a scribe) to lift the holding tab. Then withdraw the connector from the holder.

Some of the pin connectors are grouped together and mounted in a plastic holder; the overall result is that these connectors are removed and installed as a multi-pin connector (see Troubleshooting Aids). If the individual end-lead pin connectors are removed from the plastic holder, note the order of the individual wires for correct replacement in the holder.

PUSHBUTTON SWITCHES

The pushbutton switches used in the R7103 Oscilloscope are circuit-board mounted. First remove the associated circuit board following the procedure given under Circuit Boards in this section. Figure 4-19 gives removal and replacement instructions for pushbutton switches.

GRATICULE LIGHT BULBS

To remove or replace the graticule light bulbs, first remove the plastic crt mask, light filter, and metal light shield. Pull on the white tabs to remove the graticule lamp assembly. Next, slide the retaining strip off to the side of the damaged bulb base. Pull the bulb out of the circuit board. Reverse the order of removal for replacement.

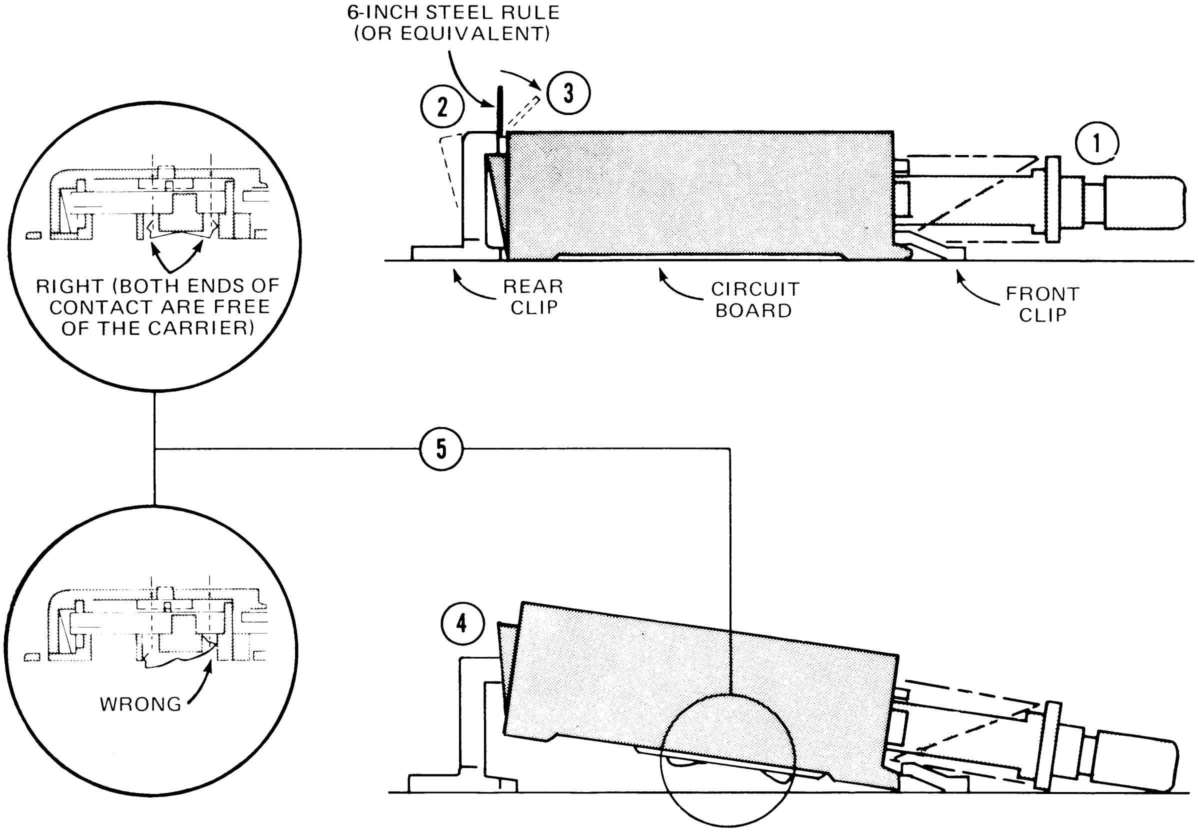
POWER TRANSFORMER

Replace the power transformer only with a direct replacement Tektronix transformer. Remove and replace the power transformer as follows:

1. Remove the A24 Control Rectifier Board as described under Circuit Boards in this section.

2. Remove the bracket which holds the transformer to the rear heatsink.

3. Unsolder the transformer leads from the circuit



(1) Make sure that all switch shafts are in the OUT position to clear the rear clip.

(2) Place the long edge of a six-inch rule or similar thin straight edge between the top edge of the rear clip and the switch body.

(3) Carefully pry the rear clip back just far enough to push the steel rule down between the clip and switch body.

CAUTION

When the switch is removed, the contacts may drop free and be damaged or lost. Body salts or acids can contaminate the switch contacts. Wear cotton gloves to prevent touching the contacts in the switch or on the board with bare hands.

(4) Pull the rear of the switch up, remove the steel rule, and pull the switch out of the front clip.

(5) To replace the switch, first check that the slide contacts are properly installed in the carrier. Then, place the front of the switch into the front clip and push the rear of the switch down until the rear clip catches and holds the switch in place.

C1967-3

Figure 4-19. How to remove and replace pushbutton switches.

boards. Remove the excess solder from the circuit-board pads (see Soldering Techniques). Note the position of the transformer leads so they may be correctly replaced.

4. Place the new transformer in position but do not solder the leads to the circuit-board pads.

5. Secure the bracket to the A24 Control Rectifier Board and attach the transformer to the bracket with the four securing screws.

6. Reposition the A24 Control Rectifier Board and secure with three screws. Attach the bracket securely to the rear heatsink.

7. Solder the transformer leads to the circuit-board pads.

8. Continue replacing the A24 Control Rectifier Board.

The line fuse used in the R7103 is located on the rear panel of the power supply. Replace the line fuse (F10) only with one of proper type and rating.

NOTE

Line voltage fuse F10 is used for both 110 volt and 220 volt operation. No change in the fuse is necessary when switching the LINE VOLTAGE SELECTOR switch between 110 volts and 220 volts.

ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as the adjustment of any closely related circuits. Because the low-voltage supplies affect all circuits, adjustment of the entire instrument should be checked if component replacements have been made in these supplies or if the power transformer has been replaced. See section 5, Checks and Adjustment for a complete adjustment procedure.

CHECKS AND ADJUSTMENT

This section provides procedures for checking and adjusting the R7103. These procedures are designed to compare the performance of this instrument with other measurement instruments of known accuracy to detect, correlate, or eliminate by adjustment, any variation from the electrical specifications. These procedures also verify that the controls function properly.

The Checks and Adjustment section has two parts: Part I—Performance Check is provided for those who wish to verify that this instrument meets the applicable electrical specifications in section 1 without making internal adjustments. Part II—Adjustment and Performance Check provides a complete check and adjustment procedure in addition to verifying that the controls function properly. The procedures in Part I and Part II are written so that the entire instrument or any major circuit or part of a circuit can be checked or adjusted.

Table 5-1, Calibration Procedure Electives, lists the choices available and instructions for performing complete or partial calibration procedures. Also refer to page 5-2, Using These Procedures, for more detailed information.

TABLE 5-1
Calibration Procedure Electives

Electives	Procedure
Functional Check	Perform Power-Up Sequence in Part II—Adjustment and Performance Check. Then proceed sequentially through subsections (A, B, C, etc.) to end. If a functional check only is desired, perform the Operators Checkout Procedure in Section 2.
Performance Check Only	Perform Power-Up Sequence in Part I—Performance Check Then proceed sequentially through subsections (A, B, C, etc.) to end.
Complete Calibration (Part II—Adjustment and Performance Check)	Perform Power-up Sequence for Part I—Performance Check Performance Check. Then proceed sequentially through subsections (A, B, C, etc.) to end.
Partial Part I—Performance Check or Part II—Adjustment and Performance Check by Subsection (A, B, C, etc.)	Perform Power-up Sequence for Part I—Performance Check or Part II—Adjustment and Performance Check. Perform Before You Begin and Preliminary Control Settings instructions for the desired subsection. Then proceed sequentially through the procedures in desired subsection.
Partial Part I—Performance Check or Partial Part II—Adjustment and Performance Check by Step (A1, A2, B1, B2, etc.) within Subsection (A, B, C, etc.)	Perform Power-Up Sequence for Part I—Performance Check or Part II—Adjustment and Performance Check. Perform Before You Begin and Preliminary Control Settings instructions for subsection (A, B, C, etc.) containing the desired step (A1, A2, B1, B2, etc.). Then proceed through the instructions (a, b, c, etc.) in the desired step. **NOTE** *Although a partial adjustment procedure may be done, we recommend that the entire subsection procedure be performed if any adjustments are made.*

USING THESE PROCEDURES

NOTE

In these procedures, capital letters within the body of the text identify front-panel controls, indicators and connectors on the R7103 (e.g., READOUT). Initial capitals identify controls, indicators, and connectors (e.g., Position) on associated test equipment used in this procedure. Initial capitals also identify adjustments inside the R7103 (e.g., Vert Gain).

These procedures are divided into subsections by major functional circuits (e.g., A. Z-Axis And Display, B. Calibrator And Output Signals, etc.). The order in which the subsections and procedures appear is the recommended sequence for a complete performance check or adjustment and performance check of the instrument.

Each step contains the Setup Conditions which, if applicable, include control settings for the R7103, a test setup illustration, and test equipment control settings. The Setup Conditions are written so that, if desired, each subsection (A, B, C, etc.) or step (A1, A2, B1, B2, etc.) can be performed separately.

A heading system is provided to readily identify the steps (A1, A2, B1, B2, etc.) that contain performance check and/or adjustment instructions. For example, if CHECK is the first word in the title of a step, an electrical specification is checked. If ADJUST is the first word in the title, the step concerns one or more internal adjustments. If CHECK/ADJUST appears in the title, the step involves electrical specification checks and related adjustments. If EXAMINE is the first word in the step title, the step concerns measurement limits that indicate whether the instrument is operating properly; these limits are not to be interpreted as electrical specifications.

The alphabetical instructions under each step (a, b, c, etc.) may contain CHECK, EXAMINE, ADJUST, or INTERACTION as the first word of the instruction. These terms are defined as follows:

1. **CHECK**—indicates that the instruction accomplishes an electrical specification check. Each electrical specification checked is listed in Table 5-2, Performance Check Summary (see Performance Check Summary discussion for more information).

2. **EXAMINE**—usually precedes an ADJUST instruction and indicates that the instruction determines whether adjustment is necessary. If no ADJUST instruction appears in the same step, the EXAMINE instruction concerns measurement limits that have no related adjustment. Measurement limits following the word EXAMINE are not to be interpreted as electrical specifications. They are provided as indicators of a properly functioning instrument and to aid in the adjustment process.

3. **ADJUST**—describes which adjustment to make and the desired result. We recommend that the adjustments not be made if a previous CHECK or EXAMINE instruction indicates that no adjustment is necessary.

4. **INTERACTION**—indicates that the adjustment described in the preceding instruction interacts with other circuits. The nature of the interaction is described and reference is made to the step(s) affected.

PERFORMANCE CHECK SUMMARY

Table 5-2, Performance Check Summary, lists the electrical specifications that are checked in Part I and Part II of this section. Table 5-2 is intended to provide a convenient means for locating the procedures in Part I and Part II that check and/or adjust the instrument to meet the applicable electrical specifications. For example: If the A25 Regulator Board has been repaired or replaced, use Table 5-2 to locate the electrical specifications affected by the repair or replacement. Then note the title of the procedure in Part I or Part II in which those specifications are checked and/or adjusted. Use the index provided at the front of Part I and Part II to find the page number of the desired procedures.

TABLE 5-2
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
VERTICAL MODE			
Deflection Factor	Compatible with all 7000-series plug-in units.	Implicitly checked in step E1. Check Vertical Amplifier Gain.	Implicitly checked in step F2. Check/Adjust Vertical Amplifier Gain.
Difference Between Vertical Compartments	1% or less.		
Low-Frequency Linearity	0.1 div or less compression or expansion of a center-screen 2 div signal positioned anywhere vertically within the graticule area.	E2. Check Vertical Low-Frequency Linearity.	F3. Check Vertical Low-Frequency Linearity.
Frequency Response		Implicitly checked in step E3. Check Vertical Amplifier 1 GHz Gain.	Implicitly checked in step F6. Check Vertical Amplifier 1 GHz Gain.
Step Response	Varies with plug-in unit selected. See R7103 Oscilloscope Vertical System Specification, Table 1-7.	Does not normally require customer verification. However, risetime can be calculated from the Vertical Bandwidth.	
Isolation Between Vertical Compartments (eight-div signal)		E4. Check Vertical Channel Isolation.	F7. Check Vertical Channel Isolation.
Left, Right, Alt Modes	At least 160:1 from dc to 100 MHz and at least 80:1 from 100 MHz to 1 GHz.		
Delay Line	Permits viewing the leading edge of triggering signal.	Checked throughout procedure where single pulse is displayed on crt.	
Difference in Signal Delay Between Vertical Compartments	50 ps or less.	Does not normally require customer verification; verified at the factory.	
Vertical Display Modes	Selected by front-panel VERTICAL MODE selector.	E5. Check Vertical Display Modes.	F8. Check Vertical Display Modes.
LEFT	Signal from left vertical unit displayed.		
ALT	Display alternates between signals from Left and Right vertical units at rate determined by Horizontal plug-in unit.		

TABLE 5-2 (CONT)
Performance Check Summary

<table>
<tr><th>Characteristic</th><th>Performance Requirement</th><th>Part I
Performance Check
Procedure Title</th><th>Part II
Adjustment and
Performance Check
Procedure Title</th></tr>
<tr><td colspan="4">VERTICAL MODE (CONT)</td></tr>
<tr><td>Vertical Display Modes (Cont)
ADD</td><td>Display is algebraic sum of signals from Left and Right vertical units.</td><td rowspan="2">E5. Check Vertical Display Modes.</td><td rowspan="2">F8. Check Vertical Display Modes.</td></tr>
<tr><td>CHOP</td><td>Display chops between Left and Right vertical units asynchronously to horizontal plug-in unit.</td></tr>
<tr><td>Repetition Rate</td><td>1 MHz within 20%.</td><td colspan="2">Does not normally require customer verification. Satisfactory operation is substantiated by other tests.</td></tr>
<tr><td>RIGHT</td><td>Signal from right vertical unit displayed.</td><td>E5. Check Vertical Display Modes.</td><td>F8. Check Vertical Display Modes.</td></tr>
<tr><td colspan="4">TRIGGERING SYSTEM</td></tr>
<tr><td>TRIGGER SOURCE</td><td>Selected by front-panel TRIGGER SOURCE buttons. Lights behind the buttons illuminate to indicate the trigger source.</td><td rowspan="3">C2. Check Trigger Selector Operation.</td><td rowspan="3">D3. Check Trigger Selector Operation.</td></tr>
<tr><td>VERT MODE</td><td>The trigger source is selected by the VERT MODE button. The source (sources) is (are) shown by the illumination of the LEFT VERT and RIGHT VERT trigger source buttons. The source follows (is same as) the Vert Display with the following two exceptions:<table><tr><th>VERT MODE</th><th>Trigger Source</th></tr><tr><td>CHOP</td><td>Left</td></tr><tr><td>ALT</td><td>Right trigger, then Left trigger</td></tr></table></td></tr>
<tr><td>LEFT VERT</td><td>Trigger source: Left vertical unit; LEFT VERT trigger source button illuminated.</td></tr>
</table>

TABLE 5-2 (CONT)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
TRIGGERING SYSTEM (CONT)			
TRIGGER SOURCE (Cont) RIGHT VERT	Trigger source: Right vertical unit; RIGHT VERT trigger source button illuminated.	C2. Check Trigger Selector Operation.	D3. Check Trigger Selector Operation.
HORIZONTAL SYSTEM			
Deflection Factor	Compatible with all 7000-series plug-in units.	D1. Check Horizontal Amplifier Gain.	E1. Check/Adjust Horizontal Amplifier.
Gain Differences Between Horizontal Compartments	1% or less.		
DC Linearity	0.05 division or less error at each graticule line after adjusting for no error at the second and tenth graticule line.		
Fastest Calibrated Sweep Rate	200 ps/division.	D2. Check High-Frequency Timing.	E2. Check/Adjust High-Frequency Timing.
Phase Shift Between Vertical and Horizontal Systems	2° or less from dc to at least 50 kHz.	Satisfactory operation verified at the factory.	
Bandwidth	350 MHz.	D3. Check Horizontal Bandwidth.	E3. Check Horizontal Bandwidth.
CALIBRATOR			
Wave Shape	Square wave.	B3. Check Calibrator Rise Time, Fall Time, and Duty Cycle.	C3. Check Calibrator Rise Time, Fall Time, and Duty Cycle.
Polarity	Positive going with base line at 0 volts.		
Output Resistance	450 Ω.	Satisfactory operation verified at the factory.	
Output Voltage	Selected by front-panel CALIBRATOR buttons.	B1. Check Calibrator Output Voltage.	C1. Check/Adjust Calibrator Output Voltage.
Into 100 kΩ or Greater	40 mV, 0.4 V, 4 V.		
Into 50 Ω	4 mV, 40 mV, 0.4 V.	Satisfactory operation verified at the factory.	

TABLE 5-2 (CONT)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
CALIBRATOR (CONT)			
Output Current	40 mA available through CALIBRATOR output with optional bnc to current loop adaptor. CALIBRATOR switch must be set to 4 V for calibrated output.	Satisfactory operation verified at the factory.	
Amplitude Accuracy (P-P Voltage)	Within 1%.	B1. Check Calibrator Output Voltage.	C1. Check/Adjust Calibrator Output Voltage.
Repetition Rate	1 kHz within 0.25%	B3. Check Calibrator Rise Time, Fall Time, and Duty Cycle.	C3. Check Calibrator Rise Time, Fall Time and Duty Cycle.
Duty Cycle	49.8% to 50.2%.		
Rise Time and Fall Time	500 nsec or less into 100 pF or less.		
SIGNAL OUTPUTS			
+ SAWTOOTH OUT		B4. Check Sawtooth Output Signal.	C4. Check Sawtooth Output Signal.
Source	HORIZ time-base.		
Polarity	Positive-going with base-line at 0 V within 1 V into 1 MΩ.		
Output Voltage		Does not normally require customer verification. Satisfactory operation verified at the factory.	
Rate of Rise			
Into 50 Ω	50 mV/unit of time selected by the time-base time/div switch, within 15%, 100 ns/div maximum sweep rate.		
Into 1 MΩ	1 V/unit of time selected by the time-base time/div switch, within 10%, 1 μsec/div maximum sweep rate.	B4. Check Sawtooth Output Signal.	C4. Check Sawtooth Output Signal.
Output Resistance	Approximately 950 Ω.	Does not normally require customer verification. Satisfactory operation verified at the factory.	
+ GATE OUT		B5. Check Gate Output Signal.	C5. Check Gate Output Signal.
Source	Gate, derived from HORIZ time-base main gate.		
Polarity	Positive-going with base-line at 0 V within 1.0 V into 1 MΩ.		

TABLE 5-2 (CONT)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
SIGNAL OUTPUTS			
+ GATE OUT (Cont)		B5. Check Gate Output Signal.	C5. Check Gate Output Signal.
Output Voltage			
Into 50 Ω	0.5 V within 10%.		
Into 1 MΩ	10 V within 10% (up to 1 sec/div sweep rate).		
Rise Time into 50 Ω	5 nsec or less.		
Fall Time into 50 Ω	15 nsec or less.		
Output Resistance	Approximately 950 Ω.		
SIG OUT	Selected by TRIGGER SOURCE buttons.	C2. Check Trigger Selector Operation.	D3. Check Trigger Selector Operation.
Source	Same as TRIGGER SOURCE.		
Output Voltage		Satisfactory operation verified at the factory	
Into 50 Ω	25 mV/div or vertical deflection within 25%.		
Into 1 MΩ	For a maximum output of ±2 V; 0.5 V/div of vertical deflection within 25%.		
Bandwidth into 50 Ω	Varies with vertical plug-in selected. See R7103 Oscilloscope Vertical System Specification, Table 1-7.		
Dc Centering	0 V within 1 V into 1 MΩ.	C1. Check Vertical Signal Out Dc Centering.	D2. Check/Adjust Vertical Signal Out DC Centering.
Aberrations	15% or less peak-to-peak within 20 ns of step.	Satisfactory operation verified at the factory.	
Output Resistance	Approximately 950 Ω.		

TABLE 5-2
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
READOUT DISPLAY			
Readout Modes		F1. Check Readout Modes.	G4. Check Readout Modes.
Free-Run (Not Labeled)	Continuously displayed.		
PULSED	Single-shot operation.		
Pulse Source	Selected by front-panel buttons. + GATE: Triggered by the trailing edge of the + GATE. EXT: Controlled through rear-panel remote control connector. MAN: Manual trigger, independent of other pulse sources.		
DISPLAY			
Graticule		B6. Check Graticule Illuminated Operation.	C6. Check Graticule Illuminated Operation.
Type	Internal, illuminated with variable edge lighting.		
Lighting			
Normal	Continuously lighted.		
PULSED	Single-shot operation. Lights are pulsed on for approximately 0.5 second.		
Pulse Source	Selected by front-panel buttons. + GATE: Triggered by the trailing edge of the + GATE. EXT: Controlled through rear-panel remote control connector. MAN: Manual trigger, independent of other pulse sources.		

TABLE 5-2 (CONT)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
DISPLAY (CONT)			
Area	8 × 10 div. (0.85 cm/div).	Checked at the factory.	
Phosphor	P31.		
Vertical and Horizontal Resolution	17 lines/div.		
Limited Viewing Time Indicator		Checked in the Operators Checkout Procedure, in Section 2.	
Steady Yellow	Crt display time is limited to about 20 min.		
Flashing Yellow	Crt display time is limited to one minute or less and intensity is being limited.		
Shutdown Indicator		Checked in the Operators Checkout Procedure, in Section 2.	
Flashing Red	Crt will be shut off within 10 seconds.		
Steady Red	Indicates crt display is shut off.		
Geometry	Within 0.1 div of vertical and horizontal graticule lines.	A2. Check Geometry.	B5. Check/Adjust Geometry.
BEAMFINDER	When actuated, limits the display within the graticule area and defocuses the display.	Checked in the Operators Checkout Procedure in Section 2.	
Minimum Photographic Writing Speed	20 cm/nsec (without blue filter). Phosphor: Standard P31. Camera: Tektronix C53; f/1.9 1:0.85 lens. Film: Polaroid Type 107; 3000 ASA.	G1. Check Photographic Writing Rate.	H1. Check/Adjust Photographic Writing Rate.
REMOTE CONNECTORS AND SWITCHES			
Control Illumination	High, medium and off. (Three-position switch located on rear panel of power supply).	Checked in the Operators Checkout Procedure in Section 2.	
Camera Power	Three-contact connector compatible with Tektronix C-50 series cameras.	Implicitly checked in step G1. Check Photographic Writing Rate.	Implicitly checked in step H1. Check/Adjust Photographic Writing Rate.

TABLE 5-2 (CONT)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
REMOTE CONNECTORS AND SWITCHES (CONT)			
Camera Power (Cont)		Implicitly checked in step G1. Check Photographic Writing Rate.	Implicitly checked in step H1. Check/Adjust Photographic Writing Rate.
Bottom Pin	Ground		
Center Pin	Single sweep reset.		
Top Pin	+15 V.		
SINGLE SWEEP RESET	Input to reset single-sweep function of time base installed in HORIZ compartment. Also resets Limited Viewing Time circuitry.	Does not normally require customer verification. Satisfactory operation verified at the factory.	
Signal Required	Closure to ground or switching from the high level (+50 V to +10 V; sink less than 40 μA) to the low level (+0.5 V to -5 V; sink less than 12 mA) in less than 1 msec; resets the sweep. Compatible to 15 V open-collector TTL source.		
Minimum Pulse Width	10 μs at 50% amplitude points.		
Maximum Safe Input Voltage	50 V to -5 V (dc + peak ac).		
SINGLE SWEEP READY	Bnc connector on rear panel. Remote ready indicator for HORIZ time base.		
Output Signal	Open when not ready. +5 V at 47 Ω source impedance when ready. Output will light a No. 49 bulb.		
GRAT/READOUT SINGLE SHOT	Bnc connector on rear panel. Switching to the low level (+1 V to -5 V; sink less than 2 mA) from the high level (+10 V to +15 V; sink less than 0.3 mA), in less than 1 μsec, triggers the Readout to display one complete	Does not normally require customer verification. Satisfactory operation verified at the factory.	

TABLE 5-2 (CONT)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
REMOTE CONNECTORS AND SWITCHES (CONT)			
GRAT/READOUT SINGLE SHOT (Cont)	readout frame and the GRAT ILLUM (to be displayed for approximately 0.5 sec.). Compatible to 15 V open collector TTL Source.	Does not normally require customer verification. Satisfactory operation verified at the factory.	
Maximum Open Circuit Voltage	+15 V.		
Maximum Safe Input Voltage	+15 V to -5 V (dc plus peak ac).		
Probe Power	Two probe power connectors on rear panel.		
Pin 1	+5 V.		
Pin 2	Chassis ground.		
Pin 3	-15 V.		
Pin 4	+15 V.		
EXTERNAL Z-AXIS INPUT	Bnc connector on rear panel.	A3. Check External Z-Axis Operation	B7. Check External Z-Axis Operation.
Polarity and Sensitivity	Positive 2 V provides complete blanking from maximum intensity condition. Negative 2 V provides complete unblanking from minimum intensity condition.		
Low Frequency Limit	Dc.	Does not normally require customer verification. Satisfactory operation verified at the factory.	
Input Resistance	Approximately 500 ohms.		
Input Capacitance	Less than 50 pF.		
Open Circuit Voltage	0 V.		
Maximum Safe Input Voltage	15 V, dc plus peak ac.		
Maximum Repetition Rate	1 MHz.		

TABLE 5-2
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
POWER SOURCE			
Voltage Range (AC, RMS)	Selected by rear-panel LINE VOLTAGE SELECTOR.	Does not normally require customer verification. Satisfactory operation verified by other tests.	
115 V Rated	From 90 V to 132 V.		
230 V Rated	From 180 V to 250 V.		
Line Frequency	From 48 Hz to 440 Hz.	Does not normally require customer verification. Satisfactory operation verified at the factory.	
Maximum Power Consumption	165 W, worst case.		
Maximum Current	3.3 A at 60 Hz, 90 V line. 1.7 A at 60 Hz, 180 V line.		
Fuse	4 A fast blow. (For both LINE VOLTAGE SELECTOR ranges.)		

ADJUSTMENT INTERVAL

To maintain instrument accuracy, check performance every 1000 hours of operation, or every 6 months if used infrequently. Before complete adjustment, thoroughly clean and inspect the R7103 as outlined in the Maintenance section.

TEKTRONIX FIELD SERVICE

Tektronix Field Service Centers and the Factory Service Center provide instrument repair and adjustment services. Contact your Tektronix Field Office or representative for further information.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 5-3 is required for a complete Adjustment and Performance Check of the R7103. If only a Performance Check is to be performed, the items required for Adjustment are not required and are indicated by footnote 1. The remaining test equipment is common to both procedures.

The specifications for test equipment given in Table 5-3 are the minimum required to meet the performance requirements. Detailed operating instructions for test equipment are omitted in these procedures. Refer to the test equipment instruction manual if more information is needed.

SPECIAL FIXTURES

Special fixtures are used only where they facilitate instrument adjustment. These fixtures are available from Tektronix, Inc. Order by part number from Tektronix Field Offices or representatives.

TEST EQUIPMENT ALTERNATIVES

All the listed test equipment is required to completely check and adjust the R7103. However, complete checking or adjusting may not always be necessary or desirable. You may be satisfied with checking selected characteristics only, thereby reducing the amount of test equipment actually required.

The Adjustment and Performance Check procedures in Part II are based on the first item of equipment given as an example. When other equipment is substituted, control settings or setups may need to be altered. If the exact item of equipment given as an example in Table 5-3 is not available, first check the Minimum Specifications column carefully to see if any other equipment might suffice. Then check the Purpose column to see where this item is used. If used for a performance check or adjustment that is of little or no importance for your measurement requirements, the item and corresponding step(s) can be deleted.

TABLE 5-3
Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Test Oscilloscope	Bandwidth, dc to 200 megahertz; minimum deflection factor, 10 millivolts/division; accuracy, within 3%. Dual-channel with an inverting input and both added and alternate vertical modes.	Used throughout calibration procedure.	a. TEKTRONIX 7704A Oscilloscope System with 7A18 and 7A29 Amplifier; 7B80 or 7B10 Time Base, and P6053B Probe. b. TEKTRONIX 475 Oscilloscope with P6053B Probe. c. Refer to the Tektronix Products catalog for compatible oscilloscope system.
2. Amplifier	Tektronix 7A-series plug-in amplifier.	Used throughout procedure to provide vertical input to the instrument under test.	a. TEKTRONIX 7A29 Amplifier.
3. Amplifier (dual-trace)	Tektronix dual-trace plug-in amplifier. Input impedance, 1 MΩ.	Used to check position and operation of readout display.	a. TEKTRONIX 7A18A or 7A26 dual-trace amplifier (may be shared with a 7000-series test oscilloscope).
4. Time-Base (two required)	Any Tektronix 7B-series time base with a sweep rate of 200 ps/division.	Used throughout procedure to provide sweep.	a. TEKTRONIX 7B15 Time Base. b. TEKTRONIX 7B10 Time Base.
5. Signal Standardizer (two required)	Produces gain-check and pulse-response waveforms.	Used throughout procedure to standardize instrument so plug-in units can be interchanged without complete readjustment, and to adjust crt geometry.	a. Tektronix Calibration Fixture 067-0587-02. b. 7000-series plug-in units with suitable signal sources may be substituted if lower performance is acceptable.
6. Plug-In Extender[1] (Rigid Calibration Fixture)	Provides access to power supply voltages.	Power Supply Voltage, Trigger System check. and adjustment.	a. Tektronix Part 067-0589-00.
7. Camera	f/1.9, 1:0.85 lens.	Check Photographic writing rate.	a. TEKTRONIX C-53 Oscilloscope Camera.
8. Precision DC Voltmeter (DVM)	Range, −75 to +200 volts; accuracy, within 0.1%.	Check and adjustment of calibrator output accuracy, power supply voltages and Z-axis display voltages	a. TEKTRONIX DM 501A Digital Multimeter with power module. b. Fluke Model 825A Differential DC Voltmeter.
9. DC Voltmeter (VOM) with Test Leads	Range, to −2500 volts; accuracy, checked to within 1% at −2265 volts.	High-voltage power supply adjustment and geometry.	a. Valhalla Model 4500 H.V. Digital Multimeter Tektronix Part 003-0120-00.

[1]Used for Part II—Adjustment and Performance Check only; NOT used for Part I—Performance Check.

TABLE 5-3 (CONT)
Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
10. Time-Mark Generator	Marker outputs, 1 nanosecond to 0.1 second; marker accuracy, within 0.1%; trigger output, 1 millisecond.	Check and adjustment of horizontal timing, and calibrator frequency.	a. TEKTRONIX TG 501 Time-Mark Generator with power module.
11. Low-Frequency Sine-Wave Generator	Frequency, 250 kilohertz to 250 megahertz; output amplitude, variable from 50 millivolts to 3 volts into 50 ohms.	Check and adjust horizontal bandwidth and external Z-axis input.	a. TEKTRONIX SG 503 Leveled Sine-Wave Generator with power module. b. General Radio 1310-B Oscillator.
12. High-Frequency Sine-WAve Generator	Frequency 245 megahertz to 1 gigahertz; reference frequency, 20 megahertz or lower; output amplitude, variable from 0.5 to 4 volts into 50 ohms; amplitude accuracy, constant within 1% of reference as output frequency changes.	Check and adjustment of vertical bandwidth and vertical channel isolation.	a. TEKTRONIX SG 504 Leveled Sine-Wave Generator. b. Wiltron Model 610C Swept Frequency Generator with Model 61083C, 10 to 1220 megahertz plug-in.
13. 10X Passive Probe[1]	Compatible with test oscilloscope to be used.	Used to check signals out, calibrator and Z-axis adjustment.	a. TEKTRONIX P6053B or P6054A Probe.
14. 100X Probe	Compatible with test oscilloscope to be used; impedance, 5 kilohms.	Used to check Z-axis adjustment.	a. TEKTRONIX P6057 Probe.
15. Coaxial Cable (two of each length required)	Impedance, 50 ohms; type, RG-58/U; length, 18 and 42 inches; connectors, bnc.	Signal interconnection.	a. Tektronix Part 012-0076-00 (18 inches) and Tektronix Part 012-0057-01 (42 inches).
16. 2X Attenuator	Impedance, 50 ohms; 2X accuracy, within 2%, connectors, bnc.	Output termination for signal generators, if amplifier unit is not 50-ohm input impedance.	a. Tektronix Part 011-0069-02.
17. Adapter, bnc 'T'	Connectors: bnc male, one; bnc female, two;	Used to check external Z-axis operation and X-Y compensation. impedance, 50 Ω.	a. Tektronix Part 103-0030-00.
18. Nylon Tuning Tool[1]	1-inch shaft.	Adjust vertical high-compensation.	a. Tektronix Part 003-0675-00.
19. Screwdriver, low Capacitance[1]	1-inch shaft.	Used throughout adjustment procedure to adjust variable components.	a. Tektronix Part 003-0000-00.
20. Screwdriver[1]	Three-inch shaft, 3/32-inch bit.	Used throughout procedure	a. Xcelite R3323. to adjust variable resistors.

[1]Used for Part II—Adjustment and Performance Check only; NOT used for Part I—Performance Check.

PART I—PERFORMANCE CHECK

The following procedure (Part I—Performance Check) verifies electrical specifications without removing instrument covers or making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual.

Part II—Adjustment and Performance Check provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that all controls function properly, and (3) perform all internal adjustments.

A separate Operators Checkout Procedure is provided in section 2 for familiarization with the instrument and also to verify that all controls, indicators and connectors function properly.

NOTE

Turn the R7103 off before installing or removing plug-in units.

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PERFORMANCE CHECK POWER-UP SEQUENCE

NOTE

The R7103's performance can be checked at any ambient temperature from 0° to +50° C unless otherwise stated. Adjustments must be performed at an ambient temperature from +20° to +30° C for specified accuracies.

1. Check that the LINE VOLTAGE SELECTOR is set for the correct input line voltage.

2. Connect the instrument power cord to the power source.

3. Turn the instrument POWER on and allow at least 20 minutes before proceeding.

A. Z-AXIS AND DISPLAY

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. Test oscilloscope
3. Amplifier (1 MΩ input impedance)
4. Time base
15. Coaxial cables (two required)
17. Adapter, bnc "T"

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

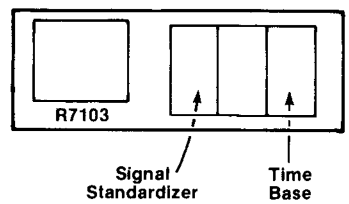
Z-AXIS AND DISPLAY PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... LEFT
TRIGGER SOURCE .... VERT MODE
INTENSITY......... Fully counterclockwise
FOCUS.......................... Midrange
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... Midrange
BEAMFINDER .... Pushbutton out

A1. CHECK TRACE ALIGNMENT

A1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Signal Standardizer
Test Selector .... Vert or Horiz Aux In

Time Base
Time/Div .... 1 ms
Magnifier X1
Triggering .... Auto, AC, Internal

5039-539

a. Set the INTENSITY control for a visible trace. Set the FOCUS and ASTIG controls for a well-defined trace.

b. Position the trace to the center graticule line.

c. **CHECK**—that the trace parallels the center graticule line within 0.1 division.

d. **ADJUST**—the front-panel TRACE ROTATION adjustment to align the trace with the vertical center graticule line.

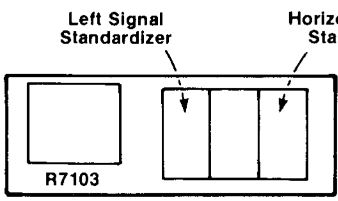
A2. CHECK GEOMETRY

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

A2. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... ALT



Test Equipment Controls:
Left Signal Standardizer
Test Selector .... Vert or Horiz Gain
Rep Rate .... 10 kHz

Horizontal Signal Standardizer
Test Selector .... Vert or Horiz Gain
Rep Rate .... 1 MHz

5039-540

a. Set the INTENSITY control for a visible display.

b. Set the FOCUS and ASTIG controls for a well-defined display.

c. **CHECK**—for a dot matrix whose dots can be set at the intersections of the graticule lines within 0.1 division.

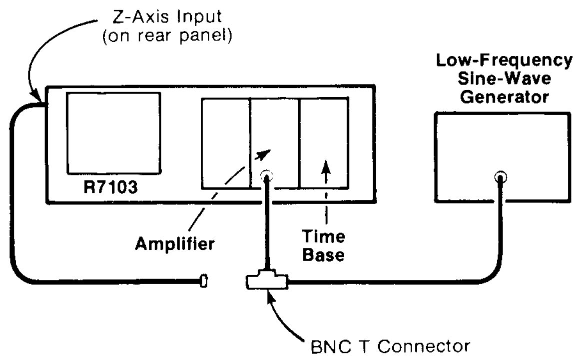
A3. CHECK EXTERNAL Z-AXIS OPERATION

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

A3. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Amplifier
Volts/Div .... 0.5 V

Time Base
Time/Div .... 20 μs
Triggering .... Auto, AC, Internal

5039-541

a. Set the INTENSITY control for a dim display.

b. Set the low-frequency sine-wave generator for a four-division display at 50 kilohertz (the reference frequency). The four-division display indicates one volt above and below ground.

c. *Momentarily* connect the cable from the Z-AXIS INPUT connector on the rear panel to the bnc T connector at the input of the amplifier.

d. **CHECK**—that the positive portion of the displayed waveform is blanked while performing part c.

B. CALIBRATOR AND OUTPUT SIGNALS

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. Test oscilloscope
4. Time base
8. Precision DC Voltmeter (DVM)
10. Time-mark generator
15. Coaxial cable (one 18-inch, two 42-inch required)
17. Adapter, bnc T

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

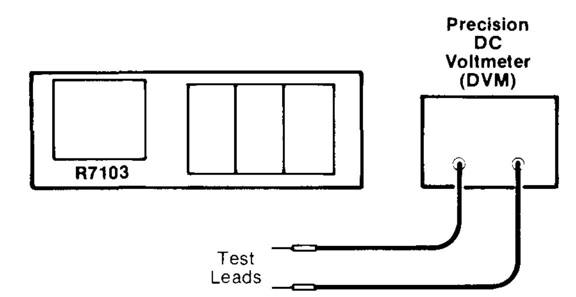
CALIBRATOR AND OUTPUT SIGNALS PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Fully counterclockwise
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... Midrange
BEAMFINDER .... Pushbutton out
CALIBRATOR .... 4 V pushbutton in

B1. CHECK CALIBRATOR OUTPUT VOLTAGE

B1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Precision DC Voltmeter (DVM)
Voltage Range .... Appropriate range for voltage to be measured.

5039-542

a. Press in both the 4 V and 0.4 V CALIBRATOR buttons.

b. Connect the precision dc voltmeter Volts/Ω lead to the CALIBRATOR output connector, and the Low lead to the R7103 front-panel ground lug.

c. **CHECK**—that the meter reading is 0.4008 volt, within the limits of 0.4004 to 0.4012 volt.

B2. CHECK CALIBRATOR 1 kHz REPETITION RATE

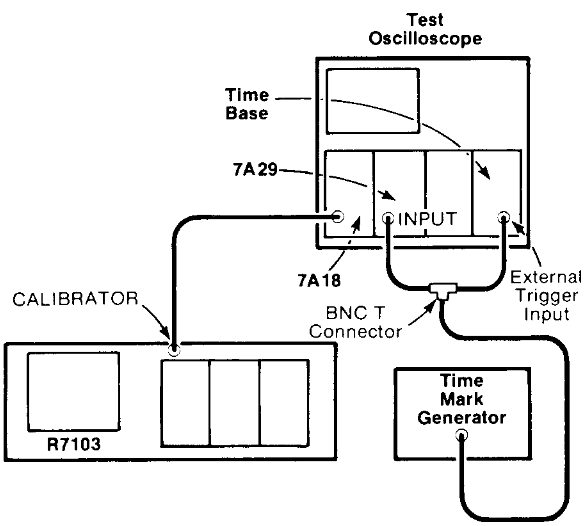
NOTE

A frequency counter with an accuracy of at least 0.1% may be used to adjust the calibrator repetition rate.

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

B2. SETUP CONDITIONS

R7103 Controls:
CALIBRATOR .... 0.4 V pushbutton in



Test Equipment Controls:
Time-Mark Generator .... 1 ms markers

Test Oscilloscope
Time/Div .... 1 ms
Triggering .... Auto, AC, External
Input Coupling .... DC
Vertical Mode .... Alt
Volts/Div
Left 0.2
Right 0.5

5039-543

a. Set the test oscilloscope Triggering Level for a stable time-mark display.

b. Observe that the 1 kHz Calibrator signal drifts across the crt of the test oscilloscope.

c. **CHECK**—that the time required for one cycle of the square-wave Calibrator signal to drift from one side of the display to the other side is 10 seconds or more.

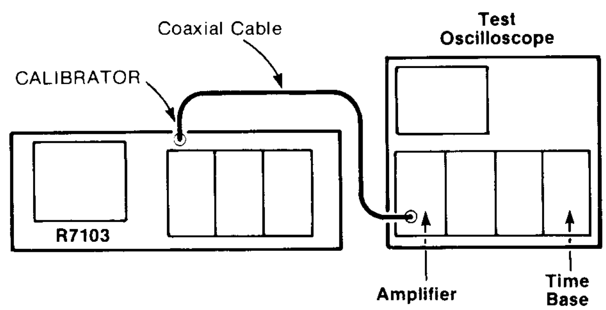
B3. CHECK CALIBRATOR RISE TIME, FALL TIME, AND DUTY CYCLE

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

B3. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope
Time/Div .... 0.2 ms
Triggering .... Auto, AC, Internal

5039-544

a. Connect the CALIBRATOR output to the inverting vertical input of the test oscilloscope.

b. Set the test oscilloscope vertical deflection to display four divisions of CALIBRATOR signal.

c. Set the time-base Time/Div to .1 μs.

d. Set the test oscilloscope for a stable display, triggered at the start of the calibrator signal.

e. **CHECK**—the displayed waveform for not more than five horizontal divisions between the 10% to 90% points of the waveform (rise time, 0.5 microsecond or less).

f. Set the time base Triggering Slope to minus.

g. Set the test oscilloscope for a stable display triggered on the negative transition of the waveform.

h. **CHECK**—the displayed waveform for not more than five divisions between the 90% and 10% points (fall time, 0.5 microsecond or less).

i. Set the test oscilloscope as follows:

Time/div.......................... 0.1 ms
Triggering
  Mode.............................. Auto
  Coupling .... AC
  Source .... Internal
  Slope .... +
  Level..........So that the display starts at the 50% point of the positive transition.

j. Set the test oscilloscope sweep magnifier to X10. Then move the display horizontally to align the negative transition of the waveform with the center vertical graticule line.

k. Set the test oscilloscope vertical to invert the display. (NOTE: The display is triggered on the opposite slope, even though the display appears the same.)

l. **CHECK**—that the 50% point on the falling edge of the waveform now displayed is within 0.2 horizontal division of the center line. (Indicates duty cycle of 50% within 0.2%.)

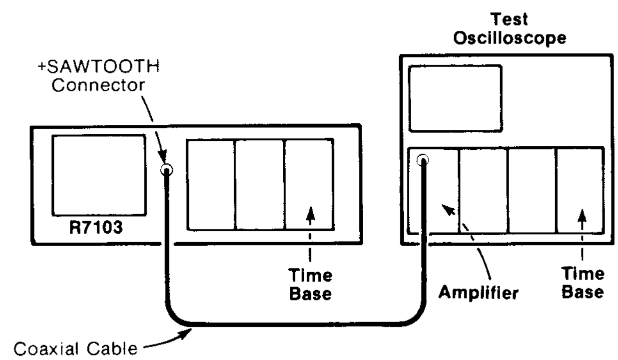
B4. CHECK SAWTOOTH OUTPUT SIGNAL

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

B4. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope
  Time/Div .... 2 ms
  Volts/Div .... 2 V
  Display Mode .... Ch 1

Time Base
  TimeDiv .... 0.2 ms
  Triggering .... Auto

5039-545

a. Connect the +SAWTOOTH output connector to the test oscilloscope channel 1 vertical input (1 megohm input).

b. **CHECK**—that 1) the slope of the test oscilloscope display is two volts/division within 10% (a 10-volt sawtooth signal is required to produce a 10-division sweep on R7103 crt), and that 2) the sawtooth baseline is within one volt of ground.

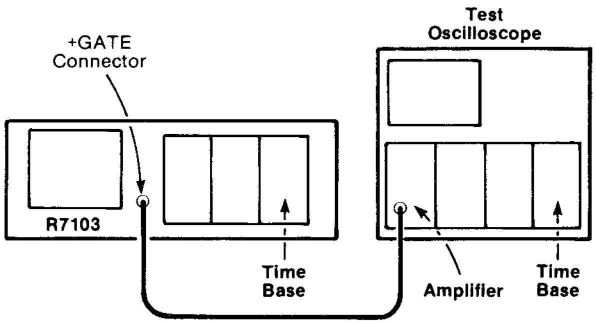
B5. CHECK GATE OUTPUT SIGNAL

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

B5. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope
Volts/Div .... 2 V
Time/Div .... 2 ms
Magnifier X1

Time Base
TimeDiv .... 0.2 ms
Triggering .... Auto, AC, Internal

5039-546

a. **CHECK**—the test oscilloscope display for a gate waveform five divisions in amplitude, within 10%, and a baseline at zero volts, within one volt.

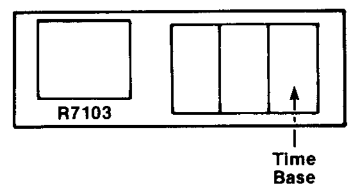
B6. CHECK GRATICULE ILLUMINATION OPERATION

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

B6. SETUP CONDITIONS

R7103 Controls:
GRAT ILLUM +GATE or EXT switch .... +GATE



Test Equipment Controls:
Time Base
Time/Div .... 0.2 s
Triggering .... Auto, AC, Internal

5039-547

a. **CHECK**—that rotating the GRAT ILLUM control through its range varies the illumination of the graticule.

b. Set the GRAT ILLUM control fully clockwise to the PULSED detent position.

c. Set the INTENSITY control for a visible display.

d. **CHECK**—that the graticule is illuminated only after the time-base unit completes a sweep (adjust GRAT ILLUM PRESET, if necessary).

e. Set the GRAT ILLUM +GATE or EXT switch to EXT

f. **CHECK**—that pressing the GRAT ILLUM MAN pushbutton causes a momentary illumination of the graticule.

g. Set the GRAT ILLUM control to midrange (out of the PULSED detent position).

C. TRIGGER SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. Test oscilloscope
3. Amplifier (dual trace)
4. Time base
5. Signal standardizer (two required)
15. Coaxial cable (42-inch)

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

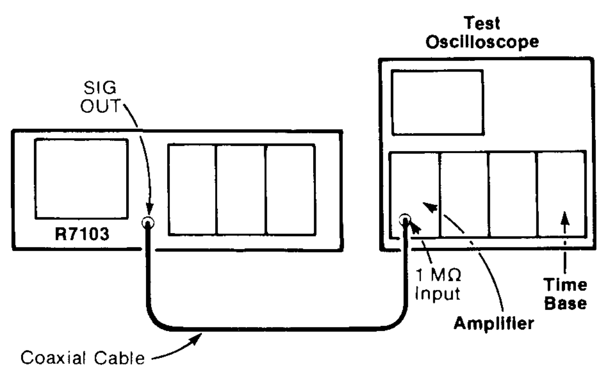
TRIGGER SYSTEM PRELIMINARY CONTROL SETTINGS

POWER	On
VERTICAL MODE	RIGHT
TRIGGER SOURCE	VERT MODE
INTENSITY	Fully counterclockwise
FOCUS	Midrange
READOUT INTENSITY	OFF (in detent)
GRAT ILLUM	Midrange
BEAMFINDER	Pushbutton out

C1. CHECK VERTICAL SIGNAL OUT DC CENTERING

C1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope

Input Coupling	Gnd or Off
Volts/Div	1 V
Display Mode	Ch 1
Time/Div	1 ms

5039-548

a. Establish a ground reference for the test oscilloscope by setting the trace to the graticule center line. Do not move the test oscilloscope position control after setting this ground reference.

b. Set the test oscilloscope input coupling switch to dc.

c. **CHECK**—the test oscilloscope display for a dc level within one division of the ground reference established in part a.

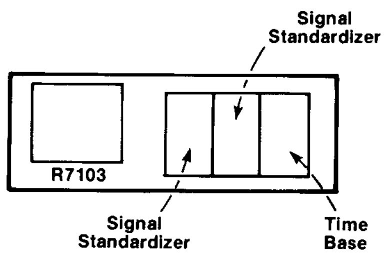
C2. CHECK TRIGGER SELECTOR OPERATION

NOTE

If the preceding step was not performed, first refer to the Trigger System Preliminary Control Settings, then proceed.

C2. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... LEFT
TRIGGER SOURCE .... VERT MODE



Test Equipment Controls:
Signal Standardizer (Right)
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 10 kHz

Signal Standardizer (Left)
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 1 kHz

Time Base
Time/Div .... 0.2 ms
Magnifier X1
Triggering .... Auto, AC, Internal
Mode..................................... Independent

5039-549

a. Set the INTENSITY control for a visible display. Set the signal standardizer Amplitude control for a two-division display in the upper half of the graticule area. Use the time-base Triggering Level control to trigger the display.

b. Set the VERTICAL MODE to RIGHT.

c. Set the signal standardizer Amplitude and Position controls for a two-division display in the lower half of the graticule area.

d. Set the VERTICAL MODE to ALT.

e. **CHECK**—the crt display for 1 kHz and 10 kHz triggered waveforms (adjust the time base Trigger Level controls as necessary).

f. Set the VERTICAL MODE to ADD.

g. **CHECK**—the crt display for a triggered waveform.

h. Set the VERTICAL MODE to CHOP.

i. **CHECK**—the crt display for a stable display of the 1-kHz waveform only.

j. Set the TRIGGER SOURCE to LEFT VERT.

k. **CHECK**—sequentially select all positions of the VERTICAL MODE selector (except RIGHT) and check for a stable display of the 1-kHz waveform only.

l. Set the TRIGGER SOURCE to RIGHT VERT.

m. **CHECK**—sequentially select all positions of the VERTICAL MODE selector (except LEFT) and check for a stable display of the 10-kHz waveform only.

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D. HORIZONTAL SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

2. Amplifier
4. Time base
5. Signal standardizer
10. Time-mark generator
11. Low-frequency sine-wave generator
15. Coaxial cable (42-inch)

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

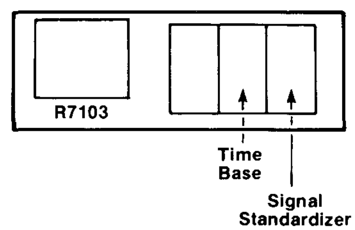
HORIZONTAL SYSTEM PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Fully counterclockwise
FOCUS .... Midrange
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... As desired
BEAMFINDER .... Pushbutton out

D1. CHECK HORIZONTAL AMPLIFIER GAIN

D1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Signal Standardizer
Test Selector .... Vert or Horiz Gain
Rep Rate .... 1 MHz

Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

5039-550

a. Set the INTENSITY control for a visible trace.

b. Use the signal standardizer Position control to align the bright vertical trace with the center vertical graticule line.

c. **CHECK**—for eight divisions of deflection between the center nine traces within 0.08 division.

d. **CHECK**—that the other vertical traces align with their respective graticule lines within 0.05 division.

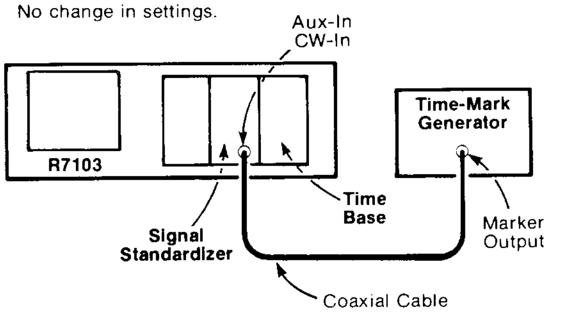
D2. CHECK HIGH-FREQUENCY TIMING

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed.

D2. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal
Mode .... Independent

Signal Standardizer
Test Selector .... Vert or Horiz Freq Resp

Time-Mark Generator .... 1 ms markers

5039-551

a. Adjust the signal standardizer Amplitude control for two divisions of display. Set the INTENSITY control for a visible display, if necessary.

b. Set the time-base triggering controls for a stable display.

c. Position the first marker to the extreme left line on the graticule.

d. Set the time-base sweep calibration control for one marker at each major graticule division between the second and tenth graticule lines (center eight divisions).

e. **CHECK**—that the other time marks do not diverge from the graticule lines by more than 0.05 division.

NOTE

If there are timing nonlinearities, refer to the time-base instruction manual for performance check or adjustment procedures for checking high-frequency timing and linearity.

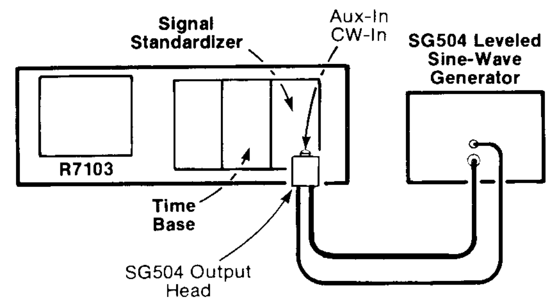
D3. CHECK HORIZONTAL BANDWIDTH

NOTE

If the preceding step was not performed, refer to the Horizontal System Preliminary Control Settings, then proceed.

D3. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

Signal Standardizer
Test Selector .... Vert or Horiz Freq Resp

5039-552

a. Set the high-frequency sine-wave generator for eight divisions of displayed signal on the R7103 crt at the generator's reference frequency (6 MHz).

b. Set the high-frequency sine-wave generator output frequency to 350 MHz.

c. **CHECK**—that the 350 MHz display is at least 5.7 divisions in amplitude.

E. VERTICAL SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

2. Amplifier
4. Time base
5. Signal standardizer (two required)
11. Low-frequency sine-wave generator
12. High-frequency sine-wave generator

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

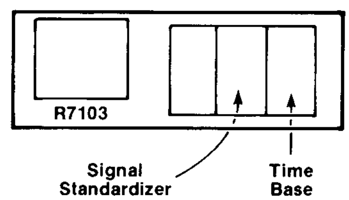
VERTICAL SYSTEM PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Midrange
FOCUS .... Midrange
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... As desired
BEAMFINDER .... Pushbutton out

E1. CHECK VERTICAL AMPLIFIER GAIN

E1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, External

Signal Standardizer
Test Selector .... Vert or Horiz Gain
Rep Rate .... 100 kHz

5039-553

a. Position the signal standardizer display to align the bright center trace with the graticule center line.

b. **CHECK**—for one trace per graticule division within 0.06 division over the center six graticule divisions. Note the exact error for comparison in part e.

c. Remove the signal standardizer from the RIGHT VERT compartment and install it in the LEFT VERT compartment.

d. Set the VERTICAL MODE switch to LEFT.

e. **CHECK**—for one trace per graticule division within 0.06 division of the error noted in part b, over the center six graticule divisions.

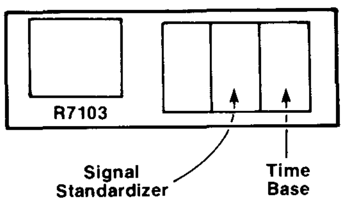
E2. CHECK VERTICAL LOW-FREQUENCY LINEARITY

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

E2. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

Signal Standardizer
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 1 kHz

5039-554

a. Set the signal standardizer Amplitude and Position controls so the display is exactly two divisions in amplitude in the center of the graticule area.

b. **CHECK**—that moving the two-division display vertically causes no more than 0.1 division of compression or expansion anywhere within the graticule area.

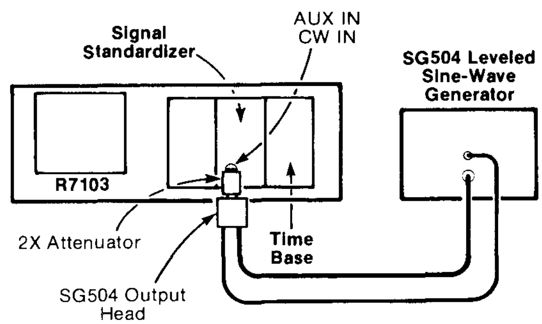
E3. CHECK VERTICAL AMPLIFIER 1 GHz GAIN (0° to +35°C)

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

E3. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 0.1 ms
Triggering .... Auto, AC, External

Signal Standardizer
Test Selector .... Vert or Horiz Freq Resp

High-Frequency Sine-Wave Generator
Reference Frequency .... 6 MHz

5039-555

a. Set the signal standardizer Amplitude control fully clockwise.

b. Connect the high-frequency sine-wave generator to the signal standardizer Aux In CW In (Freq Resp) input with a 2X attenuator.

c. Set the high-frequency sine-wave generator for a 10-division display at the reference frequency (between 6 and 50 megahertz) centered on the graticule. (To obtain a 10-division display, first set for eight divisions, then vertically position the display one division down and set the sine-wave generator to return the top of the display to the top of the graticule.)

d. Set the signal standardizer Amplitude control for a six-division display, centered on the graticule. (The CW Leveled indicator should be lit.)

e. Without changing the output amplitude, increase the sine-wave generator frequency until the displayed amplitude is reduced to five divisions. If the CW Leveled indicator goes off, increase the amplitude of the sine-wave generator signal until the light just turns on.

NOTE

The signal standardizer CW Leveled light must be on and the sine-wave generator must be properly connected for a valid check. Refer to the signal standardizer and high-frequency sine-wave generator manuals.

f. **CHECK**—that the sine-wave generator frequency is 1 gigahertz or higher (verifies 1 gigahertz gain).

g. Move the signal standardizer to the LEFT VERT compartment (leave signal connected) and set the VERTICAL MODE switch to LEFT.

h. **CHECK**—Repeat parts d through f for the LEFT VERT compartment.

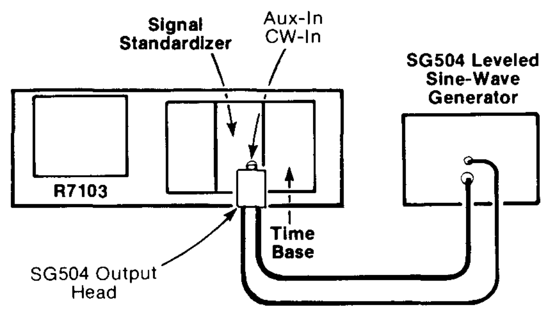
E4. CHECK VERTICAL CHANNEL ISOLATION

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

E4. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

Signal Standardizer
Test Selector .... Vert or Horiz Aux In

High-Frequency Sine-Wave Generator
Frequency .... 1 GHz

5039-556

a. Set the output of the high-frequency sine-wave generator and the signal standardizer Amplitude control for eight divisions of deflection at one gigahertz.

b. Set the VERTICAL MODE to LEFT.

c. **CHECK**—the crt display amplitude for 0.1 division or less (this verifies isolation of at least 80:1 at 1 gigahertz).

d. Move the signal standardizer to the LEFT VERT compartment without disturbing the connections.

e. Set the VERTICAL MODE to RIGHT.

f. **CHECK**—the crt display amplitude for 0.1 division or less of the 1 gigahertz signal (verifies isolation of at least 80:1 at 1 gigahertz).

g. Set the VERTICAL MODE to LEFT.

h. Connect the low-frequency sine-wave generator to the Aux In-CW In input of the signal standardizer.

i. Set the low-frequency sine-wave generator for eight divisions of deflection at 100 megahertz.

j. Set the VERTICAL MODE to RIGHT.

k. **CHECK**—for a display amplitude for 0.05 division or less of 100 megahertz signal (verifies 100 megahertz isolation of at least 160:1).

l. Move the signal standardizer to the RIGHT VERT compartment without disturbing the connections.

m. Set the VERTICAL MODE to LEFT.

n. **CHECK**—the crt display amplitude for 0.05 division or less of 100 megahertz signal (verifies isolation of at least 60:1 from dc to 100 megahertz).

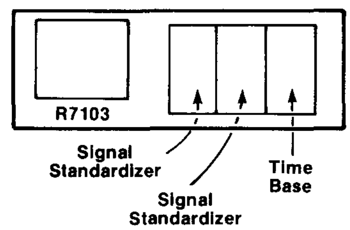
E5. CHECK VERTICAL DISPLAY MODES

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

E5. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, External

Signal Standardizer (Right)
Test Selector .... Vert or Horiz + Step Resp
Rep Rate .... 1 kHz

Signal Standardizer (Left)
Test Selector .... Vert or Horiz + Step Resp
Rep Rate .... 1 kHz

5039-557

a. Set the trace to the upper half of the graticule area with the right Position control.

b. Set the VERTICAL MODE to LEFT and position the trace to the lower half of the graticule area with the left Position control.

c. **CHECK**—the crt display for two traces in the ALT and CHOP positions of the VERTICAL MODE selector.

d. Set the VERTICAL MODE selector to ADD.

e. **CHECK**—the crt display for a single trace that can be positioned vertically with the left or right Position control.

F. READOUT SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

3. Amplifier (dual trace)
4. Time base

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change information at the rear of this manual for any modifications which may affect this procedure.

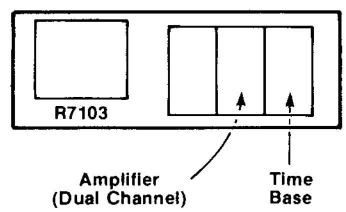
READOUT SYSTEM PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE ....RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY..................... Midrange
READOUT INTENSITY ....OFF (in detent)
GRAT ILLUM .... Midrange
BEAMFINDER .... Pushbutton out

F1. CHECK READOUT MODES

F1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

Amplifier
Display Mode .... Alt

5039-558

a. Set the READOUT INTENSITY control for a visible display.

b. **CHECK**—set the time-base to several sweep rates throughout its range and check that the readout characters are displayed independently of the sweep rate.

c. Set the READOUT +GATE or EXT switch to +GATE and the READOUT INTENSITY control to PULSED.

d. Set the READOUT PRESET control for a visible readout display.

e. Set the time-base for a free-running (not triggered) sweep at a rate of 0.2 second/division.

f. **CHECK**—that the readout characters are blanked 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.

g. Set the READOUT +GATE or EXT switch to EXT.

i. **CHECK**—that pressing the READOUT MAN pushbutton causes one frame of readout to be displayed.

G. PHOTOGRAPHIC WRITING RATE

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

2. Amplifier	7. Camera
4. Time base	12. High-frequency sine-wave generator

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

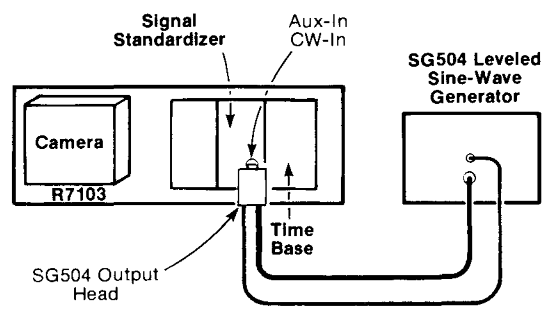
PHOTOGRAPHIC WRITING RATE PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Counterclockwise
READOUT INTENSITY ... OFF (In detent)
GRAT ILLUM .... PULSED
BEAMFINDER .... Pushbutton out

G1. CHECK PHOTOGRAPHIC WRITING RATE

G1. SETUP CONDITIONS

R7103 Controls:
GRAT ILLUM +GATE or EXT .... +GATE



Test Equipment Controls:
Signal Standardizer
Test Selector .... Vert or Horiz Aux In

Time Base
Time/Div .... 5 ns
Triggering .... Auto, AC, Internal
Magnifier X10

High-Frequency Sine-Wave Generator
Frequency .... 1 GHz

Camera
Mode .... Time
Aperture .... f 1.9

5039-559

NOTE

Section 2, Operating Instructions, contains helpful information on obtaining waveform photographs; see Graticule Illumination, Light Filter, Readout Display and Display Photography.

a. Set the INTENSITY control for a visible display.

b. Set the time base sweep magnifier to X10.

c. Set the high-frequency sine-wave generator output amplitude to display a 7.5 division signal on the R7103 crt.

d. Set the time base triggering controls for a stable display.

e. Set the FOCUS and ASTIG controls for a well-defined display.

f. Set the time base to single-sweep mode.

g. Sequentially press the time base single sweep reset control and set the GRAT ILLUM PRESET control to illuminate the graticule.

h. Focus the camera.

i. Install 3000 ASA film in the camera and close the camera viewing port.

j. Rotate the INTENSITY control fully clockwise.

k. Press the camera shutter button.

l. Press the time base Single Sweep Reset button.

m. Press the camera shutter button.

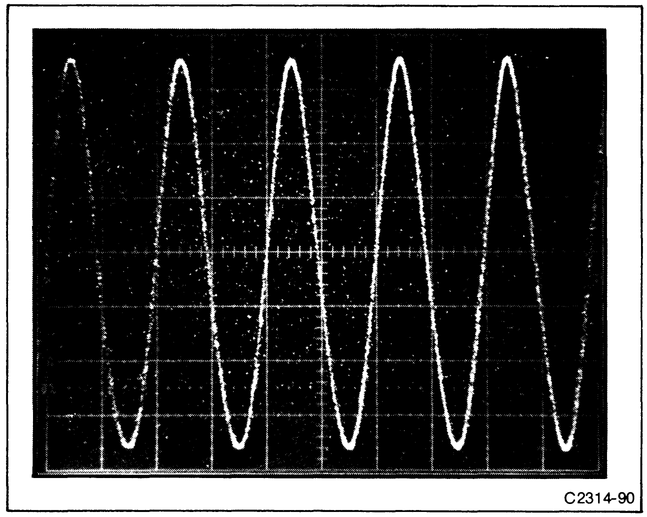


Figure 5-1. Typical display of Photographic Writing Rate test.

n. Develop film.

o. **CHECK**—that the photograph shows the 1 GHz sine-wave signal clearly (see Fig. 5-1 for typical photograph).

This concludes the Part I—Performance Check procedure.

PART II—ADJUSTMENT AND PERFORMANCE CHECK

The following procedure (Part II—Adjustment and Performance Check) provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that all controls function properly, and (3) perform all internal adjustments.

Part I—Performance Check verifies electrical specifications without removing instrument covers or making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual.

A separate Operators Checkout Procedure is provided in the Operators Manual for familiarization with the instrument and also to verify that all controls, indicators and connectors function properly.

NOTE

Turn the R7103 Power off before removing or installing plug-in units.

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ADJUSTMENT AND PERFORMANCE CHECK POWER-UP SEQUENCE

NOTE

The performance of the R7103 can be checked at any ambient temperature from 0° to +50° C unless otherwise stated. Adjustments must be performed at an ambient temperature from +20° to +30° C for specified accuracies.

1. Check that the LINE VOLTAGE SELECTOR is set to match the available line voltage.

2. Remove the top, bottom, and side cabinet panels to gain access to internal adjustments and test points.

3. Turn the instrument POWER switch on and allow at least 20 minutes warmup before proceeding.

A. POWER SUPPLY

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

8. Precision dc voltmeter (DVM)
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations A** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

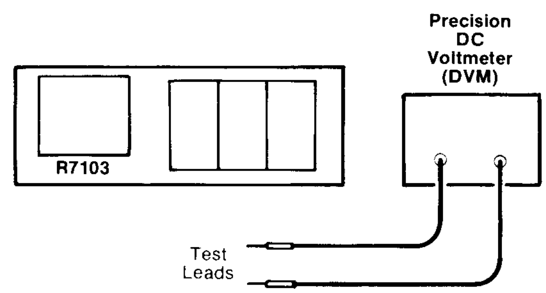
POWER SUPPLY PRELIMINARY CONTROL SETTINGS

POWER switch .... On
READOUT INTENSITY ....OFF (in detent)
GRAT ILLUM .... Counterclockwise
BEAMFINDER .... Push button out
All other controls .... No change

A1. ADJUST INVERTER CONTROL (R93)

A1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Precision DC Voltmeter (DVM)
Voltage Range .... 200 V dc

5039-501

a. Connect the precision dc voltmeter between TP126 and chassis ground (accessible from the bottom of the instrument).

b. **EXAMINE**—the Meter for a reading of +108 volts within the limits of +107.5 to +108.5 volts. If the reading is within the given tolerance, proceed to step A2.

c. **ADJUST**—Pre Reg Adj adjustment, R93, for a meter reading of +108 volts within 0.5 volt.

d. **INTERACTION**—Any change in the setting of R93 may affect the adjustment of the -50 volt power supply (R15).

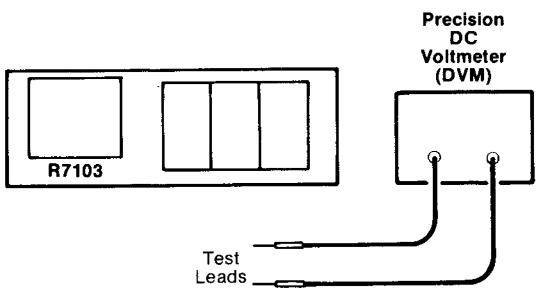
A2. ADJUST +50 VOLT POWER SUPPLY (R15)

NOTE

If the preceding step was not performed, first refer to the Power Supply Preliminary Control Settings, then proceed.

A2. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Precision DC Voltmeter (DVM)
Voltage Range .... 200 V dc

5039-502

a. Connect the precision dc voltmeter between TP −50 V Sense and TP Ground Sense on the A25 Regulator Board.

b. **EXAMINE**—the meter for a reading of −50 volts, within the limits of -49.8 to -50.2 volts.

c. **ADJUST**—+50 V adjustment R15 for a meter reading of −50 volts within 0.1 volt.

d. **INTERACTION**—Any change in the setting of R15 may affect the operation of all circuits in the instrument.

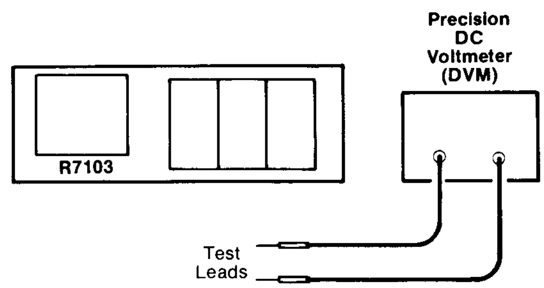
A3. EXAMINE POWER-SUPPLY VOLTAGES

NOTE

If the preceding step was not performed, first refer to the Power Supply Preliminary Control Settings, then proceed.

A3. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Precision DC Voltmeter (DVM)
Voltage Range .... Appropriate range for voltage to be measured.

5039-503

a. **EXAMINE**—Table 5-4 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 common lead to TP Ground Sense.

b. **INTERACTION**—If the power supplies are not within the tolerances given in Table 5-4, repeat steps A1 and A2.

TABLE 5-4
Power Supply Tolerance

Power Supply	Output Voltage Limits
TP -50 V Sense	-49.8 to -50.2 Volts
TP -15 V Sense	-14.85 to -15.15 Volts
TP +5 V Sense	+4.9 to +5.1 Volts
TP +15 V Sense	+14.85 to +15.15 Volts
TP +50 V Sense	+49.5 to +50.5 Volts

c. Disconnect the precision dc voltmeter.

NOTE

Regulation of the individual power supplies can be checked using the procedure given under Troubleshooting Techniques in the Maintenance section.

B. Z-AXIS AND DISPLAY

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. Test oscilloscope
2. or 3. Amplifier
4. Time base (two required)
5. Signal standardizer (two required)
8. Precision dc voltmeter (DVM)
9. DC voltmeter (VOM)
11. Low-frequency sine-wave generator
12. High-frequency sine-wave generator
13. 10X passive probe
14. 100X probe
15. Coaxial cable (two 42-inch required)
16. 2X attenuator
17. Adapter, bnc 'T'
19. Screwdriver, low-capacitance
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations B** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

(4) Remove the bottom cabinet cover.

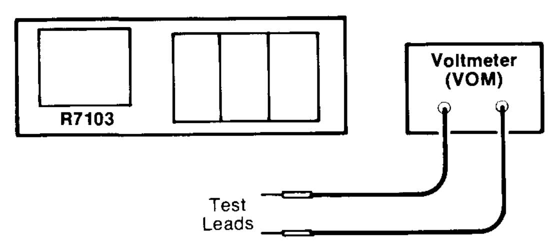
Z-AXIS AND DISPLAY PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Fully counterclockwise
FOCUS .... Midrange
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... Midrange
BEAMFINDER .... Pushbutton out

B1. ADJUST HV SUPPLY (R1805)

B1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Voltmeter (VOM)
Range .... Appropriate range for voltage to be measured.

5039-504

a. Set the POWER switch to OFF, and set the R7103 on its right side, with the bottom facing you.

b. Connect the dc voltmeter (VOM), set to measure at least -2500 volts (accuracy check to within 1%), between TP1846 (-2265 volt test point), and TP1756 (ground).

c. Set the POWER switch to On.

d. **EXAMINE**—the meter for a reading of -2265 volts, within the limits of -2243 to -2287 volts.

e. **ADJUST**—HV Adjust, R1805, for a meter reading of -2265 volts.

f. Set the POWER switch to Off.

g. Set the dc voltmeter (VOM) to measure 150 volts. Connect the VOM common lead to TP1844 (-2400 V) and the positive lead to TP1846 (-2265 volts).

WARNING

SHOCK HAZARD EXISTS WHILE PERFORMING PARTS H THROUGH N; VOM ELEVATED TO 2.4 kV. USE 100X PROBE.

h. Set the POWER switch to On.

i. **EXAMINE**—the meter for a reading of 137 volts, within the limits of 132 volts to 142 volts. If the meter reads outside these limits, corrective maintenance is needed to prevent deterioration of the crt cathode.

j. Set the POWER switch to Off and disconnect the voltmeter.

k. Remove the small plastic shield from the A21 Z-Axis Board. Set the dc voltmeter (VOM) to measure 600 mV dc. Connect the VOM common lead to TP1687 and the positive lead to TP1688 (pin 6 of P1602). (Test points TP1687 and TP1688 are the ends of R1688, which is shown on Test POint and Adjustment Locations B.)

l. Set the Power switch to On.

m. **EXAMINE**—the meter for a *momentary* reading of at least 10 millivolts; if reading is less, corrective maintenance is required to prevent deterioration of the crt cathode.

n. Set the POWER switch to OFF and disconnect the dc voltmeter. Replace the plastic shield and turn on the power.

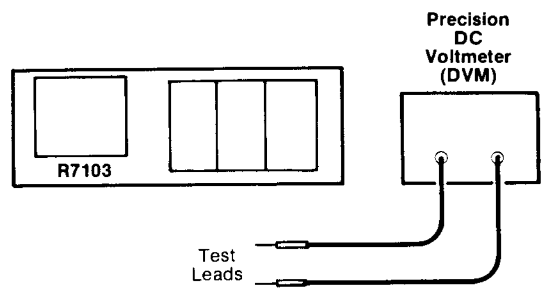
B2. ADJUST CRT GRID BIAS (R1746)

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

B2. SETUP CONDITIONS

R7103 Controls:
POWER switch .... On



Test Equipment Controls:
Precision DC Voltmeter (DVM)
Voltage Range .... Appropriate range for voltage to be measured.

5039-505

a. Connect the precision dc voltmeter (DVM) between test point TP1678, on the Z-Axis Amplifier, and chassis ground.

NOTE

If the R7103 has been turned off briefly, allow it to operate for at least five minutes before performing part b.

b. **EXAMINE**—the DVM for a reading of 8 volts within 1 volt.

c. **ADJUST**—the Z-Axis Level adjustment, R1645, for 8 volts.

d. Install an amplifier in the HORIZ compartment, and set its Position control to midrange.

e. Rotate the INTENSITY control clockwise until the DVM reads 13 volts.

NOTE

The R7103 should be turned on for at least 20 minutes to allow the crt grid cutoff voltage to stabilize.

f. **ADJUST**—Grid Bias adjustment R1746 so that the dot displayed on the crt is just extinguished.

g. Disconnect the DVM test leads.

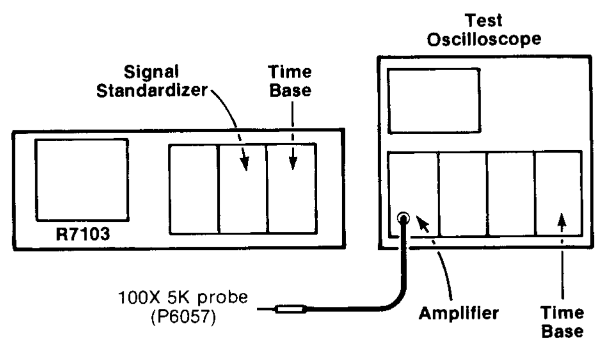
B3. ADJUST Z-AXIS AMPLIFIER (R1626, R1637, R1635, C1635, C1651 and C1663).

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

B3. SETUP CONDITIONS

R7103 Controls:
- Time Base .... 0.1 μs
- Time/Div Mag X10



Test Equipment Controls:
- Signal Standardizer
  - Test Selector .... Vert or Horiz +Step
  - Rep Rate .... 1 kHz
- Time Base
  - Time/Div .... 1 μs
  - Triggering .... Auto, AC, Internal

5039-506

a. Set the INTENSITY control for a visible display.

b. Set the time-base triggering controls for a stable display.

c. Rotate the signal standardizer Amplitude and Position controls fully counterclockwise.

d. Connect the 100X 5-kilohm probe to the input of the test oscilloscope. A 50-ohm system is needed for the 100X 5-kilohm probe.

e. Connect the probe tip to TP1678. Connect the probe ground lead to chassis ground with a short grounding lead, and set the test oscilloscope trace one division above the bottom graticule line.

f. Set the test oscilloscope as follows:

Volts/div . . . . 0.1 V
Time/div . . . . 1 ms
Triggering
  Coupling . . . . Dc

g. Set the Clamp Level adjustment, R1626, fully clockwise.

h. Set the INTENSITY control fully clockwise.

i. Set the Z-Axis Gain adjustment, R1637, for a pulse amplitude (indicated on the test oscilloscope) of 70 volts above ground.

j. Set the Clamp Level adjustment, R1626, for a pulse amplitude of 63 volts above ground.

k. Rotate the INTENSITY control counterclockwise until the pulse amplitude displayed on the test oscilloscope is 33 volts above ground.

l. Set the R7103 time-base Time/Div to 2 nanoseconds/division and set its trigger source to External.

m. Set the signal standardizer Rep Rate to 100 kHz.

n. Set the test oscilloscope as follows:

Volts/Div . . . . 50 mV (5 V/div at probe tip)
Time/Div . . . . 10 ns
Sweep Mag X1

o. **EXAMINE**—the test oscilloscope display for:

Aberrations . . . . less than 4%
Rise time . . . . less than 6.5 ns
Fall time . . . . less than 12 ns

NOTE

Use test oscilloscope X1 magnifier to check aberrations and X10 magnifier to check rise time.

p. **ADJUST**—Comp #1, #2, #3, and #4; adjustments R1635, C1635, C1651, and C1663 to minimimize the aberrations and rise time of the pulse displayed on the test oscilloscope.

NOTE

Use test oscilloscope X1 magnifier to check aberrations and X10 magnifier to check rise time.

q. Disconnect the test oscilloscope probe.

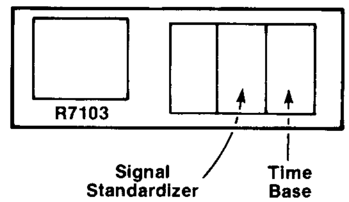
B4. CHECK/ADJUST TRACE ALIGNMENT (R1888)

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

B4. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Signal Standardizer
Test Selector . . . . Vert or Horiz Aux In

Time Base
Time/Div . . . . 1 ms
Magnifier X1
Triggering . . . . Auto, AC, Internal

5039-507

a. Set the INTENSITY control for a visible trace. Set the FOCUS and ASTIG controls for a well-defined trace.

b. Position the trace to the center graticule line.

c. **CHECK**—that the trace parallels the center graticule line within 0.1 division over its full length.

d. **ADJUST**—the TRACE ROTATION adjustment to align the trace with the vertical center graticule line.

e. Move the signal standardizer to the HORIZ compartment and the time base to the RIGHT VERT compartment.

f. **CHECK**—that the trace is parallel to the center graticule line within 0.1 division.

i. **ADJUST**—Y Align (Ortho) adjustment R1888 so that the trace is parallel to the center graticule line.

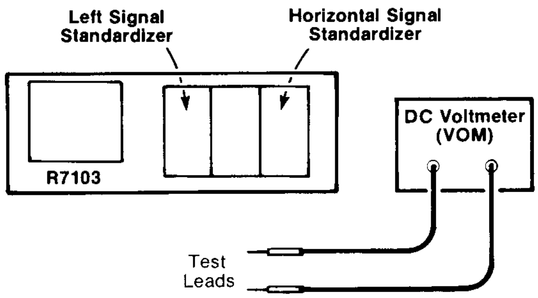
B5. CHECK/ADJUST GEOMETRY (R740, R830, R1030, R1888, R1062, R1853-R1856, R1883, R1825, R1891, R1873-R1876, R1874-R1875, R1891, R1864-R1865, R1863-R1866, R1854-R1855).

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

B5. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... ALT



Test Equipment Controls:
Left Signal Standardizer
Test Selector .... Vert or Horiz Gain
Rep Rate .... 10 kHz

Horizontal Signal Standardizer
Test Selector .... Vert or Horiz Gain
Rep Rate .... 1 MHz

VOM .... Appropriate range for voltage to be measured.

5039-508

a. Set the INTENSITY control for a visible display.

b. Set the FOCUS control to midrange.

c. **ADJUST**—Stigmator adjustment R1894, Focus Preset adjustment R1825 and the front-panel ASTIG control for best overall focus of the dot matrix display.

d. **CHECK**-for a dot matrix whose dots can be set on the intersections of the graticule lines within 0.1 division.

e. **INTERACTION**—Performing the adjustments in the remainder of this procedure (B5) may uncalibrate the vertical and horizontal amplifiers. Therefore, perform procedures E. Horizontal System, and F. Vertical System in this section.

f. Set both signal standardizer Test selectors to Vert or Horiz Com Mode.

g. Move Jumper P1062 to connect the two pins closest to the left side of the R7103.

NOTE

Adjustment and Test Point Locations B shows the normal operating position for P1062 (located by dotted lines).

h. **EXAMINE**—the displayed dot; it should align with the center vertical graticule line within 0.1 division.

i. **ADJUST**—Ctr (center) adjustment R1030 (Horizontal Amplifier) to position the dot to the center vertical graticule line.

j. Return Jumper P1062 to the storage pins.

k. **EXAMINE**—the displayed dot; it should align with the center horizontal graticule line within 0.l division.

l. **ADJUST**—MVA Center (main vertical amplifier) adjustment R740 to set the dot to the center horizontal graticule line.

m. Set both signal standardizer Test selectors to Vert or Horiz Gain.

n. Set the TRACE ROTATION control so that the horizontal trace is parallel to the center graticule line.

o. Set the left signal standardizer Rep Rate to 1 MHz and the right signal standardizer Rep Rate to 10 kHz.

p. **ADJUST**—Y Alignment (Ortho) adjustment R1888 so that the vertical trace is parallel to the center graticule line.

q. Set the INTENSITY control for a visible dot matrix display.

r. **ADJUST**—FOCUS and ASTIG controls, and Stigmator adjustment R1894 for best overall focus of the crosshatch pattern.

s. **ADJUST**—D1-D2 Shield adjustment R1891 for sharply focused outer dots.

NOTE

As this control is adjusted, the top and bottom portions of the dot matrix become more or less focused. This is the control's primary function. Due to interaction effects, the display will also change height and show vertical pin-cushion or barrel distortions. These effects will be corrected later.

t. **ADJUST**—Vertical Linearity adjustment R1853-R1856 for best overall vertical linearity (expand dot matrix display until best linearity is achieved).

NOTE

There may be some imbalance (i.e., compression at top and expansion at bottom) which should be averaged out so that the errors are of the same magnitude. As the Vertical Linearity adjustment is adjusted, the display will either shrink and become barreled vertically, or expand and become pin-cushioned vertically. These effects will be corrected later.

u. **ADJUST**—If any vertical linearity imbalance is observed in previous steps, adjust the Vertical Differential Linearity adjustment R1854-R1855 to correct this condition. (i.e., place each horizontal line coincident with a graticule line.) As this control is adjusted, the vertical columns of dots will become keystoned (nonparallel). This effect will be corrected later.

v. **ADJUST**—Geometry adjustment R1863-R1866 for straight vertical traces (aim for straightness without keystone).

NOTE

As R1863-R1866 is adjusted, the display will also expand or contract horizontally. This effect will be corrected later.

w. **ADJUST**—If any vertical keystone is present on the display, it should be corrected by adjusting the Differential Geometry adjustment R1864-R1865.

x. Set the signal standardizer Rep Rate controls as follows:

Left .... 10 kHz
Right ....1 MHz

y. **ADJUST**—Horizontal Bowing adjustment R1883 to obtain straight horizontal lines at the top and bottom of the the crt screen.

NOTE

As this control is adjusted, the display will shrink or expand horizontally. This effect will be compensated for later. The line-straightening effect of this control is very slight.

z. Set the signal standardizer installed in the HORIZ compartment to Vert or Horiz Aux In.

aa. Rotate the HORIZ signal standardizer Position control to align the column-of-dots trace with the graticule line two divisions from the left side of the crt screen.

bb. With a precision dc voltmeter, measure the differential voltage on the crt horizontal deflection plates. Record this voltage.

cc. Rotate the HORIZ signal standardizer Position control to align the trace with the graticule line two divisions from the right side of the crt screen.

dd. With the precision dc voltmeter, measure the differential voltage on the crt horizontal deflection plates. Record this voltage.

ee. **EXAMINE**—the sum of the absolute voltages measured in parts bb and dd; it should be 9.4 volts within 0.94 volt (1.88 volts/division of deflection, within 10%).

ff. **ADJUST**—Horizontal Sensitivity adjustment R1873-R1876 to obtain a crt horizontal sensitivity that is 1.88 volts/division, within 10% (9.4 volts within 0.94 volt for five divisions of deflection).

NOTE

If this adjustment is moved an appreciable amount, it may be necessary to readjust the Geometry adjustment R1863-R1866 to compensate for the slight pin-cushion or barrel distortion of the vertical lines. If the crt horizontal sensitivity of 1.88 volts/division within 10% cannot be achieved with the Horizontal Sensitivity adjustment R1873-R1876, it may be corrected by adjusting the Horizontal Bowing adjustment R1883 slightly at the expense of minor horizontal line bowing.

gg. Set the signal standardizer installed in the HORIZ compartment to Vert or Horiz Gain.

hh. **ADJUST**—if horizontal nonlinearity or nonuniform bowing of vertical lines is observed on the display, adjust the Horizontal Differential Sensitivity adjustment R1874-R1875 to correct the nonlinearity.

ii. **ADJUST**—FOCUS control, ASTIG control and Stigmator adjustment R1894 for best overall focus of crosshatch pattern.

jj. **EXAMINE**—the displayed dot matrix pattern; it should align with the vertical and horizontal graticule lines within 0.1 division everywhere on the graticule.

kk. **ADJUST**—Vert Gain adjustment R830 and LF Gain adjustment R1062 so that the vertical and horizontal traces of the crosshatch display align with the vertical and horizontal graticule lines within 0.1 division.

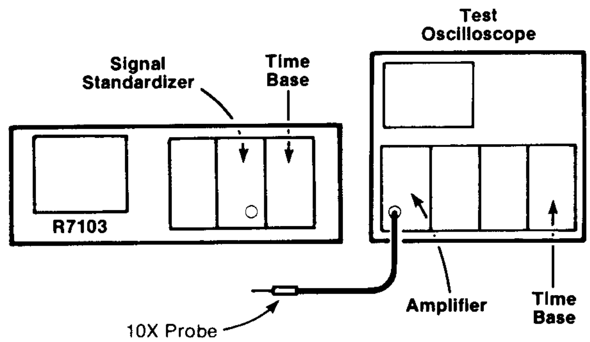
B6. ADJUST AUTO FOCUS (R1622, C1620)

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

B6. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Test Oscilloscope
Volts/Div .... 0.2 V
Time/Div .... 20 ns
Triggering .... Negative slope

Time Base
Time/Div .... 2 ns
Magnifier X1
Triggering .... Auto, AC, Internal
Trace Sep .... OFF

Signal Standardizer
Test .... Vert or Horiz + Step Resp
Rep Rate .... 100 Hz

5039-509

a. Set the time-base triggering level so that the Triggered light comes on.

b. Set the INTENSITY control for a low-intensity display.

c. Set the display to the center of the crt with the signal standardizer Position control.

d. Set the FOCUS control and ASTIG adjustment for a well-defined display.

e. Connect the 10X probe from the test oscilloscope to TP1628 on the A21 Z-Axis Board.

f. Use the signal standardizer Position control to move the displayed waveform off the crt screen.

g. Set the INTENSITY control fully clockwise.

h. **ADJUST**—the Focus Gain adjustment R1622 for maximum pulse amplitude displayed on the test oscilloscope.

i. **EXAMINE**—the pulse displayed on the test oscilloscope; its amplitude should be at least six volts, and its leading-edge fall time should be 20 nanoseconds or less with less than 25% aberrations.

j. Set the READOUT INTENSITY control for a visible readout display.

k. Set the FOCUS control for optimum focus of the readout display.

l. Rotate the signal standardizer Position control to move the display to the crt screen center.

m. **EXAMINE**—rotate the FOCUS control and check that the pulse and readout displays focus at the same point on the FOCUS control.

n. **ADJUST**—the Focus Gain adjustment, R1622, for optimum focus of the displayed pulse.

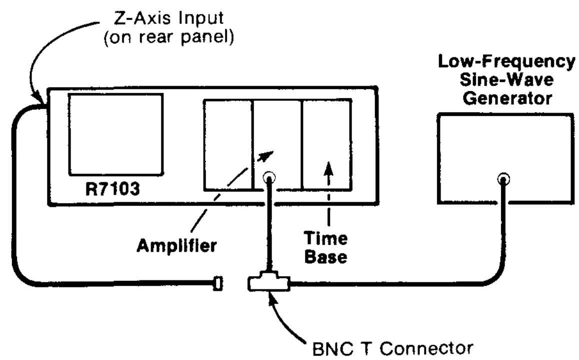
B7. CHECK EXTERNAL Z-AXIS OPERATION

NOTE

If the preceding step was not performed, first refer to the Z-Axis And Display Preliminary Control Settings, then proceed.

B7. SETUP CONDITIONS

R7103 Controls:
READOUT INTENSITY .... OFF



Test Equipment Controls:
Amplifier
Volts/Div .... 0.5 V

Time Base
Time/Div .... 20 μs
Triggering .... Auto, AC, Internal

5039-510

a. Set the INTENSITY control for a dim display.

b. Set the low-frequency sine-wave generator for a four-division display at 50 kilohertz (the reference frequency). The four-division display indicates one volt above and below ground.

c. Momentarily connect the cable from the Z-AXIS INPUT connector on the rear panel to the bnc T connector at the input to the amplifier.

d. **CHECK**—that the positive portion of the displayed waveform is blanked while performing part c.

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C. CALIBRATOR AND OUTPUT SIGNALS

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. Test oscilloscope
4. Time base
8. Precision dc voltmeter (DVM)
10. Time-mark generator
15. Coaxial cable (one 18-inch, two 42-inch required)
17. Adapter, bnc T
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations C** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

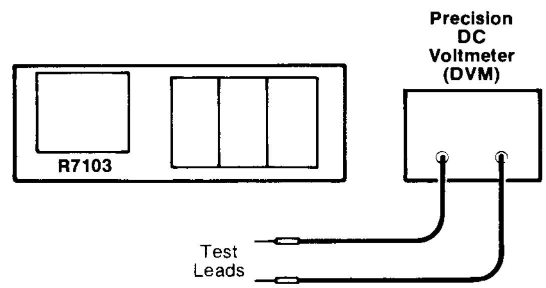
CALIBRATOR AND OUTPUT SIGNALS PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE ....RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY......... Fully counterclockwise
READOUT INTENSITY ....OFF (in detent)
GRAT ILLUM .... Midrange
BEAMFINDER .... Pushbutton out
CALIBRATOR ....4 V pushbutton in

C1. CHECK/ADJUST CALIBRATOR OUTPUT VOLTAGE (R385)

C1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Precision DC Voltmeter (DVM)
Voltage Range .... Appropriate range for voltage to be measured.

5039-511

a. Press in the 4 V and 0.4 V CALIBRATOR pushbuttons.

b. Connect the precision dc voltmeter to the CALIBRATOR output connector.

c. **CHECK**—that the meter reading is 0.4008 volt, within the limits of 0.4004 to 0.4012 volt.

d. **ADJUST**—the 0.4 V ADJ adjustment, R385, for a meter reading of exactly 0.4008 volt. (Access to R385 is through the top of the instrument.)

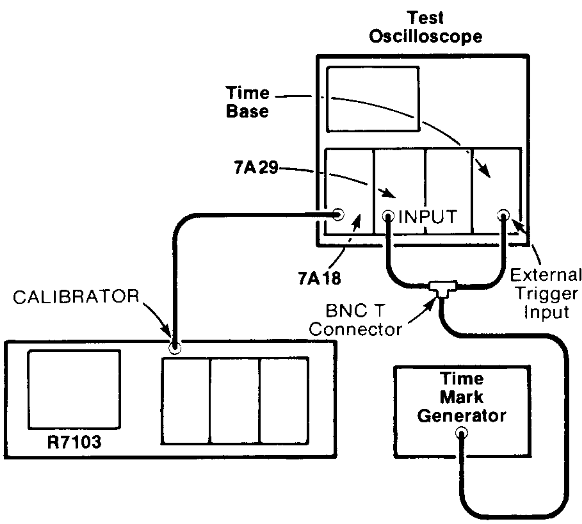
C2. CHECK/ADJUST CALIBRATOR 1 kHz REPETITION RATE (R375)

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

C2. SETUP CONDITIONS

R7103 Controls:
CALIBRATOR .... 0.4 V pushbutton in



Test Equipment Controls:
Time-Mark Generator .... 1 ms markers

Test Oscilloscope
Time/Div .... 1 ms
Triggering .... Auto, AC, External
Input Coupling .... DC
Vertical Mode .... Alt
Volts/Div
Left 0.2
Right 0.5

5039-512

NOTE

A frequency counter with an accuracy of at least 0.1% may be used to adjust the calibrator repetition rate.

a. Set the test oscilloscope triggering level for a stable time-mark display.

b. Observe that the 1 kHz Calibrator signal drifts across the crt of the test oscilloscope.

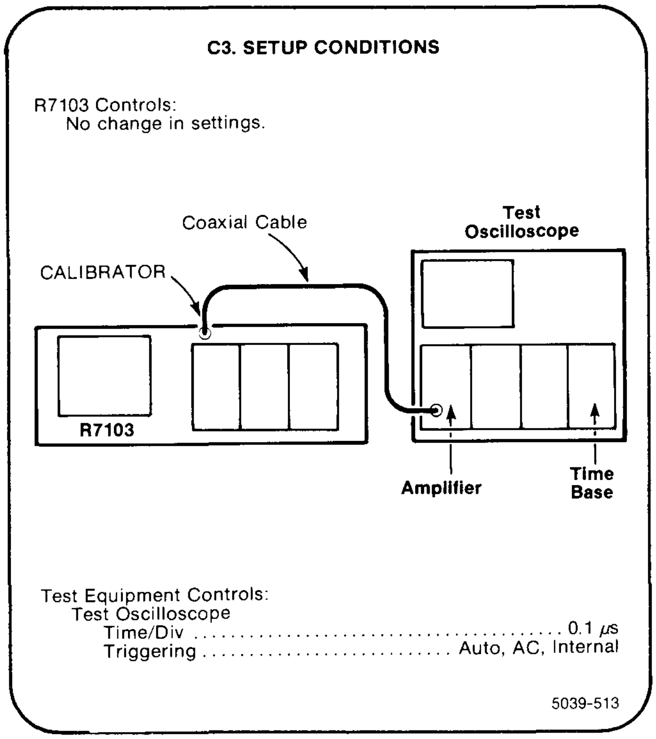
c. **CHECK**—that the time required for one cycle of the square-wave Calibrator signal to drift from one side of the display to the other is 10 seconds or more.

d. **ADJUST**—1 kHz adjustment R375 for minimum drift. (R375 can be reached through the top of the instrument with the top removed.)

C3. CHECK CALIBRATOR RISE TIME, FALL TIME, AND DUTY CYCLE

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.



a. Connect the CALIBRATOR output to the inverting vertical input of the test oscilloscope.

b. Set the test oscilloscope vertical deflection to display four divisions of calibrator signal.

c. Set the test oscilloscope for a stable display, triggered on the positive transition of the calibrator signal.

d. **CHECK**—the displayed waveform for not more than five horizontal divisions between the 10% and 90% points of the waveform (rise time, 0.5 microsecond or less).

e. Set the test oscilloscope for a stable display triggered on the negative transition of the waveform.

f. **CHECK**—the displayed waveform for not more than 5 divisions between the 90% and 10% points (fall time, 0.5 microsecond or less).

g. Set the test oscilloscope as follows:

Input Coupling	AC
Time/Div	0.1 ms
Triggering	
Slope	+
Level	So that display starts at 50% point (middle) of positive transition.
Mode	Auto
Coupling	AC
Source	Int

h. Set the test oscilloscope sweep magnifier to X10. Then move the display horizontally to align the negative transition of the waveform with the center vertical graticule line.

i. Set the test oscilloscope vertical to invert the display. (NOTE: The display is triggered on the opposite slope, even though the display appears the same.)

j. **CHECK**—that the 50% point on the falling edge of the waveform now displayed is within 0.2 horizontal divisions of the center line. (Indicates a duty cycle of 50% within 0.2%.)

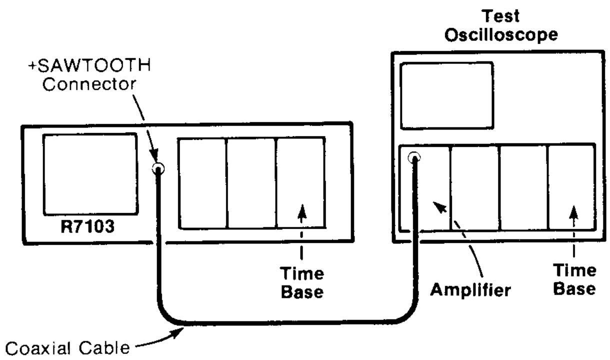
C4. CHECK SAWTOOTH OUTPUT SIGNAL

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Setting, then proceed.

C4. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope
Time/Div .... 2 ms
Volts/Div .... 2 V
Display Mode .... Ch 1

Time Base
Time/Div .... 0.2 ms
Triggering .... Auto

5039-514

a. Connect the +SAWTOOTH output connector to the test oscilloscope channel 1 vertical input (1 megohm input).

b. **CHECK**—that 1) the slope of the waveform displayed on the test oscilloscope display is 2 volts/division within 10% (a 10-volt sawtooth signal is required to produce a 10-division sweep on the R7103 crt), and that 2) the sawtooth baseline is within one volt of ground.

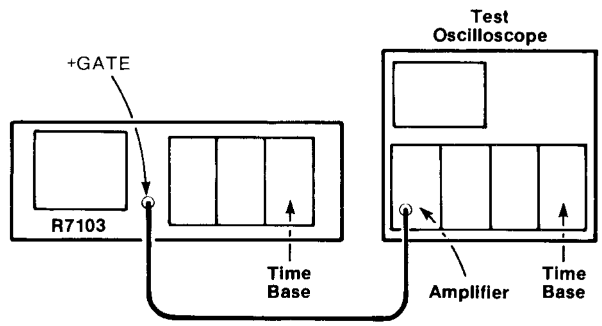
C5. CHECK GATE OUTPUT SIGNAL

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

C5. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope
Volts/Div .... 2 V
Time/Div .... 2 ms
Magnifier X1

Time-Base
Time/Div .... 0.2 ms
Triggering .... Auto, AC, Internal

5039-515

a. **CHECK**—the test oscilloscope display for a gate waveform five divisions in amplitude, within 10%, and a baseline at zero volts, within one volt.

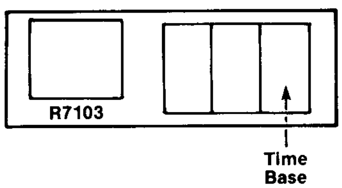
C6. CHECK GRATICULE ILLUMINATION OPERATION

NOTE

If the preceding step was not performed, first refer to the Calibrator And Output Signals Preliminary Control Settings, then proceed.

C6. SETUP CONDITIONS

R7103 Controls:
GRAT ILLUM +GATE or EXT switch . . . . +GATE



Test Equipment Controls:
Time Base
Time/Div . . . . 0.2 s
Triggering . . . . Auto, AC, Internal

5039-516

a. **CHECK**—that rotating the GRAT ILLUM control through its range varies the illumination of the graticule.

b. Set the GRAT ILLUM control fully clockwise to the PULSED detent position.

c. Set the INTENSITY control for a visible display.

d. **CHECK**—that graticule illumination occurs only after the time base has completed a sweep (adjust GRAT ILLUM PRESET, if necessary).

e. Set the GRAT ILLUM +GATE or EXT switch to EXT.

f. **CHECK**—press the GRAT ILLUM MAN pushbutton and check for one momentary illumination of the graticule.

g. Set the GRAT ILLUM control to midrange (out of the PULSED detent position).

D. TRIGGER SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. Test oscilloscope
3. Amplifier
4. Time base (two required)
5. Signal standardizer
6. Plug-in extender (rigid calibration fixture)
15. Coaxial cable (one 18-inch, two 42-inch required)
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations D** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

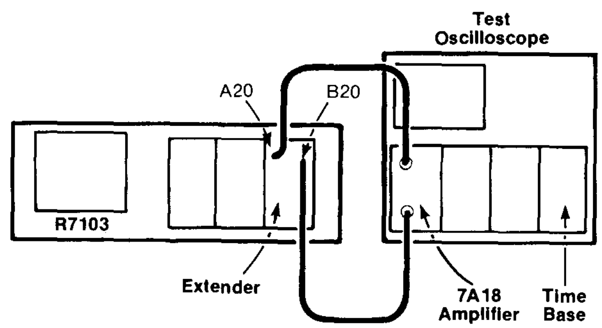
TRIGGER SYSTEM PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Fully counterclockwise
FOCUS .... Midrange
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... Midrange
BEAMFINDER .... Pushbutton out

D1. ADJUST TRIGGER SELECTOR CENTERING AND GAIN (R256, R274, R279)

D1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope
Volts/Div
Channel 1 .... 50 mV
Input Coupling .... Gnd or Off
Channel 2 .... 50 mV/div
Input Coupling .... Gnd or Off
Time/Div .... 1 ms

5039-517

a. Within the plug-in extender, disconnect the top connector on the left and right sides (labeled A20 and B20). Connect each female connector to one of the test oscilloscope vertical input channels with the 42-inch coaxial cables and 50-ohm terminations (omit the 50-ohm terminations if the test oscilloscope has 50-ohm input impedance). Connect A20 to Ch 1 of the test oscilloscope and B20 to Ch 2.

b. Set the test oscilloscope for differential operation between the two channels (Add display mode with one channel inverted).

c. Establish a ground reference level for the test oscilloscope by setting the trace to the center horizontal line of the graticule.

Do not change the test oscilloscope position controls after setting this ground reference.

d. Set both channels of the test oscilloscope for dc input coupling.

e. **EXAMINE**—the test oscilloscope display a for dc level within one division (50 millivolts) of the ground reference level in the LEFT, RIGHT, and ADD positions of the VERTICAL MODE selector.

f. **ADJUST**—Trig DC Center adjustment R256 for a dc level within one division (50 millivolts) of the ground reference level in the LEFT, RIGHT, and ADD positions of the VERTICAL MODE selector.

g. Install a signal standardizer in the LEFT VERT compartment.

h. Set the VERTICAL MODE to LEFT.

i. Set the signal standardizer Test selector to Trigger +Step Resp, and the Rep Rate to 1 kHz. Use the signal standardizer Position and Amplitude controls to center a six-division display on the test oscilloscope. Set the test oscilloscope sweep rate to 0.5 millisecond/division.

j. **EXAMINE**—the test oscilloscope display for less than +3% and -3% aberrations (+0.18 div. and -0.18 div.).

k. Set the signal standardizer Test selector to Trigger Gain and the Rep Rate to 1 MHz. Use the signal standardizer Position control to move the bright trace display on the test oscilloscope to the center graticule line.

l. **EXAMINE**—the test oscilloscope display for nine traces with six divisions of vertical deflection between the center seven traces, within 0.6 division (300 millivolts, within 20 millivolts).

m. **ADJUST**—the Gain adjustment, R274, for a test oscilloscope display of six divisions of deflection between the center seven traces, within 0.6 division (300 millivolts, within 30 millivolts).

n. Remove the signal standardizer from the LEFT VERT compartment.

o. Set the test oscilloscope to alternate between channel 1 and channel 2. Re-establish a ground reference for both channels of the test oscilloscope. Then set both channels to dc coupling.

p. **EXAMINE**—the test oscilloscope display for a dc level within one division, (50 millivolts) of the established ground reference.

q. **ADJUST**—the DC Common Mode adjustment, R279, for a dc level within one division of ground.

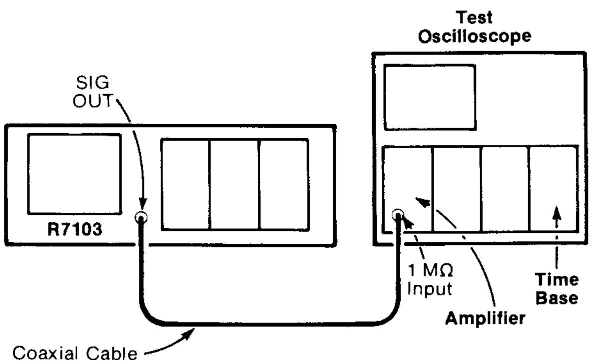
D2. CHECK/ADJUST VERTICAL SIGNAL OUT DC CENTERING (R485, R480, R490)

NOTE

If the preceding step was not performed, first refer to the Trigger System Preliminary Control settings, then proceed.

D2. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Test Oscilloscope

Input Coupling	Gnd or Off
Volts/Div	0.5 V
Display Mode	Ch 1
Time/Div	0.2 ms

5039-518

a. Establish a ground reference for the test oscilloscope by setting the trace to the graticule horizontal center line. Do not move the test oscilloscope position control after setting this ground reference.

b. Set the test oscilloscope to dc coupling.

c. **EXAMINE**—the test oscilloscope display for a dc level within 1 division of the ground reference established in part a.

d. **ADJUST**—the Signal Out DC Center adjustment, R485, for a dc level within one division of the ground reference level.

e. Install the signal standardizer in the LEFT VERT compartment.

f. Set the Test selector to Trigger +Step Resp and the Rep Rate to 1 kHz.

g. Rotate the signal standardizer Position and Amplitude controls to display a six-division triggered signal on the test oscilloscope.

h. **EXAMINE**—the test oscilloscope square-wave display for optimum flat top within 0.1 division.

i. **ADJUST**—the Signal Out Thermal 1 adjustment, R480, to optimize the test oscilloscope square-wave display.

j. Set the signal standardizer Rep Rate to 10 kHz.

k. Set the test oscilloscope Time/Div to 20 μs.

l. **EXAMINE**—the test oscilloscope square-wave display for a flat top within 0.2 division.

m. **ADJUST**—the Signal Out Thermal 2 adjustment, R490, to optimize the test oscilloscope square-wave display.

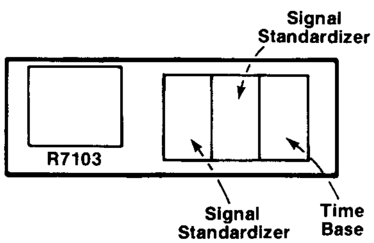
D3. CHECK TRIGGER SELECTOR OPERATION

NOTE

If the preceding step was not performed, first refer to the Trigger System Preliminary Control Settings, then proceed.

D3. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... LEFT
TRIGGER SOURCE .... VERT MODE



Test Equipment Controls:
Signal Standardizer (Right)
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 10 kHz

Signal Standardizer (Left)
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 1 kHz

Time Base
Time/Div .... 0.2 ms
Magnifier X1
Triggering .... Auto, AC, Internal
Mode .... Independent

5039-519

a. Connect the CALIBRATOR 4 V output to the amplifier. Set the INTENSITY control for a visible display. Set the amplifier for a two-division display in the upper half of the graticule area. Use the time-base trigger level to trigger the display.

b. Set the VERTICAL MODE to RIGHT.

c. Set the signal standardizer Amplitude and Position controls for a two-division display in the lower half of the graticule area.

d. Set the VERTICAL MODE to ALT.

e. **CHECK**—the crt display for 1 kHz and 10 kHz triggered waveforms (adjust the time-base trigger level controls as necessary).

f. Set the VERTICAL MODE to ADD.

g. **CHECK**—the crt display for a triggered waveform.

h. Set the VERTICAL MODE to CHOP.

i. **CHECK**—the crt display for a stable display of the 1 kHz waveform only.

j. Set the TRIGGER SOURCE to LEFT VERT.

k. **CHECK**—sequentially select all positions of the VERTICAL MODE selector (except RIGHT) and check for a stable display of the 1 kHz waveform only.

l. Set the TRIGGER SOURCE to RIGHT VERT.

m. **CHECK**—sequentially select all positions of the VERTICAL MODE selector (except LEFT) and check for a stable display of the 10 kHz waveform only.

E. HORIZONTAL SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

2. Amplifier (two required, one with variable delay)
4. Time base
5. Signal standardizer
8. Precision dc voltmeter (DVM)
10. Time-mark generator
11. Low-frequency sine-wave generator
15. Coaxial cable (one 18-inch, two 42-inch required)
17. Adaptor, bnc T
19. Screwdriver, low capacitance
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations E** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

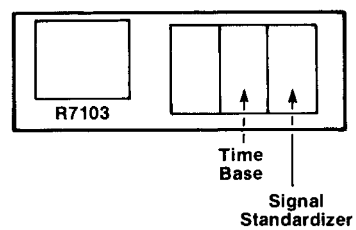
HORIZONTAL SYSTEM PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE ....RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY.........Fully counterclockwise
FOCUS.......................... Midrange
READOUT INTENSITY ....OFF (in detent)
GRAT ILLUM ....As desired
BEAMFINDER .... Pushbutton out

E1. CHECK/ADJUST HORIZONTAL AMPLIFIER GAIN (R1030, R995, R965, R1062)

E1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Signal Standardizer
Test Selector .... Vert or Horiz Com Mode
Rep Rate .... 1 MHz

Time Base
Time/Div .... 0.1 ms
Triggering .... Auto, AC, Internal

5039-520

a. Set the INTENSITY control for a visible trace.

b. Move jumper P1062 to connect the two pins closest to the outside of the R7103. Note: Test Point and Adjustment Locations E (Section 8, Diagrams and Circuit Board Illustrations) shows the desired position of P1062 located by dotted lines.

c. **EXAMINE**—the display; the vertical trace should be within 0.5 division of the center vertical graticule line.

d. **ADJUST**—the Ctr adjustment, R1030, to align the displayed trace with the center vertical graticule line.

e. Return jumper P1062 to the storage pins.

f. **EXAMINE**—the display; the vertical trace should be within 0.5 division of the center graticule line.

g. **ADJUST**—the A Ctr adjustment, R995, to align the trace with the center graticule line.

h. Set the signal standardizer as follows:

Test .... Vert or Horiz Gain
Rep Rate .... 100 kHz
Position .... Align the brighter vertical trace with the vertical center graticule line.

i. **CHECK**—for eight divisions of deflection between the center nine traces within 0.08 division. And, CHECK that the other vertical traces align with their respective graticule lines within 0.05 divisions. (Specified at the center graticule line.)

j. **ADJUST**—LF Gain Adjustment R1062 for exactly eight divisions of total deflection for the center nine traces. (Measure between the second and tenth graticule lines.)

k. **INTERACTION**—If R1062 was adjusted in step E1, step E2 should be performed.

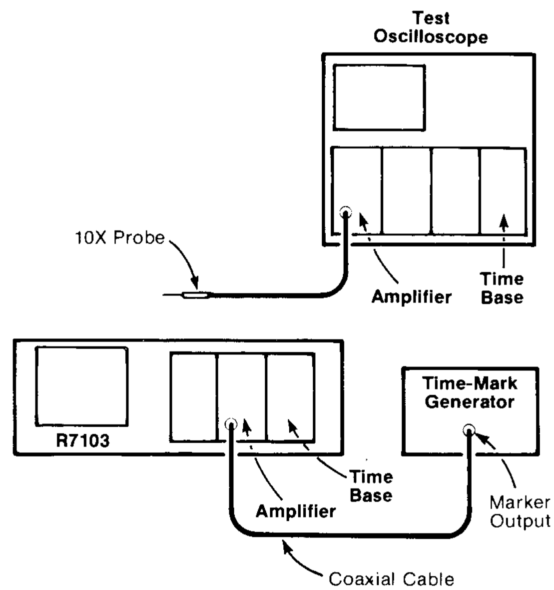
E2. CHECK/ADJUST HIGH-FREQUENCY TIMING (R1005, R1062, R975, R988, R985, R982, R980, R1082, R1073, C1036, C1040, C1060, R1099).

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed.

E2. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:

Test Oscilloscope
Volts/Div .... 0.5 V
Time/Div .... 5 μs
Triggering .... Auto, AC, Internal
Input Coupling .... Dc

Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal
Mode .... Independent

Amplifier
Volts/Div .... 0.5 V
Input Coupling .... DC

Time-Mark Generator .... 1 ms markers

5039-521

a. Connect 1-millisecond markers from the time-mark generator to the amplifier input. Set the amplifier deflection factor for about two divisions of display. Set the INTENSITY control for a visible display, if necessary.

b. Set the time-base triggering controls for a stable display.

c. Position the first marker to the extreme left graticule line.

d. Adjust the time-base sweep calibration control to set a marker at each major graticule division between the second and tenth graticule lines (center 8 divisions).

e. **CHECK**—refer to the time-base instruction manual for performance check or calibration procedures for checking high-frequency timing and linearity. If the given limits are met, omit the remainder of this step.

f. Remove the amplifier and time base from the R7103.

g. Install a time base in the RIGHT VERT compartment and a signal standardizer in the HORIZ compartment.

h. Set the signal standardizer Test selector to Vert or Horiz +Step Resp and the Rep Rate to 1 MHz.

i. Set the time base as follows:

Time/div .... 1 ms
Triggering
  Mode .... Auto
  Coupling .... AC
  Source .... Ext

j. Set the signal standardizer Amplitude and Position controls for a 10-division display centered on the crt.

k. Connect a 10X probe from the test oscilloscope to the horizontal crt termination, R1099. Connect the probe ground lead to the R7103 chassis.

NOTE

Test Point and Adjustment Locations E, in Section 8 (Diagrams and Circuit Board Illustrations) shows where to connect the 10X probe.

l. Set the test oscilloscope variable gain control for two divisions of displayed waveform and position the bottom of the displayed waveform to align with the center graticule line on the test oscilloscope crt.

m. Rotate the signal standardizer Position control counterclockwise to align the right side of the R7103 display with the left-most graticule line on the left side of the R7103 crt.

n. **ADJUST**—Clamp adjustment R1005 so that the bottom of the displayed test oscilloscope waveform aligns with the first graticule line below the center graticule line on the test oscilloscope crt.

o. Disconnect the 10X probe.

p. Set the time base as follows:

Time/div .... 0.2 ms
Mag X10
Triggering
  Slope .... +
  Mode .... Auto
  Coupling .... AC
  Source .... Ext

q. Connect a coaxial cable from the signal standardizer Pre Trigger Out connector to the time-base External Trigger In connector, then adjust the time base Triggering Level control to trigger the sweep.

r. Set the signal standardizer Position and Amplitude controls for an eight-division display at a Rep Rate of 10 kHz. (Align the waveform on the second and tenth graticule lines.)

s. Set the time-base Time/Div to 1 microsecond and the signal standardizer Rep Rate to 1 MHz.

t. ADJUST—HF Gain adjustment, R1082, so that the displayed pulse is eight divisions wide at a point 10 nanoseconds from the leading edge.

u. **ADJUST**—SP Damp adjustment, R1073, and Delay adjustment C1036 to optimize step response.

v. Set the time base Time/Div to 20 nanoseconds.

w. Use the time base Position and Triggering Level controls to set the leading edge of the pulse near the second graticule line from the bottom of the crt. Set the Triggering Slope to minus.

x. **ADJUST**—Comp #9 and #10 adjustments, C1040 and C1060, to optimize the first two nanoseconds of the front corner on the displayed pulse.

y. **ADJUST**—HF Gain adjustment, R1082, to align the area of the pulse three nanoseconds from the front corner with the retrace overshoot.

z. **ADJUST**—Horiz CRT termination adjustment, R1099, to align the area of the pulse eight nanoseconds from the front corner of the pulse with the retrace overshoot.

aa. **INTERACTION**—adjustments in parts x and y interact. Repeat them as necessary to eliminate interaction.

bb. Set the time-base Time/Div to 0.5 microsecond/division and the triggering to negative slope. Use the time-base Position control to align the front corner of the pulse with the second graticule line from the bottom of the crt.

cc. **ADJUST**—SP Damp adjustment, R1073, and Delay adjustment, C1036, to optimize the the front corner of the displayed pulse.

dd. Set the time base Time/Div to 2 microseconds.

ee. Set the signal standardizer Position and Amplitude controls so that the displayed pulse is exactly eight divisions in amplitude (align the waveform on the second and tenth graticule lines; use the center horizontal graticule line to set eight divisions), measured 200 nanoseconds from the front-corner of the pulse (the front corner of the pulse is the right side of displayed waveform lower corner).

NOTE

Be careful not to change the signal standardizer Amplitude control throughout the remaining parts of this step.

ff. Set the time-base Time/Div to 2 milliseconds, the magnifier to X1, and the signal standardizer Rep Rate to 100 Hz.

NOTE

Adjustments in the remainder of this step are measured and adjusted at the graticule's vertical center by vertically positioning the trace with the time-base Position control as needed.

gg. **ADJUST**—A LF ADJ adjustment, R975, for exactly eight divisions at the trailing edges of the displayed pulse (trailing edge of pulse is upper portion of pulse on left and right sides of waveform).

hh. Set the time-base Time/Div to 1 millisecond.

ii. **ADJUST**—Comp #5 adjustment, R988, for eight divisions of pulse amplitude 0.2 millisecond from the front corner of the pulse.

jj. Set the time-base Time/Div to 0.2 millisecond. Set the signal standardizer Rep Rate to 1 kHz.

kk. **ADJUST**—Comp #6 adjustment, R985, for eight divisions of pulse amplitude 20 microseconds from the front corner of the pulse.

ll. Set the time-base Time/Div to 20 microseconds, and the signal standardizer Rep Rate to 10 kHz.

mm. **ADJUST**—Comp #7 adjustment, R982, for an eight-division pulse two microseconds from the front corner of the pulse.

nn. Set the time-base Time/Div to 2 microseconds, and the signal standardizer Rep rate to 100 kHz.

oo. **ADJUST**—Comp #8 adjustment, R980, so that the pulse is eight divisions in amplitude 0.2 microsecond from its front corner.

pp. Set the time base to Internal triggering and the signal standardizer Test selector to Vert or Horiz Gain.

qq. **ADJUST**—Align the bright center trace with the center graticule line and set LF Gain adjustment R1062 for eight divisions of deflection between the center nine traces.

rr. Set the time-base Magnifier to X10 and the Triggering to External. Set the signal standardizer Test selector to Vert or Horiz +Step and the Rep Rate to 1 MHz.

ss. **ADJUST**—HF Gain R1082 for a flat top.

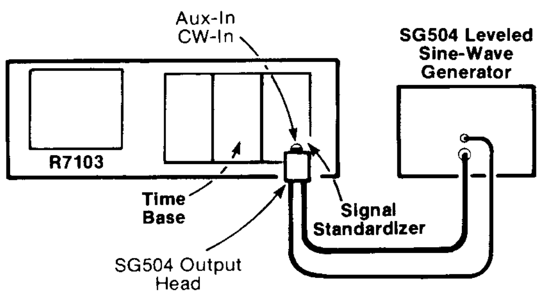
E3. CHECK HORIZONTAL BANDWIDTH

NOTE

If the preceding step was not performed, refer to the Horizontal System Peliminary Control Settings, then proceed.

E3. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, External

Signal Standardizer
Test Selector .... Vert or Horiz Freq Resp

5039-522

a. Set the high-frequency sine-wave generator for eight divisions of displayed signal on the R7103 crt at the generator's reference frequency (6 MHz). The CW Leveled indicator on the signal standardizer must be on at all times.

b. Set the high-frequency sine-wave generator output frequency to 350 MHz.

c. **CHECK**—that the 350 MHz display is at least 5.7 divisions in amplitude.

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F. VERTICAL SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

2. Amplifier
4. Time base
5. Signal standardizer
11. Low-frequency sine-wave generator
12. High-frequency sine-wave generator
16. 2X attenuator
19. Screwdriver, low capacitance
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations F** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

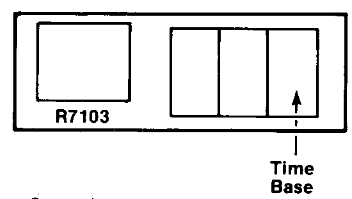
VERTICAL SYSTEM PRELIMINARY CONTROL SETTINGS

POWER switch .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Counterclockwise
FOCUS .... Midrange
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... As desired
BEAMFINDER .... Pushbutton out

F1. ADJUST VERTICAL AMPLIFIER CENTERING (R740, R535)

F1. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... ALT



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal
Magnifier X1

5039-523

a. Set the INTENSITY control as desired.

b. **EXAMINE**—the vertical position of the alternating traces (they might appear as a single trace); they should be within 0.5 division of the graticule center line.

c. Set the VERTICAL MODE to LEFT.

d. **ADJUST**—MVA Center adjustment, R740, to align the trace with the center graticule line.

e. Set the VERTICAL MODE to RIGHT.

f. **ADJUST**—Right Ctr adjustment, R535, to align the trace with the center graticule line.

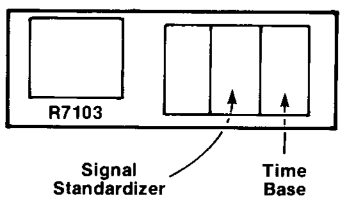
F2. CHECK/ADJUST VERTICAL AMPLIFIER GAIN (R830)

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

F2. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 10 μs
Triggering .... Auto, AC, External

Signal Standardizer
Test Selector .... Vert or Horiz Gain
Rep Rate .... 100 kHz

5039-524

a. Position the signal standardizer display to align the bright center trace with the graticule center line.

b. **CHECK**—for one trace per graticule division within 0.06 division over the center six graticule divisions. Note the exact error for comparison in part f.

c. **ADJUST**—Vert Gain adjustment, R830, for one division between each of the center seven displayed traces, within 0.01 division.

d. Remove the signal standardizer from the RIGHT VERT compartment and install it in the LEFT VERT compartment.

e. Set the VERTICAL MODE to LEFT.

f. **CHECK**—for one trace per graticule division within 0.06 division of the error noted in part b, over the center six graticule divisions.

g. **ADJUST**—if necessary, compromise the setting of Vert Gain adjustment R830 for optimum gain for both LEFT and RIGHT compartments.

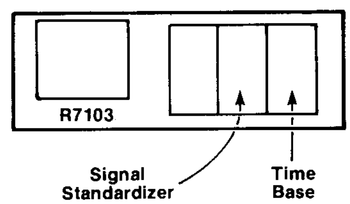
F3. CHECK VERTICAL LOW-FREQUENCY LINEARITY

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

F3. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

Signal Standardizer
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 1 kHz

5039-525

a. Set the signal standardizer Amplitude and Position controls so that the display is exactly two divisions in amplitude in the center of the graticule area.

b. **CHECK**—that moving the two-division display vertically causes no more than 0.1 division of compression or expansion anywhere within the graticule area.

c. **ADJUST**—If the specification of part b was not met, perform steps F1, F2, F4, and F5.

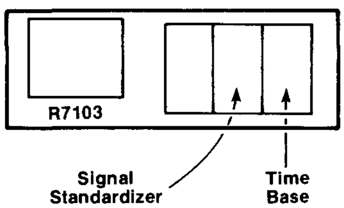
F4. ADJUST THERMAL COMPENSATIONS (C808, R785, R801, R795, R806, R791, R787, R836)

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

F4. SETUP CONDITIONS

R7103 Controls:
TRIGGER SOURCE .... RIGHT VERT



Test Equipment Controls:
Time Base
Time/Div .... 10 μs
Triggering .... Auto, AC, Internal

Signal Standardizer
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 100 kHz

5039-526

a. Set the signal standardizer Position and Amplitude controls for a six-division display centered on the crt.

b. Set the VERTICAL MODE to CHOP.

c. Set the READOUT INTENSITY control for a visible readout display.

d. **EXAMINE**—the readout display for less than 0.05 divisions of jitter and 0.05 divisions of deviation, between switch settings, in the center displayed trace using the time-base sweep rates and signal standardizer rep rates given in Table 5-5.

e. **ADJUST**—Thermal Compensation adjustments as given in Table 5-5 for minimum jitter on the Readout display and minimum deviation of the displayed center trace.

f. **INTERACTION**—The adjustments listed in Table 5-5 may interact with steps F2, F3, F4, and F5; repeat as necessary.

TABLE 5-5
Vertical Compensation Adjustments
(Signal Rep Rate vs: Sweep Rate)

Adjustment	Signal Standardizer Rep Rate	Sweep Rate
Comp #1 (A17R785), Comp #7 (A17C808)	1 MHz	1 μs
Comp #8 (A17R836), Comp #5 (A17R801)	100 kHz	10 μs
Comp #4 (A17R795)	10 kHz	0.1 ms
Comp #3 (A17R791)	1 kHz	1 ms
Comp #6 (A17R806)	100 Hz	10 ms
Comp #2 (A17R787)	10 Hz	50 ms

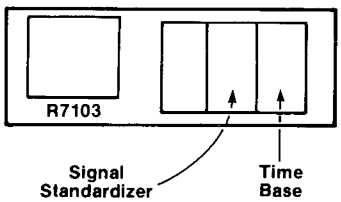
F5. ADJUST VERTICAL LOW-FREQUENCY COMPENSATION (C538, R530, R525, R520, R515, R512, C638, R630, R625, R620, R615, R612, C705, R715)

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

F5. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT VERT
TRIGGER SOURCE .... VERT MODE



Test Equipment Controls:
Time Base
Time/Div .... 2 μs
Triggering .... Auto, AC, Internal

Signal Standardizer
Test Selector .... Vert or Horiz +Step Resp
Rep Rate .... 100 kHz

5039-527

a. Set the signal standardizer Amplitude control for a six-division display.

b. Set the time-base triggering and position controls for a stable display.

c. **EXAMINE**—the displayed pulse for optimum flat top, within 0.06 division, with the signal standardizer Rep Rates and time-base sweep rates given in Table 5-6A.

d. **ADJUST**—Compensation adjustments #14, #13, #12, #11, #10 and #9 as given in Table 5-6A for optimum flat top on the displayed waveform.

e. Move the signal standardizer to the LEFT VERT compartment.

f. Set the VERTICAL MODE to LEFT VERT.

g. Set the signal standardizer Rep Rate to 100 kHz and the time-base Time/Div to 2 μs. Set the Amplitude and Position controls for a six-division display, centered in the graticule area.

TABLE 5-6A
Low-Frequency Compensation
(Signal Rep Rate vs: Sweep Rate)

Adjustment	Signal Standardizer Rep Rate	Sweep Rate
Comp #14 (A16C538), Comp #13 (A16R530)	100 kHz	2.0 μs
Comp #12 (A16R525)	10 kHz	20.0 μs
Comp #11 (A16R520)	1 kHz	0.2 ms
Comp #10 (A16R515)	100 Hz	2.0 ms
Comp #9 (A16R512)	10 Hz	20.0 ms

TABLE 5-6B
Low-Frequency Compensation
(Signal Rep Rate vs: Sweep Rate)

Adjustment	Signal Standardizer Rep Rate	Sweep Rate
Comp #20 (A15C638), Comp #19 (A16R630)	100 kHz	2.0 μs
Comp #18 (A16R625)	10 kHz	20 μs
Comp #17 (A16R620)	1 kHz	0.2 ms
Comp #16 (A16R615)	100 Hz	2.0 ms
Comp #15 (A16R612)	10 Hz	20.0 ms

h. **EXAMINE**—the displayed pulse for optimum flat top within 0.06 division with the signal standardizer Rep Rate and the time-base sweep rates given in Table 5-6B.

i. **ADJUST**—Compensation adjustments #20, #19, #18, #17, #16, and #15 as given in Table 5-6B for optimum flat top on the displayed waveform.

j. Set the signal standardizer Rep Rate to 1 MHz.

k. Set the time base to 2 ns/division. Set the triggering controls for a stable display triggered on the pulse's positive transition.

l. **EXAMINE**—the displayed pulse for optimum corner and flat top within the following limits: Aberrations in the first 5 nanoseconds after the 50% point of the step should not exceed 0.3 division peak-to-peak. Aberrations from 5 to 10 nanoseconds after the 50% point of the step should not exceed 0.18 division peak-to-peak. Aberrations after 10 nanoseconds of the 50% point of the step should not exceed 0.06 divisions peak-to-peak except to allow 0.12 division of aberrations for delay-line termination at about 105 nanoseconds from the step. Rise time of the pulse should be 350 picoseconds between the 10% and 90% points.

m. **ADJUST**—Comp #21 and #22 adjustments, C705 and R705, respectively, for optimum rise time (less than 350 picoseconds) and flat top with minimum aberrations within the limits given in part I. Use the low-capacitance screwdriver to adjust the variable capacitors. Repeat the complete adjustment procedure as necessary to obtain optimum step response.

n. **INTERACTION**—adjustments in step F5 interact with steps F2, F3, and F4; repeat as necessary.

o. Move the signal standardizer to the RIGHT VERT compartment and set the VERTICAL MODE to RIGHT.

p. **ADJUST**—If necessary, compromise the high-frequency Comp #21 adjustment, C705, for optimum pulse response for both vertical compartments.

q. **EXAMINE**—the displayed pulse for optimum square corner and flat top with aberrations within the limits given in part I.

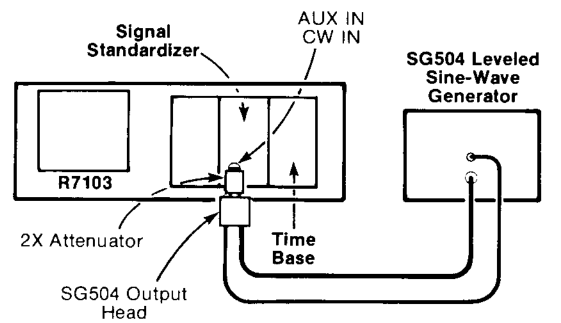
F6. CHECK VERTICAL AMPLIFIER 1 GHz GAIN (0° to +35°C)

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

F6. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 0.1 ms
Triggering .... Auto, AC, External

Signal Standardizer
Test Selector .... Vert or Horiz Freq Resp

High-Frequency Sine-Wave Generator
Reference Frequency .... 6 MHz

5039-528

a. Set the signal standardizer Amplitude control fully clockwise.

b. Connect the high-frequency sine-wave generator to the signal standardizer Aux In Cw In (Freq Resp) input with a 2X attenuator.

c. Set the high-frequency sine-wave generator for a 10-division display at the reference frequency (between 6 and 50 megahertz) centered on the graticule. (To obtain a 10-division display, first set the high-frequency sine-wave generator to produce an eight-division display, then vertically position the display one division down and increase the amplitude of the sine-wave generator signal to return the top of the display to the top of the graticule.)

d. Set the signal standardizer Amplitude for a six-division display, centered on the graticule. (The CW Leveled indicator should be lit.)

e. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to five divisions. If the CW Leveled indicator extinguishes, increase the amplitude of the sine-wave generator signal until the light just turns on.

NOTE

The signal standardizer CW Leveled light must be on and the sine-wave generator must be properly connected for a valid check. Refer to the signal standardizer and high-frequency sine-wave generator manuals.

f. **CHECK**—that the sine-wave generator frequency is 1 gigahertz or higher (verifies 1 gigahertz gain).

g. Move the signal standardizer to the LEFT VERT compartment (leave signal connected) and set the VERTICAL MODE to LEFT.

h. **CHECK**—repeat parts d. through f. for the LEFT VERT compartment.

i. **ADJUST**—perform steps F1, F2, F3, F4, and F5.

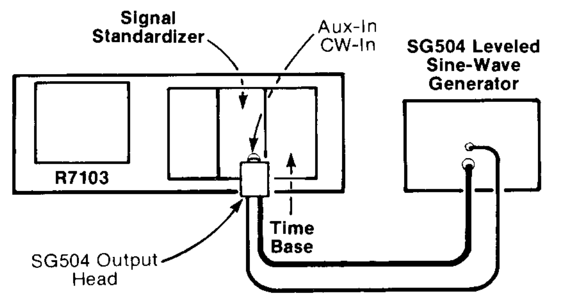
F7. CHECK VERTICAL CHANNEL ISOLATION

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

F7. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

Signal Standardizer
Test Selector .... Vert or Horiz Aux In

High-Frequency Sine-Wave Generator .... 1 GHz

5039-529

a. Set the output of the high-frequency sine-wave generator and the signal standardizer Amplitude control for eight divisions of deflection at 1 gigahertz.

b. Set the VERTICAL MODE to LEFT.

c. **CHECK**—the crt display amplitude for 0.1 division or less of the 1 gigahertz signal (verifies isolation at least 80:1 at 1 gigahertz).

d. Move the signal standardizer to the LEFT VERT compartment without disturbing the connections.

e. Set the VERTICAL MODE to RIGHT.

f. **CHECK**—the display amplitude for 0.1 division or less of the 1 gigahertz signal (verifies isolation at least 80:1 at 1 gigahertz).

g. Set the VERTICAL MODE to LEFT.

h. Connect the low-frequency sine-wave generator to the signal standardizer Aux In-CW In connector.

i. Set the low-frequency sine-wave generator for eight divisions of deflection at 100 megahertz.

j. Set the VERTICAL MODE to RIGHT.

k. **CHECK**—the display amplitude for 0.05 division or less of 100 megahertz signal (verifies 100 megahertz isolation of at least 160:1).

l. Move the signal standardizer to the RIGHT VERT compartment without disturbing the connections.

m. Set the VERTICAL MODE to LEFT.

n. **CHECK**—the display amplitude for 0.05 division or less of 100 MHz signal (verifies isolation of at least 60:1 from dc to 100 MHz).

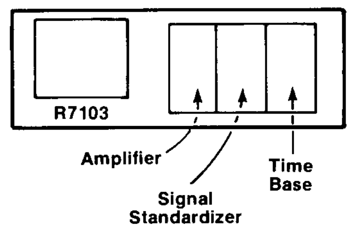
F8. CHECK VERTICAL DISPLAY MODES

NOTE

If the preceding step was not performed, first refer to the Vertical System Preliminary Control Settings, then proceed.

F8. SETUP CONDITIONS

R7103 Controls:
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

Amplifier
Volts/Div .... 0.1 V
Input Coupling .... DC

Signal Standardizer
Test Selector .... Vert or Horiz Aux In

5039-530

a. Position the trace to the upper half of the graticule area with the signal standardizer Position control.

b. Set the VERTICAL MODE to LEFT and position the trace to the lower half of the graticule area with the left vertical position control.

c. **CHECK**—the display for two traces in the ALT and CHOP positions of the VERTICAL MODE selector.

d. Set the VERTICAL MODE to ADD.

e. **CHECK**—the display for a single trace that can be positioned vertically with either left or right vertical Position control.

G. READOUT SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

2. Amplifier (dual trace)
4. Time base
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations G** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

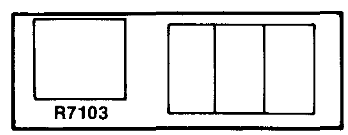
READOUT SYSTEM PRELIMINARY CONTROL SETTINGS

POWER.......................................On
VERTICAL MODE ....RIGHT
TRIGGER SOURCE....................VERT MODE
INTENSITY ....Midrange
READOUT INTENSITY..............OFF (in detent)
GRAT ILLUM ....Midrange
BEAMFINDER .... Pushbutton out
Readout Selector Switch... Free Run (see Test Point and Adjustment Locations G.)

G1. ADJUST READOUT VERTICAL SEPARATION AND CENTERING (R3490, R701, R1025, R1035)

G1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
No equipment necessary.

5039-531

a. Turn the POWER off.

b. Remove Q3416 from its socket on the A15 Readout System Board.

c. Set the POWER switch to On.

d. Set the READOUT INTENSTIY control for visible characters (all zeros).

NOTE

The following tolerances are provided as guides to correct instrument operation and are not instrument specifications.

e. **EXAMINE**—the crt display for two rows of zeros, 30 zeros to a row with no character overlap. The two rows of zeros should be located vertically in the middle of the top and bottom divisions of the graticule (see Fig. 5-2).

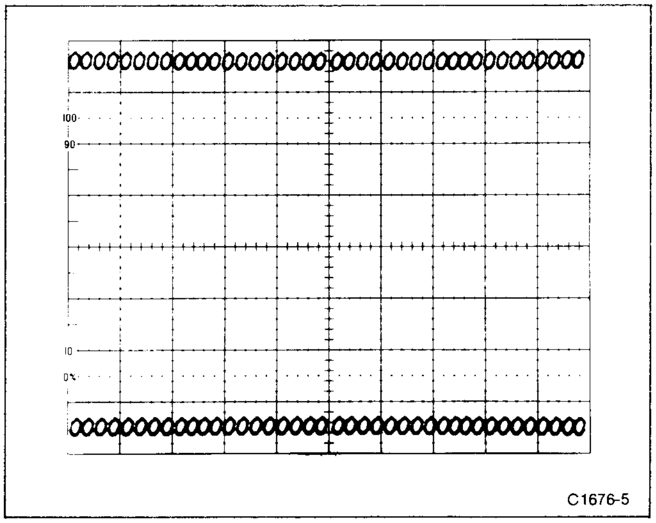


Figure 5-2. Readout display with Q3416 removed.

NOTE

The MVA Center (Main Vertical Amplifier) adjustment, R740, must be correct before making the next adjustment. Refer to F. Vertical System procedure.

f. **ADJUST**—Vertical Separation adjustment, R3490, and R/O Center adjustment, R701, to position the two rows of readout characters to the middle of the top and bottom divisions of the graticule.

g. **EXAMINE**—the display for two rows of zeros, 30 zeros to each row, with no character overlap. Total length of each row of character is between 9.5 and 10 divisions.

h. **ADJUST**—RO Ctr adjustment, R1025, and RO Gain, R1035, to horizontally center the zeros display and set the length of each row of characters between 9.5 and 10 divisions.

i. Turn the POWER off and replace Q3416 in its socket.

j. Turn the POWER on.

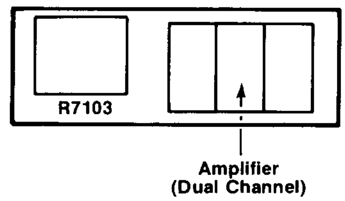
G2. ADJUST FULL-CHARACTER SCAN (R3437)

NOTE

If the preceding step was not performed, first refer to the Readout System Preliminary Control Settings, then proceed.

G2. SETUP CONDITIONS

R7103 Controls:
POWER .... On
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Amplifier
Volts/Div, both .... 50 mV/div
Display Mode .... Dual trace

5039-532

a. **EXAMINE**—the displayed characters for completeness without overscanning; overscanning causes a bright dot where traces overlap.

b. **ADJUST**—Character Scan adjustment R3437 for fully scanned characters without overscanning. The m and the 5 will show the most change.

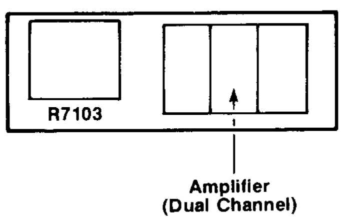
G3. ADJUST COLUMN AND ROW MATCH (R3407, R3422)

NOTE

If the preceding step was not performed, first refer to the Readout System Preliminary Control Settings, then proceed.

G3. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Amplifier
Display Mode .... Alt

5039-533

a. Press and hold one of the amplifier trace-identify buttons.

b. **EXAMINE**—the readout display for correct indication of the word "IDENTIFY." If the readout display is incorrect, adjustment is required.

c. **ADJUST**—Column Match adjustment, R3407, and Row Match adjustment, R3422, for correct readout of "IDENTIFY." Set these adjustments to the center of the adjustment range which provides correct readout indication. Release the amplifier trace-identify button.

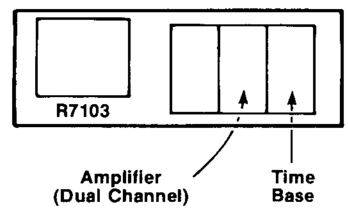
G4. CHECK READOUT MODES

NOTE

If the preceding step was not performed, first refer to the Readout System Preliminary Control Settings, then proceed.

G4. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

5039-534

a. Set the READOUT INTENSITY control for a visible display.

b. **CHECK**—set the time base to several sweep rates throughout its range and check that the readout characters are displayed independently of the sweep.

c. Set the READOUT +GATE or EXT switch to +GATE and the READOUT INTENSITY control to PULSED.

d. Set the READOUT PRESET control for a visible readout display.

e. Set the time base for a free-running (not triggered) sweep of 0.2 second/division.

f. **CHECK**—that the readout characters are blanked 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.

g. Set the READOUT +GATE or EXT switch to EXT.

h. **CHECK**—press the READOUT MAN pushbutton and notice that one frame of readout is displayed.

H. PHOTOGRAPHIC WRITING RATE

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

2. Amplifier
4. Time base
7. Camera
12. High-frequency sine-wave generator
20. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations H** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

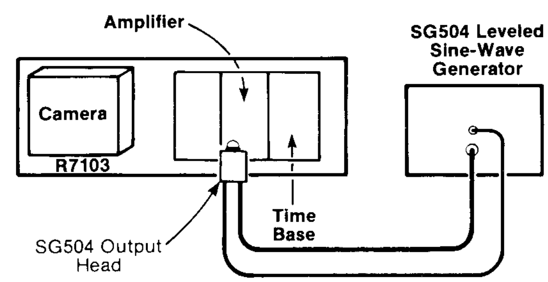
PHOTOGRAPHIC WRITING RATE PRELIMINARY CONTROL SETTINGS

POWER .... On
VERTICAL MODE .... RIGHT
TRIGGER SOURCE .... VERT MODE
INTENSITY .... Midrange
READOUT INTENSITY .... OFF (in detent)
GRAT ILLUM .... PULSED
BEAMFINDER .... Pushbutton out

H1. CHECK/ADJUST PHOTOGRAPHIC WRITING RATE (R1720)

H1. SETUP CONDITIONS

R7103 Controls:
GRAT ILLUM +GATE or EXT .... +GATE



Test Equipment Controls:
Amplifier
Volts/Div .... 0.5 V
Input Coupling .... DC

Time Base
Time/Div .... 5 ns
Triggering .... Auto, AC, Internal
Magnifier X10

High-Frequency Sine-Wave Generator
Frequency .... 1 GHz

Camera
Mode .... Time
Aperture .... f 1.9

5039-535

a. Set the INTENSITY control for a visible display.

b. Set the time-base sweep magnifier to X10.

c. Set the high-frequency sine-wave generator output amplitude to display 7.5 divisions on the R7103 crt.

d. Set the FOCUS and ASTIG controls for a well-defined display.

e. Set the time base to single-sweep mode.

f. Sequentially press the time-base single-sweep-reset control and set the GRAT ILLUM PRESET control to illuminate the graticule.

g. Focus the camera.

h. Install 3000 ASA film in the camera and close the camera viewing port.

i. Rotate the INTENSITY control fully clockwise.

j. Press the camera shutter button.

k. Press the time base Single Sweep Reset button.

l. Press the camera shutter button.

m. Develop the film.

n. **CHECK**—that the photograph shows the 1 GHz sine-wave clearly (Fig. 5-3 is a typical waveform).

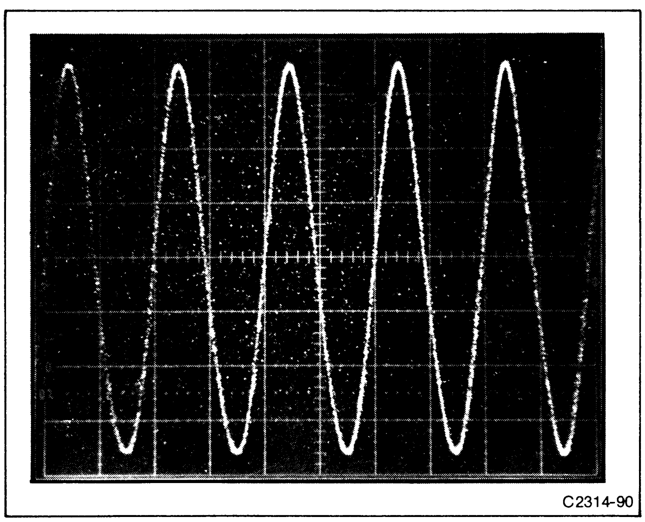


Figure 5-3. Typical display of Photographic Writing Rate test.

o. **ADJUST**—if necessary, rotate the MCP Output adjustment, R1720, clockwise to increase the photographic writing rate. Background scintillation can be reduced by rotating R1720 counterclockwise at the expense of the photographic writing rate. Adjustment R1720 should be set to the lowest usable photographic writing rate. Unnecessarily high MCP gain may shorten the life of the crt.

This concludes the Part II—Adjustment and Performance Check procedure.

INSTRUMENT OPTIONS

Your instrument may have one or more options. A brief description of each available option is given in the following discussion, and in the appropriate sections of this manual. Refer to Table 6-1 and the Table of Contents for location of option information. For further information on instrument options, see your Tektronix Products catalog or contact your Tektronix Field Office.

LIST OF OPTIONS

OPTION A1

The standard power cord is replaced with the Universal European 220 V type power cord (Tektronix Part 161-0066-09).

OPTION A2

The standard power cord is replaced with the United Kingdom 240 V type power cord (Tektronix Part 161-0066-01).

OPTION A3

The standard power cord is replaced with the Australian 240 V type power cord (Tektronix Part 161-0066-11).

OPTION A4

The standard power cord is replaced with the North American 240 V type power cord (Tektronix Part 161-0066-12).

OPTION A5

The standard power cord is replaced with the Switzerland 220 V type power cord (Tektronix Part 161-0154-00).

HOW TO IDENTIFY THE OPTIONS

OPTIONS A1 THROUGH A5

To identify Power-Cord Options A1, A2, A3, A4, and A5 refer to Table 1-2.

TABLE 6-1
Option Information Locator

Option	Location in Manual		Information
	Section	**Heading**	
A1	1 General Information	Power-Cord Information Table 1-2	Lists details of Option A1
	3 Instrument Options	Option A1	Gives a brief description of Option A1
A2	1 General Information	Power-Cord Information Table 1-2	Lists details of Option A2
	3 Instrument Options	Option A2	Gives a brief description of Option A2
A3	1 General Information	Power-Cord Information	Lists details of Option A3 Table 1-2
	3 Instrument Options	Option A3	Gives a brief description of Option A3
A4	1 General Information	Power-Cord Information	Lists details of Option A4 Table 1-2
	3 Instrument Options	Option A4	Gives a brief description of Option A4
A5	1 General Information	Power-Cord Information	Lists details of Option A5 Table 1-2
	3 Instrument Options	Option A5	Gives a brief description of Option A5

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.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.

A23R1234 — component number: A23 (Assembly number) R1234 (Circuit number)

Read: Resistor 1234 of Assembly 23

Example b.

A23A2R1234 — component number: A23 (Assembly number) A2 (Subassembly number) R1234 (Circuit number)

Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

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.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
0000L	MATSUSHITA ELECTRIC	200 PARK AVENUE, 54TH FLOOR	NEW YORK, NY 10017
000LI	TOPTRON CORP		TOKYO, JAPAN
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P.O. BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01281	TRW ELECTRONIC COMPONENTS, SEMICONDUCTOR OPERATIONS	14520 AVIATION BLVD.	LAWNDALE,CA 90260
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
02114	FERROXCUBE CORPORATION	PO BOX 359, MARION ROAD	SAUGERTIES, NY 12477
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
02777	HOPKINS ENGINEERING COMPANY	12900 FOOTHILL BLVD.	SAN FERNANDO, CA 91342
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05828	GENERAL INSTRUMENT CORP ELECTRONIC SYSTEMS DIV.	600 W JOHN ST.	HICKSVILLE LI, NY 11802
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
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
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
14936	GENERAL INSTRUMENT CORP., SEMICONDUCTOR PRODUCTS GROUP	P.O. BOX 600,600 W. JOHN ST.	HICKSVILLE, NY 11802
15454	RODAN INDUSTRIES, INC.	2905 BLUE STAR ST.	ANAHEIM, CA 92806
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
19701	ELECTRA-MIDLAND CORP., MEPCO ELECTRA INC.	P O BOX 760	MINERAL WELLS, TX 76067
20932	EMCON DIV OF ILLINOIS TOOL WORKS INC.	11620 SORRENTO VALLEY RD P O BOX 81542	SAN DIEGO, CA 92121
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
31918	IEE/SCHADOW INC.	8081 WALLACE ROAD	EDEN PRAIRIE, MN 55343
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	MUSKEGON, MI 49443
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
50558	ELECTRONIC CONCEPTS, INC.	526 INDUSTRIAL WAY WEST	EATONTOWN, NJ 07724
51406	MURATA CORPORATION OF AMERICA	2 WESTCHESTER PLAZA	ELMSFORD, NY 10523
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
51984	NEC AMERICA INC. RADIO AND TRANSMISSION DIV.	2990 TELESTAR CT. SUITE 212	FALLS CHURCH, VA 22042
52306	HIGH VOLTAGE DEVICES, INC.	7485 AVENUE 304	VISALIA, CA 93277
53184	XCITON CORPORATION	5 HEMLOCK STREET	LATHAM, NY 12110
54473	MATSUSHITA ELECTRIC, CORP. OF AMERICA	1 PANASONIC WAY	SECAUCUS, NJ 07094
55680	NICHICON/AMERICA/CORP.	6435 N PROESEL AVENUE	CHICAGO, IL 60645
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
60705	CERA-MITE CORP.	1327 6TH AVE.	GRAFTON, WI 53024
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
73899	JFD ELECTRONICS COMPONENTS CORP.	PINETREE ROAD	OXFORD, NC 27565
74276	SIGNALITE DIV., GENERAL INSTRUMENT CORP.	1933 HECK AVE.	NEPTUNE, NJ 07753
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
77342	AMF INC., POTTER AND BRUMFIELD DIV.	200 RICHLAND CREEK DRIVE	PRINCETON, IN 47670
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
82877	ROTRON, INC.	7-9 HASBROUCK LANE	WOODSTOCK, NY 12498
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
84411	TRW ELECTRONIC COMPONENTS, TRW CAPACITORS	112 W. FIRST ST.	OGALLALA, NE 69153
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
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
93958	REPUBLIC ELECTRONICS CORPORATION	176 E 7TH STREET	PATERSON, NJ 07524
95275	VITRAMON, INC.	P O BOX 544	BRIDGEPORT, CT 06601
96733	SAN FERNANDO ELECTRIC MFG CO	1501 FIRST ST	SAN FERNANDO, CA 91341
S3774	OSHINO ELECTRIC LAMP WORKS LTD	5 2 MINAMI SHINAGAWA 2 CHORE SHINAGAWA KU	TOKYO, JAPAN

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				ASSEMBLIES		
A1	670-4895-20			CKT BOARD ASSY:FRONT PANEL	80009	670-4895-20
A3	670-4778-01			CKT BOARD ASSY:TRIGGER LIGHT	80009	670-4778-01
A5	670-8411-00			CKT BOARD ASSY:MODE SWITCH	80009	670-8411-00
A6	670-8412-00			CKT BOARD ASSY:MAIN INTERFACE	80009	670-8412-00
A7	670-5098-00			CKT BOARD ASSY:TRIGGER A FOLLOWER	80009	670-5098-00
A10	670-5096-00			CKT BOARD ASSY:HORIZONTAL A FOLLOWER	80009	670-5096-00
A11	670-5097-00			CKT BOARD ASSY:VERTICAL CHANNEL FOLLOWER	80009	670-5097-00
A12	670-5097-00			CKT BOARD ASSY:VERTICAL CHANNEL FOLLOWER	80009	670-5097-00
A13	670-8408-00			CKT BOARD ASSY:LOGIC	80009	670-8408-00
A14	670-8409-00			CKT BOARD ASSY:TRIGGER SELECTOR	80009	670-8409-00
A15	670-1885-11			CKT BOARD ASSY:READOUT	80009	670-1885-11
A16	670-4769-02			CKT BOARD ASSY:VERTICAL CHANNEL SWITCH	80009	670-4769-02
A17	672-0802-01			CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	672-0802-01
A17A1	670-5616-00			CKT BOARD ASSY:VERTICAL CRT FLEX CON	80009	670-5616-00
A17A1	----- -----			(NO REPLACEABLE SUBPARTS)		
A18	672-0800-00			CKT BOARD ASSY:CRT TERMINATION	80009	672-0800-00
A18A1	670-5616-00			CKT BOARD ASSY:VERTICAL CRT FLEX CON	80009	670-5616-00
A18A1	----- -----			(NO REPLACEABLE SUBPARTS)		
A19	672-0140-00			CKT BOARD ASSY:HORIZONTAL AMPLIFIER	80009	672-0140-00
A19A1	670-5094-00			CKT BOARD ASSY:HORIZONTAL CRT FLEX CON	80009	670-5094-00
A19A1	----- -----			(NO REPLACEABLE SUBPARTS)		
A20	670-0702-06			CKT BOARD ASSY:GRATICULE LAMPS	80009	670-0702-06
A21	670-4774-02			CKT BOARD ASSY:Z AXIS	80009	670-4774-02
A22	670-8410-00			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-8410-00
A23	620-0283-01			PWR SUPPLY ASSY:	80009	620-0283-01
A23	----- -----			(INCLUDES A23,A24,A25 ASSEMBLIES)		
A23	670-6259-01	B010100	B029999	CKT BOARD ASSY:INVERTER	80009	670-6259-01
A23	----- -----			(PART OF 620-0283-XX)		
A23	670-6259-02	B030000		CKT BOARD ASSY:INVERTER	80009	670-6259-02
A23	----- -----			(PART OF 620-0283-XX)		
A23A1	670-6259-01	B010100	B029999	CKT BOARD ASSY:INVERTER	80009	670-6259-01
A23A1	----- -----			(PART OF 620-0283-XX)		
A23A1	670-6259-02	B030000		CKT BOARD ASSY:INVERTER	80009	670-6259-02
A23A1	----- -----			(PART OF 620-0283-XX)		
A24	670-5959-03			CKT BOARD ASSY:CONTROL RECTIFIER	80009	670-5959-03
A24	----- -----			(PART OF 620-0283-XX)		
A25	670-5960-03			CKT BOARD ASSY:LOW VOLTAGE REGULATOR	80009	670-5960-03
A25	----- -----			(PART OF 620-0283-XX)		

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-4895-20			CKT BOARD ASSY:FRONT PANEL	80009	670-4895-20
A1C1901	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A1C1904	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A1C1906	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A1C1908	290-0187-00			CAP.,FXD,ELCTLT:4.7UF,20%,35V	56289	150D475X0035B2
A1C1914	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	04222	MA101A470KAA
A1C1916	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A1C1918	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A1C1920	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A1C1921	281-0813-00			CAP.,FXD CER DI:0.047UF,20%,50V	96733	R2980
A1C1935	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	04222	MA106A150KAA
A1C1938	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A1C1950	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C1952	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	04222	MA101A151KAA
A1C1953	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C1955	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
A1C1956	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A1C1968	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A1C1969	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A1C1971	285-0913-00			CAP.,FXD,PLSTC:3UF,5%,50V	84411	TEK34-3055R5
A1C1982	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C1984	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A1C1985	290-0574-00			CAP.,FXD,ELCTLT:47UF,10%,20V	90201	TDC476K020CL
A1C1990	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
A1C1993	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A1C1994	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C1995	290-0804-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	55680	ULA1E100TEA
A1C1996	290-0804-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	55680	ULA1E100TEA
A1C1997	290-0804-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	55680	ULA1E100TEA
A1CR1900	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1902	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1916	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
A1CR1918	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1922	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1923	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1927	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1928	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1929	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1946	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1947	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1948	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1963	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1971	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1972	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1974	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1991	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1992	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1993	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1994	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR1998	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1E1946	276-0532-00			SHIELDING BEAD,:	02114	56-590-65/4A6
A1J1915	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A1J1924	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A1J1943	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A1J1992	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1L1995	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A1L1996	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A1L1997	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A1P1900	131-0589-00	B010100	B030299	TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A1P1900	-----			(QUANTITY OF 8)		
A1P1900	-----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A1P1904	131-0608-00	B010100	B030299	TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A1P1904	-----			(QUANTITY OF 8)		
A1P1904	-----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A1P1909	131-0608-00	B010100	B030299	TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A1P1909	-----			(QUANTITY OF 6)		
A1P1909	-----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A1P1910	131-0608-00	B010100	B030299	TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A1P1910	-----			(QUANTITY OF 4)		
A1P1910	-----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A1P1917	131-0608-00	B010100	B030299	TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A1P1917	-----			(QUANTITY OF 5)		
A1P1917	-----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A1Q1908	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	X13T520
A1Q1910	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q1916	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1Q1928	151-0271-00			TRANSISTOR:SILICON,PNP	04713	SPS8236
A1Q1934	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
A1Q1938	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
A1Q1942	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A1Q1943	151-0198-00			TRANSISTOR:SELECTED	04713	SPS8802-1
A1Q1946	151-0198-00			TRANSISTOR:SELECTED	04713	SPS8802-1
A1Q1956	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q1970	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q1974	151-1021-00			TRANSISTOR:SILICON,JFE	17856	FN5055
A1Q1978	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1Q1980	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1Q1982	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A1Q1994	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A1Q1995	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1Q1998	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A1Q1999	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1R301	303-0301-00			RES.,FXD,CMPSN:300 OHM,5%,1W	01121	GB3015
A1R1900	311-1587-00			RES.,VAR,NONWIR:10K OHM,20%,1W	01121	12M435
A1R1901	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A1R1902	311-1319-00			RES.,VAR,NONWIR:10K OHM,10%,0.75W	73138	89-126-1
A1R1903	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1905	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1906	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1908	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R1909	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	57668	NTR25J-E 240K
A1R1910	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1911	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
A1R1914	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R1915	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1916	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R1917	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A1R1918	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A1R1919	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1R1920	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1921	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
A1R1922	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
A1R1923	311-1339-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	89-131-1
A1R1924	311-1588-00			RES.,VAR,NONWIR:5K OHM,20%,1W	01121	20M718
A1R1925	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A1R1926	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1927	321-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
A1R1928	321-0180-00			RES.,FXD,FILM:732 OHM,1%,0.125W	91637	CMF55116G732R0F
A1R1929	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
A1R1930	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	57668	NTR25J-E 430E
A1R1932	323-0189-00			RES.,FXD,FILM:909 OHM,1%,0.50W	24546	NA65 9090F
A1R1933	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1934	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	57668	NTR25J-E300E
A1R1935	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A1R1936	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1937	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A1R1938	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A1R1940	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A1R1942	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	57668	NTR25J-E 200K
A1R1943	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A1R1944	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
A1R1945	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
A1R1946	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A1R1948	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
A1R1950	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
A1R1951	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	91637	CMF55116G10003F
A1R1952	321-0300-00			RES.,FXD,FILM:13K OHM,1%,0.125W	91637	MFF1816G13001F
A1R1953	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1954	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1955	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1956	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A1R1957	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A1R1958	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
A1R1959	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	91637	CMF55116G17800F
A1R1960	321-0039-00			RES.,FXD,FILM:24.9 OHM,1%,0.125W	91637	CMF55116G24R90F
A1R1961	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1962	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	19701	5043CX510K0J
A1R1963	321-0283-00			RES.,FXD,FILM:8.66K OHM,1%,0.125W	91637	CMF55116G86600F
A1R1964	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	CMF55116G13300F
A1R1965	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
A1R1966	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1967	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A1R1968	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1969	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A1R1970	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A1R1971	315-0625-00			RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
A1R1972	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1973	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1974	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1975	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
A1R1976	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1977	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	57668	NTR25J-E043K
A1R1979	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	91637	MFF1816G11801F

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1R1980	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1981	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A1R1982	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A1R1983	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
A1R1985	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
A1R1986	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1987	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R1988	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A1R1989	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1990	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R1991	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1992	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A1R1993	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1995	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R1996	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1997	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R1998	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A1R1999	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1S1905	260-1380-00			SWITCH,PUSH:2 STATION,NON-SHORT,INTLK	71590	2KBM020000-619
A1S1910	-----			(PART OF S1905)		
A1S1915	260-1380-00			SWITCH,PUSH:2 STATION,NON-SHORT,INTLK	71590	2KBM020000-619
A1S1920	-----			(PART OF S1915)		
A1TP1908	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1925	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1952	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1956	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1958	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1962	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1968	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1970	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1986	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1991	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1TP1992	214-0579-00	B010100	B030249	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A1U1952	156-0686-00			MICROCIRCUIT,LI:OPNL AMPL,HIGH IMPEDANCE	02735	CA3130S
A1U1958	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
A1U1968	156-0402-00			MICROCIRCUIT,LI:TIMER	27014	LM555CN
A1U1970	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A1U1986	156-0402-00			MICROCIRCUIT,LI:TIMER	27014	LM555CN
A1U1992	156-0038-02			MICROCIRCUIT,DI:J-K MASTER SLAVE FF,SCRN	01295	SN7472(NP3/JP4)
A1VR1910	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00

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A3	670-4778-01			CKT BOARD ASSY:TRIGGER LIGHT	80009	670-4778-01
A3DS342	150-0048-01			LAMP,INCAND:5V,0.06A,#683,AGED & SEL	S3774	OL683AS15 TPL
A3DS345	150-0048-01			LAMP,INCAND:5V,0.06A,#683,AGED & SEL	S3774	OL683AS15 TPL
A3DS346	150-0048-01			LAMP,INCAND:5V,0.06A,#683,AGED & SEL	S3774	OL683AS15 TPL
A3P346	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A3P346	----- -----			(QUANTITY OF 4)		
A5	670-8411-00			CKT BOARD ASSY:MODE SWITCH	80009	670-8411-00
A5C324	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A5C325	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	04222	MA101A470KAA
A5C326	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A5C376	285-1130-00			CAP.,FXD,PLSTC:0.22UF,1%,100V	50558	MH12D224F
A5C384	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	04222	MA101A470KAA
A5C386	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	04222	MA101A470KAA
A5CR319	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR362	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR386	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5J392	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A5P303	----- -----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A5P304	----- -----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A5P306	----- -----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A5P308	----- -----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A5P309	----- -----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A5P310	----- -----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A5P2006	----- -----			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A5Q356	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A5Q357	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A5Q362	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A5Q366	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A5Q376	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A5Q382	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A5Q384	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A5R309	311-1372-01			RES.,VAR,NONWIR:100K OHM,20%,1W	01121	73U1G040L104M
A5R310	311-1972-00			RES.,VAR,NONWIR:PNL,2K OHM,10%,2.0 W	01121	70N1G100L202W
A5R313	311-1973-00			RES.,VAR,NONWIR:PNL,2.5M OHM,20%,0.75W	01121	73M1G040L255M
A5R316	311-1375-00			RES.,VAR,NONWIR:PNL,10K OHM,1W	01121	73M1G040L103M
A5R317	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
A5R318	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A5R319	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A5R351	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A5R352	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A5R353	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A5R354	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A5R355	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R356	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A5R357	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A5R358	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
A5R359	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R361	307-0109-00			RES.,FXD,CMPSN:8.2 OHM,5%,0.25W	01121	CB82G5
A5R362	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R363	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	57668	NTR25J-E 1K6

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A5R365	307-0109-00			RES.,FXD,CMPSN:8.2 OHM,5%,0.25W	01121	CB82G5
A5R366	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R367	307-0109-00			RES.,FXD,CMPSN:8.2 OHM,5%,0.25W	01121	CB82G5
A5R368	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A5R369	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A5R370	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R371	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R372	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K
A5R373	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
A5R374	321-1216-03			RES.,FXD,FILM:1.76K OHM,0.25%,0.125W	91637	MFF1816D17600C
A5R375	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91-88-0
A5R376	321-0321-00			RES.,FXD,FILM:21.5K OHM,1%,0.125W	91637	MFF1816G21501F
A5R380	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
A5R381	321-0321-00			RES.,FXD,FILM:21.5K OHM,1%,0.125W	91637	MFF1816G21501F
A5R382	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A5R383	321-0166-00			RES.,FXD,FILM:523 OHM,1%,0.125W	91637	CMF55116G523R0F
A5R384	321-0816-00			RES.,FXD,FILM:5K OHM,1%,0.125W	24546	NA55D5001F
A5R385	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
A5R386	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A5R387	321-1611-07			RES.,FXD,FILM:550 OHM,0.1%,0.125W	91637	MFF1816C550R0B
A5R391	321-0001-01			RES.,FXD,FILM:10 OHM,0.5%,0.125W	91637	MFF1816G10R00D
A5R392	321-1612-07			RES.,FXD,FILM:4.455K OHM,0.1%,0.125W	24546	NE55 4.455 K B
A5R393	321-1611-07			RES.,FXD,FILM:550 OHM,0.1%,0.125W	91637	MFF1816C550R0B
A5R394	321-1612-07			RES.,FXD,FILM:4.455K OHM,0.1%,0.125W	24546	NE55 4.455 K B
A5R395	321-1611-07			RES.,FXD,FILM:550 OHM,0.1%,0.125W	91637	MFF1816C550R0B
A5R396	321-1612-07			RES.,FXD,FILM:4.455K OHM,0.1%,0.125W	24546	NE55 4.455 K B
A5R397	321-0813-07			RES.,FXD,FILM:495 OHM,0.1%,0.125W	91637	MFF1816C495R0B
A5S309	260-1208-00			SWITCH,PUSH:DPDT,28VDC,PUSH-PUSH	31918	ORDER BY DESCR
A5S325	263-0022-02			SWITCH PB ASSY:5 LATCH,7.5 MM10 CONTACTS	80009	263-0022-02
A5S365	263-0013-10			SWITCH PB ASSY:3 LATCH,10 MM,W/3 CONTACTS	80009	263-0013-10
A5S395	263-0013-11			SWITCH PB ASSY:3-LATCH,10 MM,5 CONTACTS	80009	263-0013-11
A5U364	156-0384-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	01295	SN74LS03
A5U366	156-0722-02			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	04713	SN74LS12NDS

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A6	670-8412-00			CKT BOARD ASSY:MAIN INTERFACE	80009	670-8412-00
A6C5	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
A6C6	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
A6C7	290-0969-00			CAP.,FXD,ELCTLT:22UF,+50-10%,100V	55680	TLB2A220TCAANA
A6C8	290-0969-00			CAP.,FXD,ELCTLT:22UF,+50-10%,100V	55680	TLB2A220TCAANA
A6C9	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
A6C11	285-0674-00			CAP.,FXD,PLSTC:0.01UF,10%,100V	56289	192P10392
A6C12	285-0674-00			CAP.,FXD,PLSTC:0.01UF,10%,100V	56289	192P10392
A6C13	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A6C15	281-0815-00			CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
A6C19	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A6C85	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6C87	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A6CR3	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR32	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR33	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR34	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR35	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR36	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR37	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR38	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR39	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR42	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR43	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR44	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR45	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR46	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR47	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR48	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR49	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR52	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR62	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR63	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR64	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR65	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR66	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR67	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR68	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR69	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A6CR73	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR82	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR83	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR86	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR88	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR212	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR213	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR214	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR215	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR216	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR217	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR218	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR241	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR243	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6CR245	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6CR247	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A6J1	131-0767-10			CONN,RCPT,ELEC:CKT BD,38/76 CONTACT	80009	131-0767-10
A6J2	131-0767-10			CONN,RCPT,ELEC:CKT BD,38/76 CONTACT	80009	131-0767-10
A6J3	131-0767-10			CONN,RCPT,ELEC:CKT BD,38/76 CONTACT	80009	131-0767-10
A6J78	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A6J201	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A6J202	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A6P3	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P9	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P18	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P46	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P67	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P79	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P80	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P82	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P83	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P85	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P87	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6P89	——			(REFER TO MAINT SECTION FOR SQ PIN REPL)		
A6Q18	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
A6Q89	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A6Q90	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A6R3	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A6R14	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A6R15	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A6R16	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	57668	NTR25J-E33K0
A6R17	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A6R18	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A6R19	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A6R22	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
A6R26	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A6R32	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R33	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R34	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R35	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R42	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R43	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R44	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R45	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R52	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A6R53	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
A6R55	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A6R56	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A6R62	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R63	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R64	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R65	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
A6R73	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A6R76	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A6R83	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A6R85	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
A6R86	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A6R87	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	57668	NTR25J-E09K1

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6R88	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A6R89	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A6R90	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A6R91	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
A6R93	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	57668	NTR25J-E01K3
A6R94	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	57668	NTR25J-E01K3
A6R201	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A6R202	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A6R212	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	57668	NTR25J-E750E
A6R213	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	57668	NTR25J-E750E
A6R214	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	57668	NTR25J-E750E
A6R215	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	57668	NTR25J-E750E
A6R223	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A6R224	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A6R227	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
A6R228	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
A6R229	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
A6R241	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	57668	NTR25J-E 13K
A6R242	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
A6R243	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	57668	NTR25J-E 13K
A6R244	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A6R245	321-0308-00			RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
A6R246	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
A6R247	321-0319-00			RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	MFF1816G20501F
A6R248	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A6R251	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
A6R252	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A6R253	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
A6R254	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A6R255	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
A6R256	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
A6R257	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A6R258	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A6R264	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A6U232	155-0015-01			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01
A6U262	155-0015-01			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A7	670-5098-00			CKT BOARD ASSY:TRIGGER A FOLLOWER	80009	670-5098-00
A7P20	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A7P20	—— ——			(QUANTITY OF 2)		
A7P21	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A7P21	—— ——			(QUANTITY OF 2)		
A7P22	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A7P22	—— ——			(QUANTITY OF 2)		
A10	670-5096-00			CKT BOARD ASSY:HORIZONTAL A FOLLOWER	80009	670-5096-00
A10P11	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A10P11	—— ——			(QUANTITY OF 2)		
A10P12	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A10P12	—— ——			(QUANTITY OF 2)		
A10P13	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A10P13	—— ——			(QUANTITY OF 2)		
A10R58	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
A10R59	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
A11	670-5097-00			CKT BOARD ASSY:VERTICAL CHANNEL FOLLOWER	80009	670-5097-00
A11P11	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A11P11	—— ——			(QUANTITY OF 2)		
A11P12	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A11P12	—— ——			(QUANTITY OF 2)		
A11P13	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A11P13	—— ——			(QUANTITY OF 2)		
A12	670-5097-00			CKT BOARD ASSY:VERTICAL CHANNEL FOLLOWER	80009	670-5097-00
A12P11	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A12P11	—— ——			(QUANTITY OF 2)		
A12P12	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A12P12	—— ——			(QUANTITY OF 2)		
A12P13	131-1149-00			CONTACT,ELEC:CKT CARD EDGE	80009	131-1149-00
A12P13	—— ——			(QUANTITY OF 2)		

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A13	670-8408-00			CKT BOARD ASSY:LOGIC	80009	670-8408-00
A13C303	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A13C304	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A13C314	281-0809-00			CAP.,FXD,CER DI:200PF,5%,100V	04222	MA101A201JAA
A13C315	281-0603-00			CAP.,FXD,CER DI:39PF,5%,500V	59660	308-000C0G0390J
A13C316	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
A13C320	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
A13C341	281-0756-00			CAP.,FXD,CER DI:2.2PF,0.5%,200V	96733	R2732
A13C342	281-0862-00			CAP.,FXD,CER DI:0.001UF,+80-20%,100V	96733	ADIVSE
A13C343	281-0898-00			CAP.,FXD,CER DI:7.5PF,+/-0.5PF,500V	96733	XR3446
A13C351	281-0862-00			CAP.,FXD,CER DI:0.001UF,+80-20%,100V	96733	ADIVSE
A13C367	281-0756-00			CAP.,FXD,CER DI:2.2PF,0.5%,200V	96733	R2732
A13C368	281-0862-00			CAP.,FXD,CER DI:0.001UF,+80-20%,100V	96733	ADIVSE
A13C369	281-0898-00			CAP.,FXD,CER DI:7.5PF,+/-0.5PF,500V	96733	XR3446
A13C394	281-0756-00			CAP.,FXD,CER DI:2.2PF,0.5%,200V	96733	R2732
A13C395	281-0862-00			CAP.,FXD,CER DI:0.001UF,+80-20%,100V	96733	ADIVSE
A13C397	281-0898-00			CAP.,FXD,CER DI:7.5PF,+/-0.5PF,500V	96733	XR3446
A13C408	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A13C409	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
A13C429	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
A13C436	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A13C439	281-0862-00			CAP.,FXD,CER DI:0.001UF,+80-20%,100V	96733	ADIVSE
A13CR327	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR328	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR329	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR332	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR333	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR359	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR386	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR417	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR419	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR426	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13CR427	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A13J395	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A13J406	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A13L303	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A13L304	108-0329-00			COIL,RF:2.5UH	80009	108-0329-00
A13L317	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A13L320	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A13L408	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A13L409	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A13L436	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
A13Q336	151-0199-00			TRANSISTOR:PNP,SI,T0-92	04713	SPS6866K
A13Q342	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
A13Q352	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
A13Q364	151-0199-00			TRANSISTOR:PNP,SI,T0-92	04713	SPS6866K
A13Q368	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
A13Q391	151-0199-00			TRANSISTOR:PNP,SI,T0-92	04713	SPS6866K
A13Q395	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
A13Q416	151-0198-00			TRANSISTOR:SELECTED	04713	SPS8802-1
A13Q452	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A13R303	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	57668	NTR25J-E75E0
A13R304	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K

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A13R305	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A13R306	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A13R307	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A13R312	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	CMF55116G332R0F
A13R313	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	24546	CT55 3011 F
A13R314	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	57668	NTR25J-E09K1
A13R315	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A13R316	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A13R327	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A13R328	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A13R329	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
A13R332	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A13R333	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	57668	NTR25J-E390E
A13R336	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A13R337	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A13R338	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A13R339	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A13R341	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
A13R342	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A13R343	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A13R351	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A13R352	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A13R353	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A13R358	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	57668	NTR25J-E390E
A13R359	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
A13R362	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A13R363	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A13R364	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A13R365	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A13R367	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
A13R368	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A13R369	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A13R383	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A13R384	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A13R386	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	57668	NTR25J-E390E
A13R387	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
A13R389	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A13R390	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A13R391	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A13R392	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A13R394	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
A13R395	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A13R396	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
A13R397	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A13R413	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A13R414	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A13R415	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A13R416	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
A13R419	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
A13R423	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
A13R424	321-0160-00			RES.,FXD,FILM:453 OHM,1%,0.125W	91637	CMF116G453R0F
A13R425	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A13R428	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
A13R429	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E

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A13R437	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	CMF55116G13300F
A13R441	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
A13R451	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
A13R452	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A13R456	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A13R457	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A13U320	155-0011-00			MICROCIRCUIT,DI:ML,CLOCK AND CHOP BLANKING	80009	155-0011-00
A13U356	156-1756-00			MICROCIRCUIT,DI:DUAL D-TYPE POS-EDGE-TRIG		
A13U383	156-1756-00			MICROCIRCUIT,DI:DUAL D-TYPE POS-EDGE-TRIG		
A13U440	155-0012-00			MICROCIRCUIT,LI:ML,Z-AXIS AND AMPLIFIER	80009	155-0012-00
A13VR413	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738RL

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A14	670-8409-00			CKT BOARD ASSY:TRIGGER SELECTOR	80009	670-8409-00
A14C240	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A14C249	283-0479-00			CAP.,FXD,CER DI:0.47UF,+80-20%,25V	20932	501ES25DP474E
A14C250	290-0488-00			CAP.,FXD,ELCTLT:2.2UF,10%,20V	90201	TAC225K020P02
A14C254	283-0139-00			CAP.,FXD,CER DI:150PF,20%,50V	51642	W100-050-X5F151M
A14C483	283-0175-00			CAP.,FXD,CER DI:10PF,5%,200V	96733	TDR43BY100DP
A14C486	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A14C487	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A14C488	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A14C490	283-0423-00			CAP.,FXD,CER DI:0.22UF,+80-20%,50V	04222	DG015E224Z
A14C493	283-0175-00			CAP.,FXD,CER DI:10PF,5%,200V	96733	TDR43BY100DP
A14J201	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A14J220	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A14J270	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A14J271	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A14J400	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A14J401	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A14J496	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A14L236	108-0262-00			COIL,RF:FIXED,510NH	80009	108-0262-00
A14L238	108-0262-00			COIL,RF:FIXED,510NH	80009	108-0262-00
A14L246	108-0262-00			COIL,RF:FIXED,510NH	80009	108-0262-00
A14L248	108-0262-00			COIL,RF:FIXED,510NH	80009	108-0262-00
A14L480	108-0324-00			COIL,RF:10MH	76493	70F102A1
A14L486	108-0550-00			COIL,RF:11ONH	80009	108-0550-00
A14Q254	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A14R201	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	CMF55116G499R0F
A14R202	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	CMF55116G499R0F
A14R205	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A14R208	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	CMF55116G499R0F
A14R209	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	CMF55116G499R0F
A14R211	325-0065-00			RES.,FXD,FILM:150 OHM,0.5%,0.05W,TC=TO		
A14R212	325-0047-00			RES.,FXD,FILM:25 OHM,0.5%,0.5W	03888	PME50
A14R213	325-0065-00			RES.,FXD,FILM:150 OHM,0.5%,0.05W,TC=TO		
A14R214	325-0047-00			RES.,FXD,FILM:25 OHM,0.5%,0.5W	03888	PME50
A14R215	325-0065-00			RES.,FXD,FILM:150 OHM,0.5%,0.05W,TC=TO		
A14R216	325-0047-00			RES.,FXD,FILM:25 OHM,0.5%,0.5W	03888	PME50
A14R217	325-0065-00			RES.,FXD,FILM:150 OHM,0.5%,0.05W,TC=TO		
A14R218	325-0047-00			RES.,FXD,FILM:25 OHM,0.5%,0.5W	03888	PME50
A14R219	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
A14R220	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A14R225	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
A14R226	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A14R232	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	CMF55116G12400F
A14R233	322-0111-00			RES.,FXD,FILM:140 OHM,1%,0.25W	91637	MFF1421G140R0F
A14R234	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	CMF55116G12400F
A14R235	322-0170-00			RES.,FXD,FILM:576 OHM,1%,0.25W	75042	CEBT0-5760F
A14R236	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	CMF55116G332R0F
A14R237	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A14R238	321-0155-00			RES.,FXD,FILM:402 OHM,1%,0.125W	91637	CMF55116G402R0F
A14R239	322-0114-00			RES.,FXD,FILM:150 OHM,1%,0.25W	75042	CEBT0-1500F
A14R240	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A14R241	322-0085-00			RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
A14R242	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	CMF55116G12400F

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A14R243	322-0111-00			RES.,FXD,FILM:140 OHM,1%,0.25W	91637	MFF1421G140R0F
A14R244	322-0170-00			RES.,FXD,FILM:576 OHM,1%,0.25W	75042	CEBT0-5760F
A14R245	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	CMF55116G12400F
A14R246	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	CMF55116G332R0F
A14R247	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A14R248	321-0155-00			RES.,FXD,FILM:402 OHM,1%,0.125W	91637	CMF55116G402R0F
A14R251	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
A14R252	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	24546	CT55 3241 F
A14R254	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A14R255	311-1236-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	72-22-0
A14R256	321-0062-00			RES.,FXD,FILM:43.2 OHM,1%,0.125W	91637	CMF55-116G43R20F
A14R263	322-0151-00			RES.,FXD,FILM:365 OHM,1%,0.25W	91637	MFF1421G365R0F
A14R273	322-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.25W	75042	CEBT0-3011F
A14R274	311-1248-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	73138	72-23-0
A14R277	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A14R278	322-0085-00			RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
A14R279	311-1936-00			RES.,VAR,NONWIR:CKT BD,50 OHM,20%,0.5W	73138	72XR50-232A
A14R280	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A14R464	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	CMF55116G12100F
A14R465	321-0285-00			RES.,FXD,FILM:9.09K OHM,1%,0.125W	91637	MFF1816G90900F
A14R480	311-1237-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3386X-T07-102
A14R481	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	CMF55116G715R0F
A14R482	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	CMF55116G768R0F
A14R483	317-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.125W	01121	BB3905
A14R484	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A14R485	311-1936-00			RES.,VAR,NONWIR:CKT BD,50 OHM,20%,0.5W	73138	72XR50-232A
A14R486	321-0101-00			RES.,FXD,FILM:110 OHM,1%,0.125W	91637	CMF55116G110R0F
A14R490	311-1237-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3386X-T07-102
A14R491	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	CMF55116G715R0F
A14R492	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	CMF55116G768R0F
A14R493	317-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.125W	01121	BB3905
A14R494	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A14R495	322-0145-00			RES.,FXD,FILM:316 OHM,1%,0.25W	75042	CEBT0-3160F
A14R496	321-0101-00			RES.,FXD,FILM:110 OHM,1%,0.125W	91637	CMF55116G110R0F
A14R497	322-0175-00			RES.,FXD,FILM:649 OHM,1%,0.25W	75042	CEBT0-6490F
A14R498	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
A14R499	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A14U202	156-0730-02			MICROCIRCUIT,DI:QUAD 2-INP NOR BFR,BURN-IN	01295	SN74LS33
A14U232	155-0173-00			MICROCIRCUIT,LI:VERTICAL CHANNEL SWITCH	80009	155-0173-00
A14U252	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
A14U274	155-0175-00			MICROCIRCUIT,LI:TRIGGER AMPLIFIER	80009	155-0175-00
A14U492	155-0175-00			MICROCIRCUIT,LI:TRIGGER AMPLIFIER	80009	155-0175-00
A14VR237	153-0067-00			SEMICOND DVC SE:ZENER,PAIR	80009	153-0067-00
A14VR247	153-0067-00			SEMICOND DVC SE:ZENER,PAIR	80009	153-0067-00

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A15	670-1885-11			CKT BOARD ASSY:READOUT	80009	670-1885-11
A15C3401	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A15C3407	283-0597-00			CAP.,FXD,MICA D:470PF,10%,300V	00853	D155F471K0
A15C3418	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
A15C3420	283-0597-00			CAP.,FXD,MICA D:470PF,10%,300V	00853	D155F471K0
A15C3429	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
A15C3434	285-0698-00			CAP.,FXD,PLSTC:0.0082UF,5%,100V	84411	TEK44-82251
A15C3438	281-0612-00			CAP.,FXD,CER DI:5.6PF,+/-0.5PF,500V	59660	374-018-COH0569D
A15C3443	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
A15C3445	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
A15C3449	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A15C3470	290-0974-00			CAP.,FXD,ELCTLT:10UF,20%,50VDC	55680	ULB1H100MEA
A15C3471	290-0920-00			CAP.,FXD,ELCTLT:33UF,+50-10%,35V	55680	ULB1V330TEAANA
A15C3472	290-0974-00			CAP.,FXD,ELCTLT:10UF,20%,50VDC	55680	ULB1H100MEA
A15C3475	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A15C3485	283-0251-00			CAP.,FXD,CER DI:87 PF,5%,100V	72982	8121B145C0G0870J
A15C3495	283-0054-00			CAP.,FXD,CER DI:150PF,5%,200V	59660	855-535U2J0 151J
A15CR3416	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3431	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3432	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3433	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3438	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3439	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3441	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3442	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3443	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3445	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15CR3447	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A15J34L0	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A15J34L0	———			(QUANTITY OF 4)		
A15J34T0	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A15J34T0	———			(QUANTITY OF 10)		
A15J34S0	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A15J34S0	———			(QUANTITY OF 10)		
A15J3401	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A15J3402	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A15J3403	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A15J3404	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A15J3405	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A15L3482	108-0331-00			COIL,RF:0.75UH	80009	108-0331-00
A15Q3406	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
A15Q3411	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
A15Q3414	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
A15Q3416	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A15Q3419	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
A15Q3427	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A15Q3442	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A15Q3445	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
A15Q3486	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A15Q3489	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A15Q3493	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A15Q3499	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A15R3401	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A15R3402	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A15R3403	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A15R3404	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A15R3405	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A15R3406	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	57668	NTR25J-E 120K
A15R3407	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
A15R3408	321-0300-00			RES.,FXD,FILM:13K OHM,1%,0.125W	91637	MFF1816G13001F
A15R3409	321-0259-00			RES.,FXD,FILM:4.87K OHM,1%,0.125W	91637	MFF1816G48700F
A15R3410	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	CMF55116G750R0F
A15R3411	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A15R3412	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	91637	MFF1816G15800F
A15R3414	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A15R3416	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A15R3418	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	CMF55116G60400F
A15R3419	321-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
A15R3420	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
A15R3422	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
A15R3423	321-0372-00			RES.,FXD,FILM:73.2K OHM,1%,0.125W	91637	MFF1816G73201F
A15R3425	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
A15R3427	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A15R3430	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
A15R3431	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
A15R3432	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A15R3433	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A15R3434	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
A15R3435	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A15R3436	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	57668	NTR25J-E 18K
A15R3437	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
A15R3438	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A15R3439	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A15R3440	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A15R3441	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A15R3442	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
A15R3445	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A15R3449	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A15R3450	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A15R3451	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A15R3452	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A15R3466	321-0153-00			RES.,FXD,FILM:383 OHM,1%,0.125W	91637	CMF55116G383R0F
A15R3468	321-0641-00			RES.,FXD,FILM:1.8K OHM,1%,0.125W	91637	MFF1816G18000F
A15R3470	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A15R3472	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A15R3473	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A15R3474	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A15R3475	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	57668	NTR25J-E09K1
A15R3476	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A15R3476	321-0294-00	B030260		RES.,FXD,FILM:11.3K OHM,1%,0.125W	91637	CMF55116G11301F
A15R3476	321-0295-00	B030260		RES.,FXD,FILM:11.5K OHM,1%,0.125W	91637	MFF1816G11501F
A15R3476	321-0296-00	B030260		RES.,FXD,FILM:11.8K OHM,1%,0.125W	91637	MFF1816G11801F
A15R3476	321-0298-00	B030260		RES.,FXD,FILM:12.4K OHM,1%,0.125W	91637	MFF1816G12401F
A15R3476	321-0299-00	B030260		RES.,FXD,FILM:12.7K OHM,1%,0.125W	91637	MFF1816G12701F
A15R3476	321-0631-00	B030260		RES.,FXD,FILM:12.5K OHM,1%,0.125W	91637	MFF1816G12501F
A15R3476	——			(SELECTED)		
A15R3477	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A15R3478	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A15R3479	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K
A15R3480	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
A15R3481	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A15R3482	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
A15R3483	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
A15R3484	321-0216-00			RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
A15R3485	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
A15R3485	321-0242-00	B030260		RES.,FXD,FILM:3.24K OHM,1%,0.125W	24546	CT55 3241 F
A15R3485	321-0243-00	B030260		RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
A15R3485	321-0244-00	B030260		RES.,FXD,FILM:3.4K OHM,1%,0.125W	24546	CT553401F
A15R3485	321-0246-00	B030260		RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	CMF55116G35700F
A15R3485	321-0247-00	B030260		RES.,FXD,FILM:3.65K OHM,1%,0.125W	91637	CMF55116G36500F
A15R3485	321-0248-00	B030260		RES.,FXD,FILM:3.74K OHM,1%,0.125W	91637	CMF55116G37400F
A15R3485	——			(SELECTED)		
A15R3486	321-0199-00			RES.,FXD,FILM:1.15K OHM,1%,0.125W	91637	CMF55116G11500F
A15R3487	321-0273-00			RES.,FXD,FILM:6.81K OHM,1%,0.125W	91637	MFF1816G68100F
A15R3488	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A15R3489	321-0209-00			RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
A15R3491	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	CMF55116G13000F
A15R3492	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
A15R3493	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A15R3494	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
A15R3495	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A15R3497	321-0241-00			RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	MFF1816G31600F
A15R3498	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
A15R3499	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A15TP3445	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A15TP3450	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A15U3401	155-0018-00			MICROCIRCUIT,DI:ML,ZERO LOGIC	80009	155-0018-00
A15U3418	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
A15U3429	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
A15U3433	155-0021-01			MICROCIRCUIT,DI:SCAN OSCILLATOR & LOGIC	80009	155-0021-01
A15U3445	155-0017-00			MICROCIRCUIT,DI:ML,ZERO LOGIC COUNTER	80009	155-0017-00
A15U3450	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
A15U3461	155-0023-00			MICROCIRCUIT,DI:ML,CHAR GEN NUMERALS	80009	155-0023-00
A15U3463	155-0024-00			MICROCIRCUIT,DI:ML,CHAR GEN SPCL SYMBOLS	80009	155-0024-00
A15U3465	155-0025-00			MICROCIRCUIT,DI:ML,CHAR GEN PREFIXES	80009	155-0025-00
A15U3467	155-0026-00			MICROCIRCUIT,DI:ML,CHAR GEN LETTERS	80009	155-0026-00
A15U3469	155-0027-00			MICROCIRCUIT,DI:ML,CHAR GEN SPCL ALPHA	80009	155-0027-00
A15U3470	155-0019-00			MICROCIRCUIT,DI:ML,DECIMAL POINT AND SPACE	80009	155-0019-00
A15U3480	155-0020-00			MICROCIRCUIT,DI:ML,CHANNEL SW OUTPUT ASSY	80009	155-0020-00
A15VR3470	152-0405-00			SEMICOND DEVICE:ZENER,1W,15V,5%	14433	Z6041
A15VR3471	152-0405-00			SEMICOND DEVICE:ZENER,1W,15V,5%	14433	Z6041
A15VR3472	152-0405-00			SEMICOND DEVICE:ZENER,1W,15V,5%	14433	Z6041

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A16	670-4769-02			CKT BOARD ASSY:VERTICAL CHANNEL SWITCH	80009	670-4769-02
A16C505	281-0811-00			CAP.,FXD,CER DI:10PF,10%,100V	96733	R2911
A16C508	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A16C512	285-0650-00			CAP.,FXD,PLSTC:0.027UF,5%,100V	56289	192P27352M447
A16C515	285-0643-00			CAP.,FXD,PLSTC:0.0047UF,5%,100V	84411	TEK-180 47251
A16C520	283-0666-00			CAP.,FXD,MICA D:890PF,2%,100V	00853	D151F891G0
A16C525	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D155F1050F0
A16C531	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	19396	DU490B103J
A16C538	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	2807C00222MJ02
A16C539	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A16C582	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A16C583	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A16C584	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A16C605	281-0811-00			CAP.,FXD,CER DI:10PF,10%,100V	96733	R2911
A16C608	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A16C612	285-0650-00			CAP.,FXD,PLSTC:0.027UF,5%,100V	56289	192P27352M447
A16C615	285-0643-00			CAP.,FXD,PLSTC:0.0047UF,5%,100V	84411	TEK-180 47251
A16C620	283-0666-00			CAP.,FXD,MICA D:890PF,2%,100V	00853	D151F891G0
A16C625	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D155F1050F0
A16C631	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	19396	DU490B103J
A16C638	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	2807C00222MJ02
A16C639	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A16C675	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A16C681	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	96733	R3015
A16C695	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
A16CR552	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A16CR651	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A16CR654	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A16J502	131-2020-00			CONTACT,ELEC:DUAL,TOP,BERYLLIUM COPPER	80009	131-2020-00
A16J502	131-2022-00			CONTACT,ELEC:DUAL,BOTTOM,CU BE	80009	131-2022-00
A16J503	-----			(PART OF J502)		
A16J592	131-2032-00			CONTACT,ELEC:SINGLE,TOP,CU BE	80009	131-2032-00
A16J592	131-2033-00			CONTACT,ELEC:SINGLE,BOTTOM,CU BE	80009	131-2033-00
A16J602	131-2020-00			CONTACT,ELEC:DUAL,TOP,BERYLLIUM COPPER	80009	131-2020-00
A16J602	131-2022-00			CONTACT,ELEC:DUAL,BOTTOM,CU BE	80009	131-2022-00
A16J603	-----			(PART OF J602)		
A16J694	131-2032-00			CONTACT,ELEC:SINGLE,TOP,CU BE	80009	131-2032-00
A16J694	131-2033-00			CONTACT,ELEC:SINGLE,BOTTOM,CU BE	80009	131-2033-00
A16L582	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A16L583	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A16L584	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A16Q542	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q548	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q556	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q558	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q642	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q648	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q652	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A16Q656	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q658	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A16Q672	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A16Q676	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
A16Q682	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A16R501	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A16R502	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A16R504	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A16R505	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A16R511	321-0414-00			RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
A16R512	311-1214-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	72-16-0
A16R513	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
A16R514	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A16R515	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
A16R516	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W,TC=TO	91637	CMF55116G16201F
A16R519	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A16R520	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
A16R521	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	CMF55116G82500F
A16R524	321-0357-00			RES.,FXD,FILM:51.1K OHM,1%,0.125W	91637	MFF1816G51101F
A16R525	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
A16R526	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	CMF55116G18201F
A16R529	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	CMF55116G24301F
A16R530	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
A16R531	321-0450-00			RES.,FXD,FILM:475K OHM,1%,0.125W	91637	CMF55116G47502F
A16R532	321-0450-00			RES.,FXD,FILM:475K OHM,1%,0.125W	91637	CMF55116G47502F
A16R535	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
A16R536	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A16R537	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	57668	NTR25J-E 240K
A16R538	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	CMF55116G24301F
A16R542	323-0168-00			RES.,FXD,FILM:549 OHM,1%,0.50W	24546	NA65 5490F
A16R543	321-0065-00			RES.,FXD,FILM:46.4 OHM,1%,0.125W	57668	RB14FXE 46E4
A16R547	321-0084-00			RES.,FXD,FILM:73.2 OHM,1%,0.125W	91637	CMF55116G73R20F
A16R548	323-0168-00			RES.,FXD,FILM:549 OHM,1%,0.50W	24546	NA65 5490F
A16R549	321-0010-00			RES.,FXD,FILM:12.4 OHM,1%,0.125W	91637	MFF1816G12R40F
A16R550	323-0136-00			RES.,FXD,FILM:255 OHM,1%,0.50W	91637	MFF1226G255ROF
A16R552	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A16R555	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A16R556	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A16R557	321-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.125W	91637	MFF1816G28700F
A16R558	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A16R559	317-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.125W	01121	BB1035
A16R601	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A16R602	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A16R604	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A16R605	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A16R611	321-0414-00			RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
A16R612	311-1214-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	72-16-0
A16R613	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
A16R614	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A16R615	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
A16R616	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W,TC=TO	91637	CMF55116G16201F
A16R619	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A16R620	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
A16R621	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	CMF55116G82500F
A16R624	321-0357-00			RES.,FXD,FILM:51.1K OHM,1%,0.125W	91637	MFF1816G51101F
A16R625	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
A16R626	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	CMF55116G18201F
A16R629	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	CMF55116G24301F
A16R630	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A16R631	321-0450-00			RES.,FXD,FILM:475K OHM,1%,0.125W	91637	CMF55116G47502F
A16R632	321-0450-00			RES.,FXD,FILM:475K OHM,1%,0.125W	91637	CMF55116G47502F
A16R638	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	CMF55116G24301F
A16R642	323-0168-00			RES.,FXD,FILM:549 OHM,1%,0.50W	24546	NA65 5490F
A16R643	321-0010-00			RES.,FXD,FILM:12.4 OHM,1%,0.125W	91637	MFF1816G12R40F
A16R646	321-0080-00			RES.,FXD,FILM:66.5 OHM,1%,0.125W	91637	CMF55116G66R50F
A16R647	321-0084-00			RES.,FXD,FILM:73.2 OHM,1%,0.125W	91637	CMF55116G73R20F
A16R648	323-0168-00			RES.,FXD,FILM:549 OHM,1%,0.50W	24546	NA65 5490F
A16R649	321-0065-00			RES.,FXD,FILM:46.4 OHM,1%,0.125W	57668	RB14FXE 46E4
A16R650	323-0136-00			RES.,FXD,FILM:255 OHM,1%,0.50W	91637	MFF1226G255ROF
A16R651	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A16R652	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A16R653	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A16R654	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A16R655	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A16R656	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A16R657	321-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.125W	91637	MFF1816G28700F
A16R658	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A16R659	317-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.125W	01121	BB1035
A16R671	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	CMF55116G35700F
A16R672	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W,TC=TO	91637	CMF55116G16201F
A16R675	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A16R680	321-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.125W	91637	MFF1816G88700F
A16R681	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	91637	MFF1816G11801F
A16R682	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A16R683	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A16R684	307-0053-00			RES.,FXD,CMPSN:3.3 OHM,5%,0.50W	01121	EB33G5
A16R690	321-0279-00			RES.,FXD,FILM:7.87K OHM,1%,0.125W	91637	MFF1816G78700F
A16R691	321-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
A16R694	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A16TP500	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP508	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP538	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP552	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP555	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP582	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP583	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP584	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP600	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP608	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP648	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP657	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP682	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP684	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16TP694	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A16U508	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A16U538	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A16U608	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A16U638	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A16U668	155-0173-00			MICROCIRCUIT,LI:VERTICAL CHANNEL SWITCH	80009	155-0173-00
A16U682	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
A16U694	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A17	672-0802-01			CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	672-0802-01
A17C704	283-0320-00			CAP.,FXD,CER DI:1PF,50V,LEADLESS	95275	VJ0805A1R0C-H
A17C704	283-0158-00			CAP.,FXD,CER DI:1PF,10%,50V	51642	100-050-NP0-109B
A17C704	283-0348-00			CAP.,FXD,CER DI:0.5PF,+/-0.1PF,100V	51642	W150-100-NPO5088
A17C704	----- -----			(SELECTED)		
A17C705	281-0218-00			CAP.,VAR,CER DI:1-5PF,+2-2.5%,100V	59660	513-013A1-5
A17C730	281-0809-00			CAP.,FXD,CER DI:200PF,5%,100V	04222	MA101A201JAA
A17C751	283-0176-00			CAP.,FXD,CER D1:0.0022UF,20%,50V	56289	272C5
A17C762	283-0253-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	15051C103KZT6C
A17C780	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A17C782	281-0810-00			CAP.,FXD,CER DI:5.6PF,0.5%,100V	04222	MA101A5R6DAA
A17C783	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A17C787	285-0686-00			CAP.,FXD,PLSTC:0.068UF,10%,100V	56289	192P68392M465
A17C791	285-0643-00			CAP.,FXD,PLSTC:0.0047UF,5%,100V	84411	TEK-180 47251
A17C795	283-0666-00			CAP.,FXD,MICA D:890PF,2%,100V	00853	D151F891G0
A17C801	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D155F1050F0
A17C806	285-0683-00			CAP.,FXD,PLSTC:0.022UF,5%,100V	56289	192P22352
A17C808	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	2807C00222MJ02
A17C809	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A17C837	283-0251-00			CAP.,FXD,CER DI:87 PF,5%,100V	72982	8121B145C0G0870J
A17C838	283-0197-00			CAP.,FXD,CER DI:470PF,5%,100V	04222	SR205A471JAA
A17C842	----- -----			(SELECTED)		
A17C852	283-0353-00			CAP.,FXD,CER DI:0.1UF,10%,50V	04222	12105C104KA2075
A17C862	283-0353-00			CAP.,FXD,CER DI:0.1UF,10%,50V	04222	12105C104KA2075
A17C878	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A17C885	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	04222	ADVISE
A17C891	290-0768-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	54473	ECE-A100V10L
A17C893	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A17C895	290-0776-00			CAP.,FXD,ELCTLT:22UF,+50-10%,10V	55680	ULA1A220TEA
A17C897	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A17CR711	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR712	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR767	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
A17CR777	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
A17CR862	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR863	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR864	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR875	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR878	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A17CR883	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR886	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR891	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR893	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A17CR897	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A17L762	108-0420-00			COIL,RF:FIXED,60NH	80009	108-0420-00
A17L762	----- -----			(NOMINAL VALUE SELECTED)		
A17L762	108-0578-00			COIL,RF:FIXED,45NH	80009	108-0578-00
A17L762	108-0620-00			COIL,RF:90NH	80009	108-0620-00
A17L762	108-0260-00			COIL,RF:98NH	80009	108-0260-00
A17L762	----- -----			(L762 SELECTED-45NH MIN TO 98NH MAX)		
A17L763	108-0371-00			COIL,RF:FIXED,230NH	80009	108-0371-00
A17L763	----- -----			(NOMINAL VALUE SELECTED)		
A17L763	108-0436-00			COIL,RF:FIXED,240NH	80009	108-0436-00
A17L763	108-0182-00			COIL,RF:FIXED,285NH	80009	108-0182-00
A17L763	----- -----			(L763 SELECTED-230NH MIN TO 285NH MAX)		

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A17L764	108-0057-00			COIL,RF:FIXED,8.7UH	80009	108-0057-00
A17L772	108-0420-00			COIL,RF:FIXED,60NH	80009	108-0420-00
A17L772	----- -----			(NOMINAL VALUE SELECTED)		
A17L772	108-0578-00			COIL,RF:FIXED,45NH	80009	108-0578-00
A17L772	108-0620-00			COIL,RF:90NH	80009	108-0620-00
A17L772	108-0260-00			COIL,RF:98NH	80009	108-0260-00
A17L772	----- -----			(L772 SELECTED-45NH MIN TO 98NH MAX)		
A17L773	108-0371-00			COIL,RF:FIXED,230NH	80009	108-0371-00
A17L773	----- -----			(NOMINAL VALUE SELECTED)		
A17L773	108-0436-00			COIL,RF:FIXED,240NH	80009	108-0436-00
A17L773	108-0182-00			COIL,RF:FIXED,285NH	80009	108-0182-00
A17L773	----- -----			(L773 SELECTED-230NH MIN TO 285NH MAX)		
A17L774	108-0057-00			COIL,RF:FIXED,8.7UH	80009	108-0057-00
A17L857	108-0170-01			COIL,RF:FIXED,36ONH	80009	108-0170-01
A17L857	----- -----			(NOMINAL VALUE SELECTED)		
A17L857	108-0311-00			COIL,RF:FIXED,153NH	80009	108-0311-00
A17L857	108-0683-00			COIL,RF:FIXED,900NH	80009	108-0683-00
A17L857	108-0723-00			COIL,RF:FIXED,1.12UH	80009	108-0723-00
A17L857	----- -----			(L857 SELECTED-153NH MIN TO 1.12UH MAX)		
A17L867	108-0735-00			COIL,RF:FIXED,560NH	80009	108-0735-00
A17L867	----- -----			(NOMINAL VALUE SELECTED)		
A17L867	108-0262-00			COIL,RF:FIXED,510NH	80009	108-0262-00
A17L867	108-0215-00			COIL,RF:1.1UH	80009	108-0215-00
A17L867	108-0341-00			COIL,RF:FIXED,1.4UH	80009	108-0341-00
A17L867	108-0345-00			COIL,RF:FIXED,1.89UH	80009	108-0345-00
A17L867	----- -----			(L867 SELECTED-510NH MIN TO 1.89UH MAX)		
A17L891	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A17L893	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A17L895	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A17L897	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A17LR885	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
A17P782	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A17P782	----- -----			(QUANTITY OF 20)		
A17P783	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A17P783	----- -----			(QUANTITY OF 7)		
A17P789	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A17P789	----- -----			(QUANTITY OF 20)		
A17P790	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A17P790	----- -----			(QUANTITY OF 7)		
A17Q712	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
A17Q718	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A17Q722	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A17Q732	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	04713	SPS 8811
A17Q742	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
A17Q748	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A17Q752	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
A17Q758	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A17Q814	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A17Q824	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A17Q862	151-0183-00			TRANSISTOR:SILICON,NPN	27014	NS14069
A17Q864	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A17Q872	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A17Q873	151-0529-00			SCR:200V,0.5A	04713	MCR206
A17Q878	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A17Q884	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A17Q892	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
A17R700	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
A17R701	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
A17R702	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	57668	NTR25J-E220K
A17R703	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A17R704	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A17R705	311-0605-00			RES.,VAR,NONWIR:TRMR,200 OHM,0.5W	73138	82-23-2
A17R711	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A17R712	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A17R714	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	57668	NTR25J-E 62K
A17R718	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A17R722	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
A17R730	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A17R731	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A17R732	321-0160-00			RES.,FXD,FILM:453 OHM,1%,0.125W	91637	CMF116G453R0F
A17R733	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A17R740	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
A17R742	321-0100-00			RES.,FXD,FILM:107 OHM,1%,0.125W	91637	MFF1816G107R0F
A17R743	321-0172-00			RES.,FXD,FILM:604 OHM,1%,0.125W	91637	CMF55116G604R0F
A17R744	321-0216-00			RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
A17R747	322-0178-00			RES.,FXD,FILM:698 OHM,1%,0.25W	75042	CEBT0-6980F
A17R748	321-0233-00			RES.,FXD,FILM:2.61K OHM,1%,0.125W	91637	MFF1816G26100F
A17R749	321-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.125W	91637	MFF1816G95R30F
A17R750	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W,TC=TO	91637	CMF55116G16201F
A17R751	321-0161-00			RES.,FXD,FILM:464 OHM,1%,0.125W	91637	MFF1816G464R0F
A17R752	321-0216-00			RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
A17R753	321-0178-00			RES.,FXD,FILM:698 OHM,1%,0.125W	91637	CMF55116G698R0F
A17R754	321-0216-00			RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
A17R757	322-0178-00			RES.,FXD,FILM:698 OHM,1%,0.25W	75042	CEBT0-6980F
A17R758	321-0233-00			RES.,FXD,FILM:2.61K OHM,1%,0.125W	91637	MFF1816G26100F
A17R759	321-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.125W	91637	MFF1816G95R30F
A17R761	321-0278-00			RES.,FXD,FILM:7.68K OHM,1%,0.125W	91637	MFF1816G76800F
A17R762	321-0124-00			RES.,FXD,FILM:191 OHM,1%,0.125W	91637	CMF55116G191R0F
A17R763	321-0109-00			RES.,FXD,FILM:133 OHM,1%,0.125W	91637	CMF55116G133R0F
A17R764	321-0117-00			RES.,FXD,FILM:162 OHM,1%,0.125W	91637	CMF55116G162R0F
A17R765	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	24546	CT552321F
A17R767	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	CMF55116G649R0F
A17R772	321-0124-00			RES.,FXD,FILM:191 OHM,1%,0.125W	91637	CMF55116G191R0F
A17R773	321-0109-00			RES.,FXD,FILM:133 OHM,1%,0.125W	91637	CMF55116G133R0F
A17R774	321-0117-00			RES.,FXD,FILM:162 OHM,1%,0.125W	91637	CMF55116G162R0F
A17R775	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	CMF55116G768R0F
A17R777	321-0127-00			RES.,FXD,FILM:205 OHM,1%,0.125W	91637	CMF55116G205R0F
A17R780	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A17R781	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A17R782	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	24546	CT55 3011 F
A17R785	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
A17R786	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
A17R787	311-1214-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	72-16-0
A17R788	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	57668	NTR25J-E 62K
A17R789	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A17R791	311-1214-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	72-16-0
A17R792	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A17R793	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A17R795	311-1214-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	72-16-0
A17R796	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	57668	NTR25J-E36K0
A17R797	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
A17R801	311-1214-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	72-16-0
A17R802	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	57668	NTR25J-E33K0
A17R803	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
A17R804	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
A17R805	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	57668	NTR25J-E 56K
A17R806	311-1214-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	72-16-0
A17R808	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	57668	NTR25J-E043K
A17R814	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
A17R815	321-0090-00			RES.,FXD,FILM:84.5 OHM,1%,0.125W	91637	MFF1816G84R50F
A17R821	321-0104-00			RES.,FXD,FILM:118 OHM,1%,0.125W	91637	CMF55116G1180R0F
A17R823	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A17R824	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
A17R825	321-0057-00			RES.,FXD,FILM:38.3 OHM,1%,0.125W	91637	CMF55116G38R30F
A17R830	311-1266-00			RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	32997	3329P-L58-252
A17R831	321-0105-00			RES.,FXD,FILM:121 OHM,1%,0.125W	91637	CMF55116G121R0F
A17R832	321-0105-00			RES.,FXD,FILM:121 OHM,1%,0.125W	91637	CMF55116G121R0F
A17R836	311-1263-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
A17R837	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	CMF55116G49R90F
A17R838	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	CMF55116G49R90F
A17R849	322-0104-00			RES.,FXD,FILM:118 OHM,1%,0.25W	91637	MFF1421G118R0F
A17R854	321-0170-00			RES.,FXD,FILM:576 OHM,1%,0.125W	91637	CMF55116G576R0F
A17R855	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A17R856	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
A17R857	317-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.125W	01121	BB1225
A17R857	———			(NOMINAL VALUE-820 OHM MIN TO 1.6K MAX)		
A17R860	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
A17R861	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A17R862	301-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.5W	57668	R50J 120 OHM
A17R863	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
A17R864	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	57668	NTR25J-E 13K
A17R865	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A17R866	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A17R870	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	57668	NTR25J-E 430E
A17R871	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A17R872	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A17R873	321-0426-00			RES.,FXD,FILM:267K OHM,1%,0.125W	91637	MFF1816G26702F
A17R874	321-0377-00			RES.,FXD,FILM:82.5K OHM,1%,0.125W	91637	MFF1816G82501F
A17R875	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	57668	NTR25J-E 62K
A17R876	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A17R877	301-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.5W	01121	EB2425
A17R878	308-0243-00			RES.,FXD,WW:240 OHM,5%,3W	91637	CW2BB240R0J
A17R881	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	24546	CT555621F
A17R882	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	CMF55116G12100F
A17R883	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A17R884	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
A17R886	321-0328-00			RES.,FXD,FILM:25.5K OHM,1%,0.125W	91637	MFF1816G25501F
A17R887	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A17R888	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A17R891	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A17R892	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
A17R893	308-0298-00			RES.,FXD,WW:560 OHM,5%,3W	91637	CW2B-B560R0J T/R

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A17R894	321-0001-00			RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEAT0-10R00F
A17RT813	307-0127-00			RES.,THERMAL:1K OHM,10%	50157	2D1596
A17U705	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A17U762	155-0174-00			MICROCIRCUIT,LI:DELAY LINE COMPENSATOR	80009	155-0174-00
A17U782	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A17U808	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A17U842	155-0175-00			MICROCIRCUIT,LI:TRIGGER AMPLIFIER	80009	155-0175-00
A17U862	155-0176-00			MICROCIRCUIT,LI:MAIN VERTICAL OUTPUT	80009	155-0176-00
A17U876	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
A17VR852	152-0683-00			SEMICOND DEVICE:ZEN,SI,7.5V,5%,1.0W	12969	UZ2359
A17VR862	152-0683-00			SEMICOND DEVICE:ZEN,SI,7.5V,5%,1.0W	12969	UZ2359
A17VR878	152-0281-00			SEMICOND DEVICE:ZENER,0.4W,22V,5%	12954	1N969B
A17A1	670-5616-00			CKT BOARD ASSY:VERTICAL CRT FLEX CON	80009	670-5616-00
A17A1	----- -----			(NO REPLACEABLE SUBPARTS)		

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A18	672-0800-00			CKT BOARD ASSY:CRT TERMINATION	80009	672-0800-00
.						
A18C881	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	04222	SR303E103ZAA
A18C882	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	04222	SR303E103ZAA
.						
.						
A18A1	670-5616-00			CKT BOARD ASSY:VERTICAL CRT FLEX CON	80009	670-5616-00
A18A1	-----			(NO REPLACEABLE SUBPARTS)		
.						
.						
A19	672-0140-00			CKT BOARD ASSY:HORIZONTAL AMPLIFIER	80009	672-0140-00
.						
A19C974	281-0808-00			CAP.,FXD,CER DI:7PF,20%,100V	04222	MA101A7R04AA
A19C980	283-0597-00			CAP.,FXD,MICA D:470PF,10%,300V	00853	D155F471K0
A19C982	285-0813-00			CAP.,FXD,PLSTC:0.0015UF,5%,100V	14752	410D1B152J
A19C985	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	19396	DU490B103J
A19C988	285-0808-00			CAP.,FXD,PLSTC:0.1UF,10%,50V	56289	LP66A1A104K004
A19C1001	290-0769-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	500D152
A19C1002	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
A19C1003	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A19C1004	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
A19C1017	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A19C1019	290-0776-00			CAP.,FXD,ELCTLT:22UF,+50-10%,10V	55680	ULA1A220TEA
A19C1035	281-0601-00			CAP.,FXD,CER DI:7.5PF,500V	59660	301-000C0H0759D
A19C1036	281-0203-00			CAP.,VAR,PLSTC:2-10PF,100V	80031	2807C00210MJ02F0
A19C1040	281-0122-00			CAP.,VAR,CER DI:2.5-9PF,100V	59660	518-000A2.5-9
A19C1044	281-0592-00			CAP.,FXD,CER DI:4.7PF,+/-0.5PF,500V	59660	301000C0H0479D
A19C1060	281-0122-00			CAP.,VAR,CER DI:2.5-9PF,100V	59660	518-000A2.5-9
A19C1061	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	59660	855-547-E-502Z
A19C1064	281-0592-00			CAP.,FXD,CER DI:4.7PF,+/-0.5PF,500V	59660	301000C0H0479D
A19C1073	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A19C1075	283-0299-00			CAP.,FXD,CER DI:51PF,5%,500V	96733	R3229
A19C1077	283-0160-00			CAP.,FXD,CER DI:1.5PF,10%,50V	93958	1C15RB
A19C1077	283-0185-00			CAP.,FXD,CER DI:2.5PF,5%,50V	96733	T-DG43BY2R5BP
A19C1077	283-0190-00			CAP.,FXD,CER DI:0.47UF,5%,50V	72982	8141N077X7R0474J
A19C1077	-----			(A19C1077 IS SELECTED)		
A19C1096	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A19C1006	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A19CR1082	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A19J970	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A19J971	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A19L1001	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A19L1002	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A19L1003	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A19L1004	108-0538-00			COIL,RF:FIXED,2.7UH	76493	JWM#B7059
A19L1042	108-0733-00			COIL,RF:FIXED,113NH	80009	108-0733-00
A19L1062	108-0733-00			COIL,RF:FIXED,113NH	80009	108-0733-00
A19LR1096	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
A19Q914	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A19Q923	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A19Q992	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A19Q994	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A19Q1022	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A19Q1024	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969

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A19Q1028	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
A19Q1034	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
A19Q1046	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
A19Q1049	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A19Q1052	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A19Q1058	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A19Q1066	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
A19Q1072	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
A19Q1078	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A19Q1084	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A19R902	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A19R905	321-0186-00			RES.,FXD,FILM:845 OHM,1%,0.125W	91637	CMF55116G84500F
A19R906	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	91637	MFF1816G41200F
A19R913	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A19R921	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A19R922	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A19R923	323-0193-00			RES.,FXD,FILM:1K OHM,1%,0.50W	75042	CECT0-1001F
A19R924	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	CMF55116G51R10F
A19R926	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A19R927	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A19R928	323-0193-00			RES.,FXD,FILM:1K OHM,1%,0.50W	75042	CECT0-1001F
A19R932	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A19R933	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A19R934	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A19R963	323-0148-00			RES.,FXD,FILM:340 OHM,1%,0.50W	91637	MFF1226G340R0F
A19R968	323-0114-00			RES.,FXD,FILM:150 OHM,1%,0.50W	75042	CECT0-1500F
A19R969	323-0114-00			RES.,FXD,FILM:150 OHM,1%,0.50W	75042	CECT0-1500F
A19R971	317-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.125W	01121	BB1035
A19R972	317-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.125W	01121	BB3035
A19R973	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A19R974	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
A19R975	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
A19R976	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	57668	NTR25J-E68E0
A19R978	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A19R979	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
A19R980	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
A19R982	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
A19R985	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
A19R988	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
A19R989	321-0294-00			RES.,FXD,FILM:11.3K OHM,1%,0.125W	91637	CMF55116G11301F
A19R992	321-0102-00			RES.,FXD,FILM:113 OHM,1%,0.125W	91637	CMF55116G113R0F
A19R993	321-0127-00			RES.,FXD,FILM:205 OHM,1%,0.125W	91637	CMF55116G205R0F
A19R994	321-0267-00			RES.,FXD,FILM:5.9K OHM,1%,0.125W	91637	MFF1816G59000F
A19R995	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
A19R996	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	91637	MFF1816G41200F
A19R997	321-0102-00			RES.,FXD,FILM:113 OHM,1%,0.125W	91637	CMF55116G113R0F
A19R998	323-0114-00			RES.,FXD,FILM:150 OHM,1%,0.50W	75042	CECT0-1500F
A19R999	323-0114-00			RES.,FXD,FILM:150 OHM,1%,0.50W	75042	CECT0-1500F
A19R1001	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	57668	NTR25J-E 56K
A19R1002	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
A19R1003	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A19R1004	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
A19R1005	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
A19R1007	321-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	CMF55116G43201F

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A19R1010	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A19R1011	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
A19R1012	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A19R1013	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A19R1014	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A19R1015	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A19R1016	321-0379-00			RES.,FXD,FILM:86.6K OHM,1%,0.125W	91637	MFF1816G86601F
A19R1017	321-0396-00			RES.,FXD,FILM:130K OHM,1%,0.125W	91637	MFF1816G13002F
A19R1018	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A19R1019	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
A19R1020	321-0165-00			RES.,FXD,FILM:511 OHM,1%,0.125W	91637	CMF55116G511R0F
A19R1021	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A19R1022	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A19R1023	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
A19R1024	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A19R1025	311-1231-00			RES.,VAR,NONWIR:25K OHM,20%,0.50W	32997	3386F-T04-253
A19R1026	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A19R1028	321-0291-00			RES.,FXD,FILM:10.5K OHM,1%,0.125W	91637	MFF1816G10501F
A19R1029	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
A19R1030	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
A19R1031	321-0291-00			RES.,FXD,FILM:10.5K OHM,1%,0.125W	91637	MFF1816G10501F
A19R1032	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A19R1033	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A19R1034	321-0192-00			RES.,FXD,FILM:976 OHM,1%,0.125W	91637	CMF55116G976R0F
A19R1035	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
A19R1036	321-0235-00			RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
A19R1037	321-0192-00			RES.,FXD,FILM:976 OHM,1%,0.125W	91637	CMF55116G976R0F
A19R1040	317-0120-00			RES.,FXD,CMPSN:12 OHM,5%,0.125W	01121	BB1205
A19R1041	317-0120-00			RES.,FXD,CMPSN:12 OHM,5%,0.125W	01121	BB1205
A19R1042	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A19R1043	323-0064-00			RES.,FXD,FILM:45.3 OHM,1%,0.50W	91637	MFF1226G45R30F
A19R1044	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
A19R1045	321-0380-00			RES.,FXD,FILM:88.7K OHM,1%,0.125W	91637	MFF1816G88701F
A19R1046	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
A19R1047	323-0606-00			RES.,FXD,FILM:60 OHM,1%,0.5W	91637	MFF1226G60R00F
A19R1049	321-0160-00			RES.,FXD,FILM:453 OHM,1%,0.125W	91637	CMF116G453R0F
A19R1052	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A19R1054	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A19R1058	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	57668	NTR25J-E 130E
A19R1059	307-0113-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
A19R1060	317-0120-00			RES.,FXD,CMPSN:12 OHM,5%,0.125W	01121	BB1205
A19R1061	317-0120-00			RES.,FXD,CMPSN:12 OHM,5%,0.125W	01121	BB1205
A19R1062	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
A19R1063	323-0064-00			RES.,FXD,FILM:45.3 OHM,1%,0.50W	91637	MFF1226G45R30F
A19R1064	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
A19R1065	321-0380-00			RES.,FXD,FILM:88.7K OHM,1%,0.125W	91637	MFF1816G88701F
A19R1066	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
A19R1067	323-0606-00			RES.,FXD,FILM:60 OHM,1%,0.5W	91637	MFF1226G60R00F
A19R1069	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A19R1071	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
A19R1072	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A19R1073	311-1221-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	32997	3386F-T04-500
A19R1074	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A19R1075	317-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.125W	01121	BB8205

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A19R1076	323-0090-00			RES.,FXD,FILM:84.5 OHM,1%,0.50W	75042	CECT0-84R5F
A19R1077	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
A19R1078	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	57668	NTR25J-E 130E
A19R1079	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A19R1080	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A19R1081	301-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.5W	57668	TR50J-E 4K3
A19R1082	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
A19R1083	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	57668	NTR25J-E 1K6
A19R1084	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A19R1085	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A19R1086	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
A19R1087	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
A19R1088	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
A19R1089	321-0328-00			RES.,FXD,FILM:25.5K OHM,1%,0.125W	91637	MFF1816G25501F
A19R1094	323-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.50W	91637	MFF1226G51R10F
A19R1095	323-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.50W	91637	MFF1226G51R10F
A19R1096	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
A19RT1080	307-0181-00			RES.,THERMAL:100K OHM,10%,4MW/DEG C	15454	1DE104-K-220EC
A19TP1028	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A19TP1034	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A19TP1058	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A19TP1078	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A19U924	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
A19U962	155-0173-05			MICROCIRCUIT,DI:CHANNEL SWITCH	80009	155-0173-05
A19U974	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N/GLEA134
A19U1006	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
A19U1014	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
A19U1018	155-0179-00			MICROCIRCUIT,LI:CLAMP	80009	155-0179-00
A19U1082	155-0175-05			MICROCIRCUIT,LI:AMPLIFIER,M178		
A19U1094	155-0178-00			MICROCIRCUIT,LI:HORIZONTAL OUTPUT	80009	155-0178-00
A19VR1005	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
A19VR1082	152-0395-00			SEMICOND DEVICE:ZENER,0.4W,4.3V,5%	14552	TD332317
A19W913	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W932	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W933	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W934	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W961	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W962	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W963	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W965	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W966	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W969	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W992	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W999	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W1002	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W1034	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W1037	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W1084	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W1087	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W1089	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19W1095	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
A19A1	670-5094-00			CKT BOARD ASSY:HORIZONTAL CRT FLEX CON	80009	670-5094-00
A19A1	---- ----			(NO REPLACEABLE SUBPARTS)		

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A20	670-0702-06			CKT BOARD ASSY:GRATICULE LAMPS	80009	670-0702-06
.						
A20DS304	150-0097-00			LAMP,INCAND:6.3V,0.2A	08806	7381
A20DS305	150-0097-00			LAMP,INCAND:6.3V,0.2A	08806	7381
A20DS306	150-0097-00			LAMP,INCAND:6.3V,0.2A	08806	7381
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.						
A21	670-4774-02			CKT BOARD ASSY:Z AXIS	80009	670-4774-02
.						
A21C1601	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	04222	7001--COJ-2R7C
A21C1605	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1611	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	04222	7001--COJ-2R7C
A21C1615	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1619	281-0785-00			CAP.,FXD,CER DI:68PF,10%,100V	04222	MA101A680KAA
A21C1623	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A21C1628	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A21C1635	281-0158-00			CAP.,VAR,CER D1:7-45PF,25V	73899	DVJ-5006
A21C1636	283-0159-00			CAP.,FXD,CER DI:18PF,5%,50V	51642	150-050-NPO-180J
A21C1638	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1642	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A21C1643	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A21C1644	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A21C1645	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A21C1646	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
A21C1651	281-0158-00			CAP.,VAR,CER D1:7-45PF,25V	73899	DVJ-5006
A21C1653	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1656	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1660	281-0557-00			CAP.,FXD,CER DI:1.8PF,10%,500V	04222	7001-COK-1R8B
A21C1663	281-0158-00			CAP.,VAR,CER D1:7-45PF,25V	73899	DVJ-5006
A21C1664	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1665	281-0791-00			CAP.,FXD,CER DI:270PF,10%,100V	04222	MA101C271KAA
A21C1671	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1672	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A21C1675	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1676	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	96733	R3015
A21C1677	283-0346-00			CAP.,FXD,CER DI:0.47UF,+80-20%,100V	72982	8131-M100F474Z
A21C1680	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A21C1681	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A21C1687	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A21C1692	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A21C1694	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A21CR1600	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1607	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1608	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1609	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1618	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1623	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
A21CR1624	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1649	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1665	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1666	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1675	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
A21CR1676	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21CR1677	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308

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A21CR1678	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
A21CR1688	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A21DS1682	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A21DS1687	150-1068-00			LT EMITTING DIO:RED	50434	HLMP-6320
A21J1606	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A21J1632	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
A21L1627	108-0215-00			COIL,RF:1.1UH	80009	108-0215-00
A21L1643	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
A21L1645	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
A21LR1644	108-0537-00			COIL,RF:200UH	80009	108-0537-00
A21P1602	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A21P1602	----- -----			(QUANTITY OF 3)		
A21P1603	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A21P1605	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A21P1605	----- -----			(QUANTITY OF 8)		
A21P1609	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A21P1609	----- -----			(QUANTITY OF 4)		
A21Q1603	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1607	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A21Q1608	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1617	151-0472-00			TRANSISTOR:SILICON,NPN	51984	NE41632B
A21Q1618	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1620	151-0472-00			TRANSISTOR:SILICON,NPN	51984	NE41632B
A21Q1626	151-0427-00			TRANSISTOR:SILICON,NPN	07263	S39287
A21Q1629	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1632	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1644	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A21Q1648	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1652	151-0441-00			TRANSISTOR:SILICON,NPN	04713	SRF501
A21Q1658	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1664	151-0438-00			TRANSISTOR:SILICON,PNP,SEL FROM SPS692	80009	151-0438-00
A21Q1666	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A21Q1668	151-0659-00			TRANSISTOR:SILICON,NPN	01281	LT 1839
A21Q1672	151-0103-00			TRANSISTOR:SILICON,NPN	80009	151-0103-00
A21Q1676	151-0659-00			TRANSISTOR:SILICON,NPN	01281	LT 1839
A21Q1687	151-0444-00			TRANSISTOR:SILICON,NPN	04713	SPS797
A21R1600	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A21R1601	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A21R1602	321-0064-00			RES.,FXD,FILM:45.3 OHM,1%,0.125W	91637	CMF55116G45R30F
A21R1603	315-0510-04			RES.,FXD,CMPSN:51 OHM,5%,0.25 W	01121	CB5105
A21R1604	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	57668	NTR25J-E 33E
A21R1605	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A21R1606	321-0125-00			RES.,FXD,FILM:196 OHM,1%,0.125W	91637	CMF55116G196R0F
A21R1607	321-0234-00			RES.,FXD,FILM:2.67K OHM,1%,0.125W	91637	MFF1816G26700F
A21R1608	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
A21R1610	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	91637	MFF1816G20500F
A21R1611	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A21R1612	321-0064-00			RES.,FXD,FILM:45.3 OHM,1%,0.125W	91637	CMF55116G45R30F
A21R1613	321-0196-00			RES.,FXD,FILM:1.07K OHM,1%,0.125W	91637	CMF55116G10700F
A21R1614	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	57668	NTR25J-E 33E
A21R1615	321-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.125W	91637	CMF55116G63400F
A21R1616	321-0158-00			RES.,FXD,FILM:432 OHM,1%,0.125W	91637	CMF55116G432R0F
A21R1617	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	57668	RB14FXE681E
A21R1618	315-0510-04			RES.,FXD,CMPSN:51 OHM,5%,0.25 W	01121	CB5105

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A21R1619	321-0074-00			RES.,FXD,FILM:57.6 OHM,1%,0.125W	91637	CMF55116G57R60F
A21R1620	322-0126-00			RES.,FXD,FILM:200 OHM,1%,0.25W	91637	MFF1421G200R0F
A21R1621	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
A21R1622	311-1223-00			RES.,VAR,NONWIR:TRMR,250 OHM,0.5W	73138	72-5-0
A21R1623	315-0681-03			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
A21R1624	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
A21R1625	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	24546	CT55 3241 F
A21R1626	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
A21R1627	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A21R1628	315-0430-02			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
A21R1629	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A21R1630	315-0510-04			RES.,FXD,CMPSN:51 OHM,5%,0.25 W	01121	CB5105
A21R1632	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	91637	CMF55116G17800F
A21R1633	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	57668	NTR25J-E 27E
A21R1634	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
A21R1635	311-1259-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3329P-L58-101
A21R1636	321-0151-00			RES.,FXD,FILM:365 OHM,1%,0.125W	91637	CMF55116G365R0F
A21R1637	311-1221-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	32997	3386F-T04-500
A21R1638	322-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.25W	75042	CEBT0-1241F
A21R1639	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A21R1641	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A21R1642	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	57668	NTR25J-E01K3
A21R1643	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	57668	NTR25J-E33K0
A21R1644	322-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.25W	75042	CEBT0-1241F
A21R1645	311-1258-00			RES.,VAR,NONWIR:50 OHM,10%,0.50W	32997	3329P-L58-500
A21R1646	321-0112-00			RES.,FXD,FILM:143 OHM,1%,0.125W	91637	CMF55116G143R0F
A21R1647	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A21R1649	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
A21R1651	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	57668	NTR25J-E 15E
A21R1652	321-0108-00			RES.,FXD,FILM:130 OHM,1%,0.125W	91637	CMF55116G13000F
A21R1656	301-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.5W	57668	TR50J-E270E
A21R1657	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
A21R1658	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A21R1659	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A21R1660	323-0293-00			RES.,FXD,FILM:11K OHM,1%,0.50W	75042	CECT0-1102F
A21R1662	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
A21R1663	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	57668	NTR25J-E39E0
A21R1664	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	57668	NTR25J-E300E
A21R1665	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	57668	NTR25J-E68E0
A21R1668	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0
A21R1670	321-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
A21R1671	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K
A21R1672	301-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.5W	01121	EB2025
A21R1673	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
A21R1674	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A21R1675	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A21R1676	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	57668	NTR25J-E 62E
A21R1679	315-0430-02			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
A21R1680	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A21R1682	315-0105-03			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A21R1685	315-0105-03			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A21R1687	315-0104-03			RES.,FXD CMPSN:100K OHM,5%,0.25W	01121	CB1045
A21R1688	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A21R1692	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E

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A21R1694	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A21T1664	120-0487-00			XFMR,TOROID:5 TURNS BIFILAR	80009	120-0487-00
A21TP1628	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A21TP1672	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A21TP1678	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A21TP1687	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A21TP1688	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A21VR1653	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646RL
A21VR1671	152-0580-00			SEMICOND DEVICE:ZENER,0.4W,75V,2%	04713	SZ14358RL
A21VR1688	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3

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A22	670-8410-00			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-8410-00
A22C1672	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1707	290-0164-00			CAP.,FXD,ELCTLT:1UF,+50-10%,150V	56289	500D105F150BA7
A22C1708	290-0164-00			CAP.,FXD,ELCTLT:1UF,+50-10%,150V	56289	500D105F150BA7
A22C1710	283-0105-00			CAP.,FXD,CER DI:0.01UF,+80-20%,2000V	60705	564CBA202IP203ZA
A22C1711	283-0105-00			CAP.,FXD,CER DI:0.01UF,+80-20%,2000V	60705	564CBA202IP203ZA
A22C1712	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1714	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
A22C1715	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1722	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
A22C1724	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1732	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC101A101K
A22C1735	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1736	285-0894-00			CAP.,FXD,PLSTC:5UF,5%,50V	56289	LP66A1A505J002
A22C1747	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
A22C1749	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A22C1750	283-0105-00			CAP.,FXD,CER DI:0.01UF,+80-20%,2000V	60705	564CBA202IP203ZA
A22C1752	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1754	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1755	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1756	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1764	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	59660	3888 510 Y5S0682
A22C1770	290-0767-00			CAP.,FXD,ELCTLT:4.7UF,+75-10%,160V	56289	5020228
A22C1772	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	04222	ADIVSE
A22C1774	290-0767-00			CAP.,FXD,ELCTLT:4.7UF,+75-10%,160V	56289	5020228
A22C1775	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	04222	SR305SC474MAA
A22C1776	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	04222	SR302E105ZAA
A22C1778	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	59660	0841545Z5V00203Z
A22C1783	283-0108-00			CAP.,FXD,CER DI:220PF,10%,200V	56289	1C10C0G221K200B
A22C1785	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	59660	0831085Z5E00471J
A22C1786	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	59660	3888 510 Y5S0682
A22C1791	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1792	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1793	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1796	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1797	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1803	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1807	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A22C1818	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1819	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1820	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1821	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
A22C1831	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1834	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A22C1839	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A22C1842	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A22C1846	283-0187-00			CAP.,FXD,CER DI:0.047UF,10%,400V	72982	8131N401X5R0473K
A22C1849	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1850	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1852	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1860	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1862	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1870	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M

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A22C1872	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1877	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1880	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5SO102M
A22C1890	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22C1893	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A22CR1707	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
A22CR1708	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
A22CR1710	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	83003	VG5X-1
A22CR1711	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	83003	VG5X-1
A22CR1714	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1715	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1724	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1736	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1747	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1749	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1752	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
A22CR1753	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
A22CR1762	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
A22CR1763	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
A22CR1771	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A22CR1772	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A22CR1774	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1775	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1776	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A22CR1778	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A22CR1788	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1789	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1792	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1794	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1803	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1804	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1816	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1818	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1819	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1820	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A22CR1835	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1838	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22CR1842	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A22DS1792	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1794	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1818	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1819	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1820	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1842	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1844	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1846	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22DS1848	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A22P1700	——			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22P1700	——			(ALL)		
A22P1800	——			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22P1800	——			(ALL)		
A22Q1708	151-0150-00			TRANSISTOR:SILICON,NPN	80009	151-0150-00
A22Q1724	151-0453-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0453-00
A22Q1742	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700

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A22Q1748	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A22Q1784	151-0279-00			TRANSISTOR:SILICON,NPN	04713	SS2821
A22Q1835	151-0126-00			TRANSISTOR:SILICON,NPN	04713	ST1046
A22Q1838	151-0126-00			TRANSISTOR:SILICON,NPN	04713	ST1046
A22Q1842	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A22R1706	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A22R1708	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A22R1709	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A22R1712	301-0164-01			RES.,FXD,CMPSN:160K OHM,5%,0.5W	01121	EB1645
A22R1713	321-0414-00			RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
A22R1714	321-0138-00			RES.,FXD,FILM:267 OHM,1%,0.125W	91637	CMF55116G267R0F
A22R1716	323-0793-07			RES.,FXD,FILM:2.5 MEG OHM,0.1%,0.5W	91637	HFF129C250003B
A22R1717	323-0793-07			RES.,FXD,FILM:2.5 MEG OHM,0.1%,0.5W	91637	HFF129C250003B
A22R1718	323-0793-07			RES.,FXD,FILM:2.5 MEG OHM,0.1%,0.5W	91637	HFF129C250003B
A22R1719	321-0428-00			RES.,FXD,FILM:280K OHM,1%,0.125W	91637	MFF1816G28002F
A22R1720	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
A22R1722	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
A22R1724	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
A22R1725	301-0104-02			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
A22R1726	301-0104-02			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
A22R1732	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
A22R1733	315-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,0.25W	01121	CB7555
A22R1734	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	CMF55116G806R0F
A22R1735	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
A22R1736	315-0566-00			RES.,FXD,CMPSN:56M OHM,5%,0.25W	01121	CB5665
A22R1738	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A22R1741	321-0275-00			RES.,FXD,FILM:7.15K OHM,1%,0.125W	91637	MFF1816G71500F
A22R1742	321-0353-00			RES.,FXD,FILM:46.4K OHM,1%,0.125W	91637	MFF1816G46401F
A22R1743	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A22R1746	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
A22R1747	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1748	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1750	301-0152-03			RES.,FXD,CMPSN:1.5K OHM,5%,0.5W	01121	EB1525
A22R1754	323-0540-00			RES.,FXD,FILM:4.12M OHM,1%,0.50W	91637	HFF129-G41203F
A22R1755	301-0106-03			RES.,FXD,CMPSN:10M OHM,5%,0.5W	01121	EB1065
A22R1756	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A22R1757	321-0044-00			RES.,FXD,FILM:28 OHM,1%,0.125W	91637	CMF55116G28R00F
A22R1758	321-0033-00			RES.,FXD,FILM:21.5 OHM,1%,0.125W	91637	CMF55116G21R50F
A22R1764	301-0103-02			RES.,FXD,CMPSN:10K OHM,5%,0.5W	01121	EB1035
A22R1770	315-0470-03			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
A22R1771	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	57668	NTR25J-E390E
A22R1772	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A22R1774	307-0104-00			RES.,FXD,CMPSN:3.3 OHM,5%,0.25W	01121	CB33G5
A22R1776	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A22R1778	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A22R1783	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A22R1784	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A22R1785	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A22R1788	301-0105-01			RES.,FXD,CMPSN:1M OHM,5%,0.5W	01121	EB1055
A22R1789	301-0105-01			RES.,FXD,CMPSN:1M OHM,5%,0.5W	01121	EB1055
A22R1790	315-0104-03			RES.,FXD CMPSN:100K OHM,5%,0.25W	01121	CB1045
A22R1791	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A22R1792	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1793	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E

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A22R1794	315-0183-03			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A22R1795	315-0226-01			RES.,FXD,CMPSN:22M OHM,5%,0.25W	01121	CB2265
A22R1796	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A22R1797	321-0319-00			RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	MFF1816G20501F
A22R1800	315-0683-03			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A22R1802	307-0556-00			RES NTWK,FXD FI:HIGH VOLTAGE DIVIDER	80009	307-0556-00
A22R1803	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	57668	NTR25J-E 200K
A22R1804	315-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,0.25W	01121	CB7555
A22R1805	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
A22R1806	321-0983-00			RES.,FXD,FILM:4.5M OHM,1%,0.125W	91637	CM110216G45003F
A22R1807	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A22R1811	301-0155-01			RES.,FXD,CMPSN:1.5M OHM,5%,0.5W	01121	EB1555
A22R1812	301-0155-01			RES.,FXD,CMPSN:1.5M OHM,5%,0.5W	01121	EB1555
A22R1813	301-0205-01			RES.,FXD,CMPSN:2M OHM,5%,0.5W	01121	EB2055
A22R1814	301-0205-01			RES.,FXD,CMPSN:2M OHM,5%,0.5W	01121	EB2055
A22R1815	315-0226-01			RES.,FXD,CMPSN:22M OHM,5%,0.25W	01121	CB2265
A22R1816	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1817	315-0104-03			RES.,FXD CMPSN:100K OHM,5%,0.25W	01121	CB1045
A22R1818	315-0183-03			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A22R1819	315-0183-03			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A22R1820	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1821	315-0105-03			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A22R1822	323-0540-00			RES.,FXD,FILM:4.12M OHM,1%,0.50W	91637	HFF129-G41203F
A22R1823	323-0540-00			RES.,FXD,FILM:4.12M OHM,1%,0.50W	91637	HFF129-G41203F
A22R1824	323-0540-00			RES.,FXD,FILM:4.12M OHM,1%,0.50W	91637	HFF129-G41203F
A22R1825	311-1967-00			RES.,VAR,NONWIR:PNL,2M OHM,10%,0.50W	12697	CM41753
A22R1827	323-0540-00			RES.,FXD,FILM:4.12M OHM,1%,0.50W	91637	HFF129-G41203F
A22R1828	323-0525-00			RES.,FXD,FILM:2.87M OHM,1%,0.5W	91637	CMF65116G28703F
A22R1829	323-0540-00			RES.,FXD,FILM:4.12M OHM,1%,0.50W	91637	HFF129-G41203F
A22R1831	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A22R1834	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1835	315-0153-03			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A22R1837	315-0105-03			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A22R1838	315-0153-03			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A22R1839	321-0444-00			RES.,FXD,FILM:412K OHM,1%,0.125W	91637	MFF1816G41202F
A22R1840	321-0486-00			RES.,FXD,FILM:1.13M OHM,1%,0.125W	91637	HMF188G11303F
A22R1841	315-0184-01			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
A22R1842	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1848	315-0683-03			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A22R1849	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1850	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1852	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1853	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1854	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1855	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1856	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1857	323-0505-00			RES.,FXD,FILM:1.78M OHM,1%,0.50W	91637	MFF1226G17803F
A22R1858	323-0505-00			RES.,FXD,FILM:1.78M OHM,1%,0.50W	91637	MFF1226G17803F
A22R1859	323-0505-00			RES.,FXD,FILM:1.78M OHM,1%,0.50W	91637	MFF1226G17803F
A22R1860	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1862	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1863	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1864	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1865	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M

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A22R1866	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1867	323-0505-00			RES.,FXD,FILM:1.78M OHM,1%,0.50W	91637	MFF1226G17803F
A22R1870	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1872	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1873	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1874	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1875	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1876	311-1969-00			RES.,VAR,NONWIR:PNL,DUAL,5M OHM,20%,0.50W	01121	72P4N048S505M
A22R1877	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A22R1880	315-0161-02			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A22R1881	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	57668	NTR25J-E 360E
A22R1882	323-0540-00			RES.,FXD,FILM:4.12M OHM,1%,0.50W	91637	HFF129-G41203F
A22R1883	311-1968-00			RES.,VAR,NONWIR:PNL,5M OHM,20%,0.50W	01121	72M4N048S505M
A22R1884	323-0745-00			RES.,FXD,FILM:5M OHM,1%,0.50W	91637	MFF1226G50003F
A22R1885	323-0745-00			RES.,FXD,FILM:5M OHM,1%,0.50W	91637	MFF1226G50003F
A22R1886	323-0745-00			RES.,FXD,FILM:5M OHM,1%,0.50W	91637	MFF1226G50003F
A22R1887	323-0496-00			RES.,FXD,FILM:1.43M OHM,1%,0.50W	24546	NA65 143F
A22R1888	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
A22R1890	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A22R1891	311-1252-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	32997	3386F-T04-504
A22R1893	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A22R1894	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
A22R1895	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A22R1896	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
A22R1897	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	CMF55116G18201F
A22RT1804	307-0181-00			RES.,THERMAL:100K OHM,10%,4MW/DEG C	15454	1DE104-K-220EC
A22T1708	120-1174-00			XFMR,PWR,STU:HIGH VOLTAGE POT CORE	80009	120-1174-00
A22T1770	120-1173-00			XFMR,PWR,SDN&SU:HIGH VOLTAGE	80009	120-1173-00
A22TP1756	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1775	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1813	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1844	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1846	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1850	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1852	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1860	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1862	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1870	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22TP1872	-----			(SEE MAINT SECTION FOR SQ PIN REPL)		
A22U1700	152-0687-00			SEMICOND DEVICE:HV MULTR,SI,2.4KV PP INPUT	52306	CMX334C
A22U1714	156-0158-01			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	04713	MC1458P1DS
A22U1736	156-0512-01			MICROCIRCUIT,LI:OPNL AMPL,CHK	04713	LM308NDS
A22U1802	156-0067-01			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER,CHK	04713	MC1741CP1DS
A22VR1784	152-0470-00			SEMICOND DEVICE:ZENER,0.4W,5%,200V	04713	1N992B

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A23	620-0283-01			PWR SUPPLY ASSY:	80009	620-0283-01
A23	———			(INCLUDES A23,A24,A25 ASSEMBLIES)		
A23	670-6259-01	B010100	B029999	CKT BOARD ASSY:INVERTER	80009	670-6259-01
A23	———			(PART OF 620-0283-XX)		
A23	670-6259-02	B030000		CKT BOARD ASSY:INVERTER	80009	670-6259-02
A23	———			(PART OF 620-0283-XX)		
A23C16	290-0628-00			CAP.,FXD,ELCTLT:950UF,+50-10%,200V	56289	36D7560
A23C17	290-0628-00			CAP.,FXD,ELCTLT:950UF,+50-10%,200V	56289	36D7560
A23C37	285-0938-00			CAP.,FXD,PLSTC:0.03UF,5%,600V	56289	P192211
A23C154	290-0898-00			CAP.,FXD,ELCTLT:2200UF,+75%-10%,10VDC	56289	432D222010AA2
A23F10	159-0017-00			FUSE,CARTRIDGE:3AG,4A,250V,FAST BLOW	71400	MTH-CW-4
A23FL10	119-0420-00			FILTER,RFI:6A,250VAC,400HZ	02777	F-11935-6
A23L37	108-0761-00			COIL,RF:1MH	80009	108-0761-00
A23Q28	151-0656-00			TRANSISTOR:SILICON,NPN	04713	SJE1972
A23Q34	151-0632-00			TRANSISTOR:SILICON,NPN	04713	SJE1946
A23Q40	151-0632-00			TRANSISTOR:SILICON,NPN	04713	SJE1946
A23Q58	151-0657-00			TRANSISTOR:SILICON,PNP	04713	SJE1973
A23Q74	151-0656-00			TRANSISTOR:SILICON,NPN	04713	SJE1972
A23Q94	151-0657-00			TRANSISTOR:SILICON,PNP	04713	SJE1973
A23Q122	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
A23Q126	151-0477-01			TRANSISTOR:SCREENED	80009	151-0477-01
A23R6	303-0105-00			RES.,FXD,CMPSN:1M OHM,5%,1W	01121	GB1055
A23S12	260-1300-00			SWITCH,SLIDE:DPDT,3A,125VAC	82389	46206LFE
A23S99	260-0450-00			SWITCH,SLIDE:3 POS,DOUBLE POLE	82389	11D-1007
A23T110	120-1183-00			XFMR,PWR,STPDN:HIGH FREQUENCY	80009	120-1183-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A23A1	670-6259-01	B010100	B029999	CKT BOARD ASSY:INVERTER	80009	670-6259-01
A23A1	-----			(PART OF 620-0283-XX)		
A23A1	670-6259-02	B030000		CKT BOARD ASSY:INVERTER	80009	670-6259-02
A23A1	-----			(PART OF 620-0283-XX)		
A23A1C5	283-0022-00	B010100	B029999	CAP.,FXD,CER DI:0.02UF,1400VDCAC	59660	3888531Z5U0203Z
A23A1C5	119-1168-00	B030000		CAPACITOR-RES:0.1UF,20% & 22 OHM,10%,250V	14752	RG1782-1
A23A1C6	283-0022-00	B010100	B029999	CAP.,FXD,CER DI:0.02UF,1400VDCAC	59660	3888531Z5U0203Z
A23A1C19	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
A23A1C27	283-0280-00	B010100	B029999	CAP.,FXD,CER DI:2200PF,10%,2000V	59660	0818590Y5500222K
A23A1C27	283-0351-00	B030000		CAP.,FXD,CER DI:5000PF,20%,3000V	51406	DHR17Z5U502M3KV
A23A1C28	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	59660	0818590Y5500222K
A23A1C28	283-0351-00	B030000		CAP.,FXD,CER DI:5000PF,20%,3000V	51406	DHR17Z5U502M3KV
A23A1C29	285-0939-00			CAP.,FXD,PLSTC:3UF,5%,400V	84411	TEK111-30594
A23A1C31	290-0891-00			CAP.,FXD,ELCTLT:1UF,+75-10%,50V	55680	ULA1H010TEA
A23A1C35	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
A23A1C36	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	59660	0818590Y5500222K
A23A1C38	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-521-S-Y5S-10
A23A1C39	290-0891-00			CAP.,FXD,ELCTLT:1UF,+75-10%,50V	55680	ULA1H010TEA
A23A1C42	283-0079-00			CAP.,FXD,CER DI:0.01UF,20%,250V	59660	8151B202Y5S0103M
A23A1C43	290-0767-00			CAP.,FXD,ELCTLT:4.7UF,+75-10%,160V	56289	5020228
A23A1CR15	152-0396-01	B010100	B029999	SEMICOND DEVICE:SILICON,400V,3A	12969	652-821
A23A1CR15	152-0750-00	B030000		SEMICOND DEVICE:RECT BRIDGE,600V,3A	05828	RKBPC606-12
A23A1CR32	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
A23A1CR33	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
A23A1CR34	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
A23A1CR36	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A23A1CR37	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A23A1CR38	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
A23A1CR39	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
A23A1CR40	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
A23A1CR41	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
A23A1CR45	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A23A1CR46	152-0581-00			SEMICOND DEVICE:SILICON,20V,1A	04713	1N5817
A23A1CR49	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
A23A1DS19	150-0035-00			LAMP,GLOW:90V,0.3MA,AID-T,WIRE LD	000LI	JH005/3011JA
A23A1E8	119-0181-00			ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
A23A1E13	119-0181-00			ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
A23A1L24	108-0681-00			COIL,RF:140UH	80009	108-0681-00
A23A1Q30	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	X13T520
A23A1Q34	151-0632-00			TRANSISTOR:SILICON,NPN	04713	SJE1946
A23A1Q40	151-0632-00			TRANSISTOR:SILICON,NPN	04713	SJE1946
A23A1Q43	151-0347-00			TRANSISTOR:SILICON,NPN	56289	T7916
A23A1Q45	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A23A1Q46	151-0260-00			TRANSISTOR:SILICON,NPN	04713	ST1083
A23A1R5	304-0270-00	B010100	B029999	RES.,FXD,CMPSN:27 OHM,10%,1W	01121	GB2701
A23A1R8	308-0503-00	B010100	B029999	RES.,FXD,WW:6.8 OHM,5%,2.50W	91637	CW2B-D6R800J
A23A1R9	304-0473-00			RES.,FXD,CMPSN:47K OHM,10%,1W	01121	GB4731
A23A1R10	303-0184-00			RES.,FXD,CMPSN:180K OHM,5%,1W	01121	GB1845
A23A1R12	308-0503-00	B010100	B029999	RES.,FXD,WW:6.8 OHM,5%,2.50W	91637	CW2B-D6R800J
A23A1R13	304-0473-00			RES.,FXD,CMPSN:47K OHM,10%,1W	01121	GB4731
A23A1R19	302-0565-00			RES.,FXD,CMPSN:5.6M OHM,10%,0.05W	01121	EB5651
A23A1R21	304-0154-00			RES.,FXD,CMPSN:150K OHM,10%,1W	01121	GB1541
A23A1R25	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E

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A23A1R31	303-0100-00			RES.,FXD,CMPSN:10 OHM,5%,1W	01121	GB1005
A23A1R32	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
A23A1R36	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A23A1R37	301-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.5W	01121	EB2005
A23A1R38	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
A23A1R39	301-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.5W	01121	EB2005
A23A1R40	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
A23A1R41	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A23A1R42	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A23A1R43	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	57668	NTR25J-E270K
A23A1R44	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	57668	NTR25J-E 27E
A23A1R45	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A23A1R46	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A23A1R47	301-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.5W	01121	EB1845
A23A1RT9	307-0353-00			RES.,FXD,FILM:5 OHM,10%,DISC	15454	5DA5RO-K-270SS
A23A1RT13	307-0353-00			RES.,FXD,FILM:5 OHM,10%,DISC	15454	5DA5RO-K-270SS
A23A1T8	120-0636-00			XFMR,PWR,STPDN:LINE TRIGGER	80009	120-0636-00
A23A1T25	120-0743-00			XFMR,TOROID:13 TURNS,BIFILAR	80009	120-0743-00
A23A1T30	120-0744-00			XFMR,TOROID:5 WINDINGS	80009	120-0744-00
A23A1T35	120-0747-00			XFMR,TOROID:55 TURNS,SINGLE	80009	120-0747-00
A23A1TP31	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A23A1TP34	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A23A1TP38	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A23A1TP46	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A23A1VR38	152-0241-00			SEMICOND DEVICE:ZENER,0.4W,33V,5%	04713	SZG35009K5
A23A1VR45	152-0428-00			SEMICOND DEVICE:ZENER,0.4W,120V,5%	80009	152-0428-00
A23A1W5	131-0566-00	B030000		BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A24	670-5959-03			CKT BOARD ASSY:CONTROL RECTIFIER	80009	670-5959-03
A24	---- ----			(PART OF 620-0283-XX)		
A24C52	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A24C54	290-0573-00			CAP.,FXD,ELCTLT:2.7UF,20%,50V	56289	196D275X0050JA1
A24C55	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5SO222M
A24C64	290-0263-00			CAP.,FXD,ELCTLT:2.7UF,15V	56289	173D275X9015V
A24C66	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
A24C67	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
A24C70	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A24C71	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A24C74	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
A24C77	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
A24C78	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
A24C80	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	59821	2DDU60E223Z
A24C86	290-0580-00			CAP.,FXD,ELCTLT:0.27UF,20%,50V	56289	196D274X0050HA1
A24C90	290-0778-00			CAP.,FXD,ELCTLT:1UF,+50-10%,50V	55680	UEB1H010MAA1TD
A24C92	285-1123-00			CAP.,FXD,PLSTC:1UF,20%,200V	50558	ME2-2190
A24C94	285-0695-00			CAP.,FXD,PLSTC:0.01UF,10%,200V	56289	192P10392
A24C121	285-0892-00			CAP.,FXD,PLSTC:0.22UF,10%,200V	56289	LP66A1C224K002
A24C124	290-0758-00			CAP.,FXD,ELCTLT:2.2UF,+50-10%,160V	56289	502D227
A24C125	290-0758-00			CAP.,FXD,ELCTLT:2.2UF,+50-10%,160V	56289	502D227
A24C132	290-0768-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	54473	ECE-A100V10L
A24C133	290-0768-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	54473	ECE-A100V10L
A24C134	290-0768-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	54473	ECE-A100V10L
A24C135	290-0768-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	54473	ECE-A100V10L
A24C142	290-0772-00			CAP.,FXD,ELCTLT:330UF,+50-10%,25V	0000L	ECE-B25Z330
A24C143	290-0770-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	54473	ECE-A25V100L
A24C144	290-0772-00			CAP.,FXD,ELCTLT:330UF,+50-10%,25V	0000L	ECE-B25Z330
A24C145	290-0770-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	54473	ECE-A25V100L
A24C152	290-0771-00			CAP.,FXD,ELCTLT:220UF,+50-10%,10VDC	56289	502D231
A24C153	290-0771-00			CAP.,FXD,ELCTLT:220UF,+50-10%,10VDC	56289	502D231
A24C155	290-0773-00			CAP.,FXD,ELCTLT:1000UF,+50-10%,10V	56289	500D154
A24C156	290-0771-00			CAP.,FXD,ELCTLT:220UF,+50-10%,10VDC	56289	502D231
A24C172	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
A24C179	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	04222	SR302E105ZAA
A24C183	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	96733	ADVISE
A24CR52	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR59	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR65	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A24CR66	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A24CR73	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR74	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR75	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR76	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR81	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR82	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR83	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR84	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A24CR90	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A24CR120	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A24CR121	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A24CR122	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A24CR123	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A24CR124	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A24CR125	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A24CR127	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A24CR130	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A24CR131	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A24CR132	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A24CR133	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
A24CR140	152-0397-00			SEMICOND DEVICE:SILICON,50V,12A	80009	152-0397-00
A24CR141	152-0397-00			SEMICOND DEVICE:SILICON,50V,12A	80009	152-0397-00
A24CR142	152-0397-00			SEMICOND DEVICE:SILICON,50V,12A	80009	152-0397-00
A24CR143	152-0397-00			SEMICOND DEVICE:SILICON,50V,12A	80009	152-0397-00
A24CR151	152-0692-00			SEMICOND DEVICE:DUAL RECT,SI,30A,20V	83003	SKS017
A24CR161	152-0008-00			SEMICOND DEVICE:GERMANIUM,75V,60MA	14433	G1409
A24CR171	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A24CR183	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A24L132	108-0473-00			COIL,RF:150UH	80009	108-0473-00
A24L134	108-0473-00			COIL,RF:150UH	80009	108-0473-00
A24L142	108-0680-00			COIL,RF:27UH	80009	108-0680-00
A24L144	108-0680-00			COIL,RF:27UH	80009	108-0680-00
A24L152	108-0473-00			COIL,RF:150UH	80009	108-0473-00
A24L154	108-0556-00			COIL,RF:12UH	80009	108-0556-00
A24L156	108-0337-00			COIL,RF:25UH	80009	108-0337-00
A24P40	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A24P40	----- -----			(QUANTITY OF 4)		
A24P48	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A24P48	----- -----			(QUANTITY OF 5)		
A24P50	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A24P50	----- -----			(QUANTITY OF 7)		
A24P52	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A24P52	----- -----			(QUANTITY OF 6)		
A24P54	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A24P54	----- -----			(QUANTITY OF 4)		
A24Q52	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A24Q54	151-0273-00			TRANSISTOR:SILICON,NPN	80009	151-0273-00
A24Q162	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
A24Q171	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
A24Q173	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
A24Q177	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
A24R52	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A24R54	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A24R55	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
A24R59	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A24R60	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	57668	NTR25J-E220K
A24R61	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A24R62	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	57668	NTR25J-E300E
A24R63	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A24R64	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A24R66	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A24R67	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
A24R70	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	57668	NTR25J-E56E0
A24R71	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	57668	NTR25J-E56E0
A24R74	321-0346-00			RES.,FXD,FILM:39.2K OHM,1%,0.125W	91637	CMF55116G39201F
A24R80	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A24R81	321-0334-00			RES.,FXD,FILM:29.4K OHM,1%,0.125W	91637	MFF1816G29401F

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A24R82	321-0340-00			RES.,FXD,FILM:34K OHM,1%,0.125W	91637	CMF55116G34001F
A24R83	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A24R84	321-0005-00			RES.,FXD,FILM:11 OHM,1%,0.125W	75042	CEAT0-11R0F
A24R86	321-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.125W	91637	MFF1816G88700F
A24R87	321-0283-00			RES.,FXD,FILM:8.66K OHM,1%,0.125W	91637	CMF55116G86600F
A24R88	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
A24R90	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A24R92	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
A24R93	311-1239-00			RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	73138	72-26-0
A24R94	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A24R95	321-0419-00			RES.,FXD,FILM:226K OHM,1%,0.125W	91637	MFF1816G22602F
A24R120	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	57668	NTR25J-E 15E
A24R121	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A24R127	301-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.5W	01121	EB3915
A24R161	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A24R162	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A24R170	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
A24R171	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	57668	NTR25J-E270K
A24R172	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
A24R173	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A24R174	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A24R176	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A24R177	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A24R179	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A24R181	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A24R182	315-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.25W	57668	NTR25J-E 750K
A24TP00	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A24TP126	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A24U75	155-0067-02			MICROCIRCUIT,DI:ML,POWER SPLY RGLTR 16 DIP	80009	155-0067-02
A24U179	156-0481-02			MICROCIRCUIT,DI:TRIPLE 3 INP & GATE	27014	DM74LS11NA+
A24VR52	152-0590-00			SEMICOND DEVICE:ZENER,18V,5% AT 7MA	04713	SZG35014K2
A24VR72	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	TD3810983
A24VR88	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646RL

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A25	670-5960-03			CKT BOARD ASSY:LOW VOLTAGE REGULATOR	80009	670-5960-03
A25	———			(PART OF 620-0283-XX)		
A25C8	290-0778-00			CAP.,FXD,ELCTLT:1UF,+50-10%,50V	55680	UEB1H010MAA1TD
A25C12	290-0778-00			CAP.,FXD,ELCTLT:1UF,+50-10%,50V	55680	UEB1H010MAA1TD
A25C13	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	59821	2DDH73L271J
A25C15	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	04222	7027-C0G-330J
A25C17	290-0778-00			CAP.,FXD,ELCTLT:1UF,+50-10%,50V	55680	UEB1H010MAA1TD
A25C24	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	59660	855-547-E-502Z
A25C36	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A25C44	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	59660	835-515-Z5D0102K
A25C45	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
A25C47	290-0778-00			CAP.,FXD,ELCTLT:1UF,+50-10%,50V	55680	UEB1H010MAA1TD
A25C54	283-0100-00			CAP.,FXD,CER DI:0.0047UF,10%,200V	56289	2C20C0G472K200B
A25C64	281-0540-00			CAP.,FXD,CER DI:51PF,5%,500V	59660	301-000U2J0510J
A25C68	290-0420-00			CAP.,FXD,ELCTLT:0.68UF,20%,75V	56289	150D684X0075A2
A25C69	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	59660	835-515-Z5D0102K
A25C84	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	04222	7027-C0G-330J
A25C88	290-0420-00			CAP.,FXD,ELCTLT:0.68UF,20%,75V	56289	150D684X0075A2
A25C114	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	59660	301000Y5D201K
A25C156	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
A25CR7	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR8	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR10	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR11	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR15	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR19	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25CR20	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25CR21	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25CR22	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR28	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
A25CR45	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR49	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25CR50	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25CR51	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25CR52	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR58	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
A25CR64	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR76	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
A25CR84	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR96	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
A25CR114	152-0333-00			SEMICOND DVC DI:SW,SI,55V,200MA,D0-35	03508	DJ2011
A25CR132	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
A25CR142	152-0423-00			SEMICOND DEVICE:SILICON,400V,3A	04713	1N5000
A25CR143	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25CR144	152-0423-00			SEMICOND DEVICE:SILICON,400V,3A	04713	1N5000
A25CR148	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A25P82	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A25P82	———			(QUANTITY OF 10)		
A25P83	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A25P83	———			(QUANTITY OF 8)		
A25P90	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A25P90	———			(QUANTITY OF 2)		
A25Q22	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A25Q34	151-0103-00			TRANSISTOR:SILICON,NPN	80009	151-0103-00
A25Q38	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
A25Q52	151-0347-00			TRANSISTOR:SILICON,NPN	56289	T7916
A25Q68	151-0347-00			TRANSISTOR:SILICON,NPN	56289	T7916
A25Q88	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
A25Q118	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A25Q144	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
A25Q148	151-0373-00			TRANSISTOR:SILICON,PNP	80009	151-0373-00
A25R1	321-0369-00			RES.,FXD,FILM:68.1K OHM,1%,0.125W	91637	CMF55116G68101F
A25R2	321-0386-00			RES.,FXD,FILM:102K OHM,1%,0.125W	91637	MFF1816G10202F
A25R3	321-0336-00			RES.,FXD,FILM:30.9K OHM,1%,0.125W	91637	CMF55116G30901F
A25R4	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	CMF55116G10201F
A25R5	321-0319-00			RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	MFF1816G20501F
A25R8	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
A25R10	323-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.50W	75042	CECT0-5621F
A25R12	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A25R13	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A25R14	321-0730-06			RES.,FXD,FILM:5.703K OHM,0.25%,0.125W	91637	MFF1816C57030C
A25R15	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
A25R16	321-0331-09			RES.,FXD,FILM:27.4K OHM,1%,0.125W	91637	MFF1816C27401F
A25R17	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A25R21	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A25R22	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A25R24	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A25R25	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A25R26	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
A25R27	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A25R28	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	91637	CW2B-1R500J T/R
A25R32	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
A25R34	304-0102-00			RES.,FXD,CMPSN:1K OHM,10%,1W	01121	GB1021
A25R36	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	57668	NTR25J-E 120E
A25R37	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A25R38	301-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.5W	57668	TR50J-E1K8
A25R42	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A25R44	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A25R45	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
A25R46	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
A25R47	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A25R51	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A25R52	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A25R54	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
A25R55	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A25R56	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
A25R57	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A25R58	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
A25R61	321-0332-07			RES.,FXD,FILM:28K OHM,0.1%,0.125W	91637	MFF1816C28001B
A25R62	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
A25R63	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A25R67	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A25R68	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A25R69	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
A25R73	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
A25R74	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
A25R75	308-0804-00			RES.,FXD,NONWIR:0.025 OHM,5%,0.5W	80009	308-0804-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A25R76	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A25R77	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
A25R80	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
A25R81	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
A25R82	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	57668	NTR25J-E09K1
A25R83	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A25R87	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
A25R88	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A25R93	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
A25R94	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
A25R95	308-0804-00			RES.,FXD,NONWIR:0.025 OHM,5%,0.5W	80009	308-0804-00
A25R96	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A25R97	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
A25R113	321-1713-07			RES.,FXD,FILM:36K OHM,0.1%,0.125W	24546	NE55E3602B
A25R114	321-0926-07			RES.,FXD,FILM:4K OHM,0.1%,0.125W	91637	CMF55116C40000B
A25R121	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A25R126	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	57668	NTR25J-E 130E
A25R127	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A25R128	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
A25R129	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A25R131	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
A25R132	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
A25R133	308-0804-00			RES.,FXD,NONWIR:0.025 OHM,5%,0.5W	80009	308-0804-00
A25R134	308-0804-00			RES.,FXD,NONWIR:0.025 OHM,5%,0.5W	80009	308-0804-00
A25R135	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A25R136	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
A25R141	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
A25R142	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A25R143	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A25R144	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A25R145	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A25R148	308-0702-00			RES.,FXD,WW:0.33 OHM,5%,2W	75042	BWH-R3300J
A25R152	301-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.50W	01121	EB5615
A25R156	301-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.5W	57668	TR50J-E 430E
A25TP00	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A25U15	156-0067-12			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
A25U45	156-0067-12			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
A25U64	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A25U84	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A25U114	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A25VR10	152-0217-00			SEMICOND DVC,DI:ZEN,SI,8.2V,5%,0.4W	04713	SZG20
A25VR12	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646RL
A25VR17	152-0283-00			SEMICOND DEVICE:ZENER,0.4W,43V,5%	12954	DZ750903B1N976B
A25VR32	152-0281-00			SEMICOND DEVICE:ZENER,0.4W,22V,5%	12954	1N969B
A25VR36	152-0281-00			SEMICOND DEVICE:ZENER,0.4W,22V,5%	12954	1N969B
A25VR47	152-0283-00			SEMICOND DEVICE:ZENER,0.4W,43V,5%	12954	DZ750903B1N976B
A25VR152	152-0175-01			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG5021RL
A25VR156	152-0175-01			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG5021RL

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS, ALSO SEE POWER SUPPLY		
B90	119-1545-01			FAN,TUBEAXIAL:12V,4.8W,RPM,35CFM	82877	ST12A3
C1098	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	04222	ADVISE
DL592	119-1798-00			DELAY LINE,ELEC:52 NS,50 OHM	80009	119-1798-00
DS308	150-0121-07			LAMP,CARTRIDGE:5V,0.6A,GREEN,4.125L,5-N	80009	150-0121-07
DS1970	150-1033-00			LT EMITTING DIO:AMBER,585NM,40MA MAX	50434	HLMP 1401
DS1994	150-1031-00			LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
J30	131-0771-00			CONN,RCPT,ELEC:4 CONT,QUICK DISCONNECT	91836	1904-2M58
J33	131-0771-00			CONN,RCPT,ELEC:4 CONT,QUICK DISCONNECT	91836	1904-2M58
J81	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J83	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J95	131-1315-01			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
J396	131-1315-01			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
J497	131-1315-01			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
J1916	131-1315-01			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
J1925	131-1315-01			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
J1944	131-1315-01			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
LR1097	108-0685-00			COIL,RF:62NH	80009	108-0685-00
LR1098	108-0685-00			COIL,RF:62NH	80009	108-0685-00
R90	308-0175-00			RES.,FXD,WW:10 OHM,5%,10W	91637	HL1202Z-7-10R00J
R1099	307-0292-21			RES.,FXD,FILM:(2) 172 OHM,(2) 33.7 OHM	80009	307-0292-21
S10	260-1709-00			SWITCH,PUSH:POWER	77342	A9M1-762-6-3
S70	260-0638-00			SW,THERMOSTATIC:10A,240V,OPEN 75 DEG C	93410	430-364
S1988	260-0247-00			SWITCH,PUSH:SPST,1A,115VAC	81073	30YY1009
V1850	154-0783-00			ELECTRON TUBE:CRT,P31,T7100-31-2	80009	154-0783-00

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

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

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

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

Abbreviations are based on ANSI Y1.1-1972.

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

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

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

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

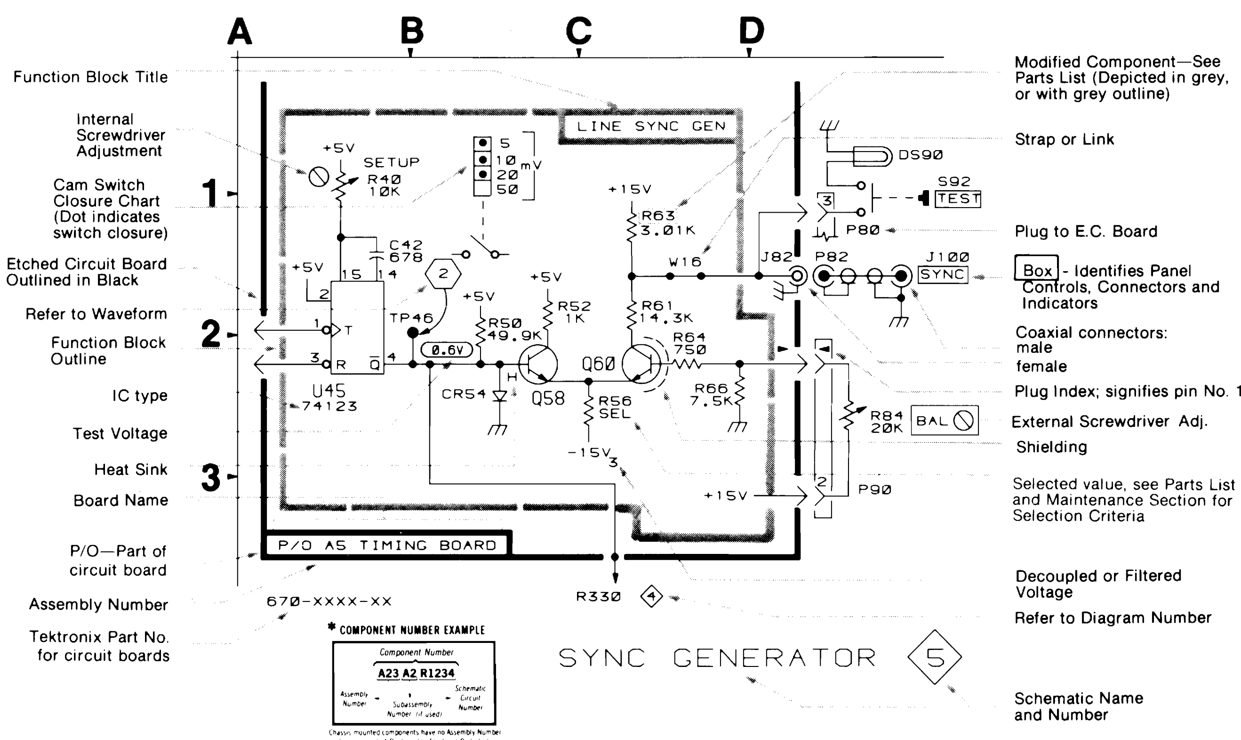
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

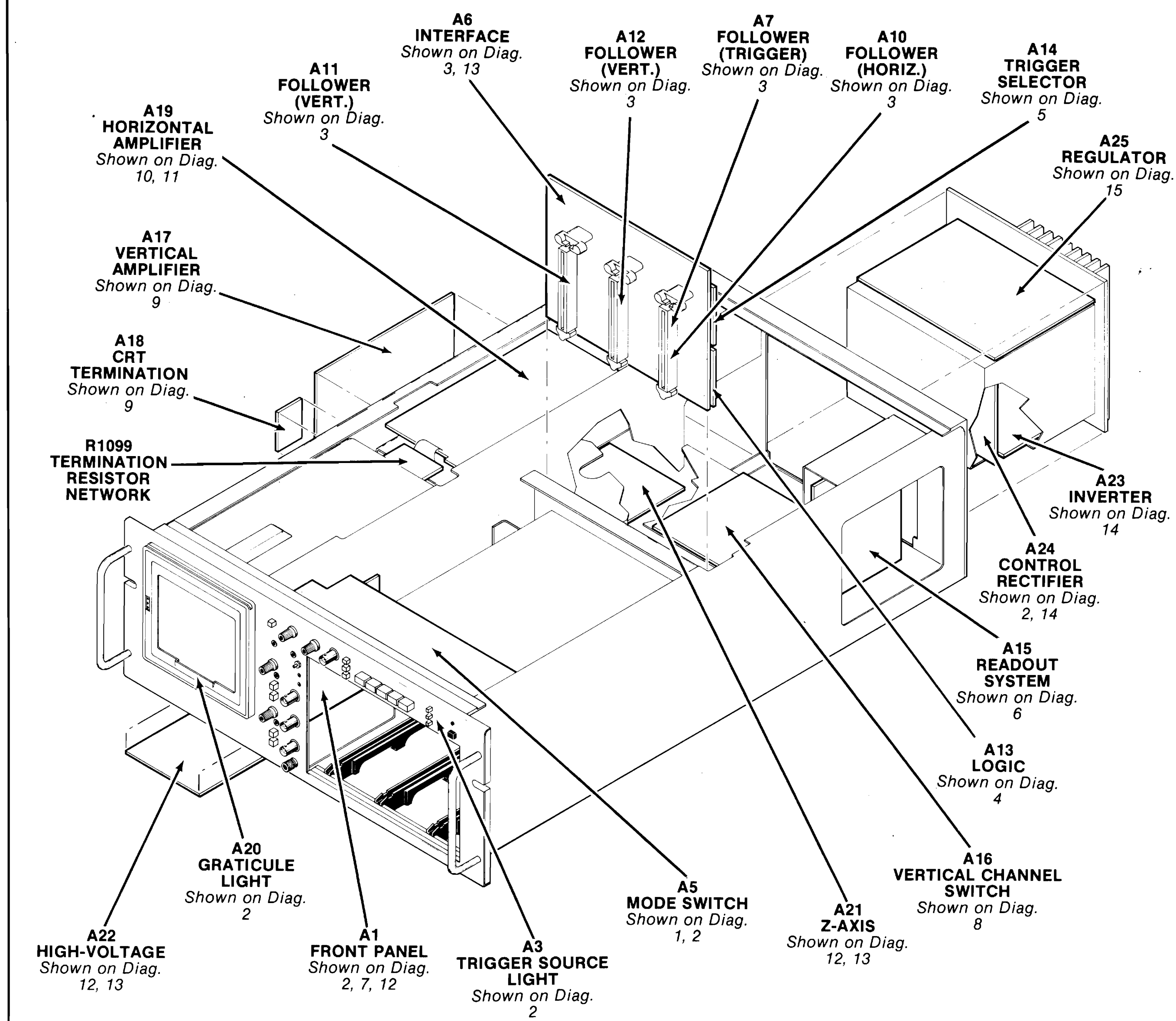
The information and special symbols below may appear in this manual.

Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.





BOARD LOCATOR BY BOARD NAME

Board Name	Assembly Number	Diagram Number
Control Rectifier Board	A24	2,14
CRT Termination Board	A18	9
Follower Board (Horizontal)	A10	3
Follower Board (Trigger)	A7	3
Follower Board (Vertical)	A11	3
Follower Board (Vertical)	A12	3
Front Panel Board	A1	2,7,12
Graticule Light Board	A20	2
High-Voltage Board	A22	12,13
Horizontal Amplifier Board	A19	10,11
Interface Board	A6	3,13
Inverter Board	A23	14
Logic Board	A13	4
Mode Switch Board	A5	2,1
Readout System Board	A15	6
Regulator Board	A25	15
Trigger Selector Board	A14	5
Trigger Source Light Board	A3	2
Vertical Amplifier Board	A17	9
Vertical Channel Switch Board	A16	8
Z-Axis Board	A21	12,13

BOARD LOCATOR BY ASSEMBLY NUMBER

Assembly Number	Board Name	Diagram Number
A1	Front Panel Board	2,7,12
A3	Trigger Source Light Board	2
A5	Mode Switch Board	2,1
A6	Interface Board	3,13
A7	Follower Board (Trigger)	3
A10	Follower Board (Horizontal)	3
A11	Follower Board (Vertical)	3
A12	Follower Board (Vertical)	3
A13	Logic Board	4
A14	Trigger Selector Board	5
A15	Readout System Board	6
A16	Vertical Channel Switch Board	8
A17	Vertical Amplifier Board	9
A18	CRT Termination Board	9
A19	Horizontal Amplifier Board	10,11
A20	Graticule Light Board	2
A21	Z-Axis Board	12,13
A22	High-Voltage Board	12,13
A23	Inverter Board	14
A24	Control Rectifier Board	2,14
A25	Regulator Board	15

5039-801

Figure 8-1. Location of Circuit Boards in R7103.

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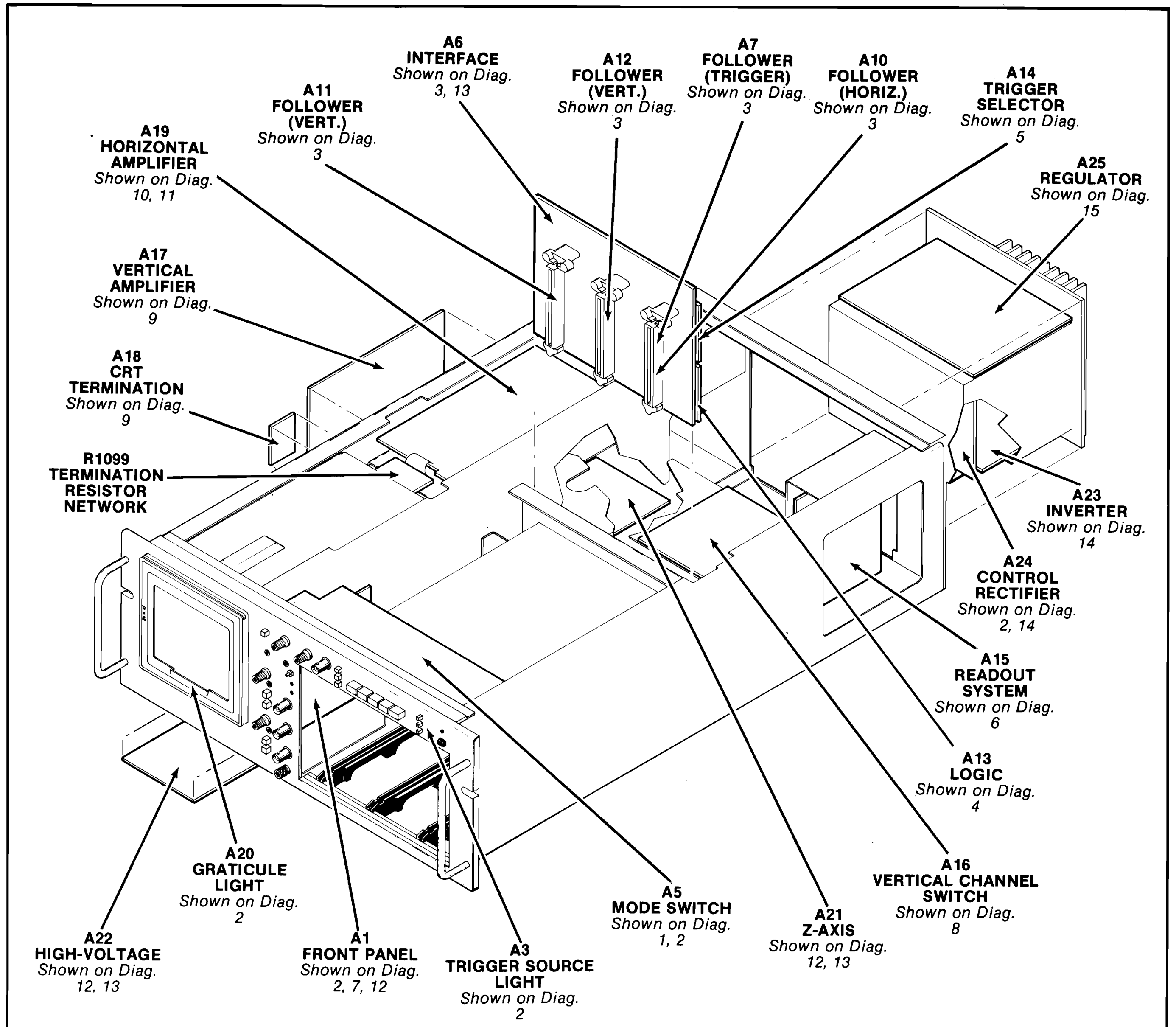


BOARD LOCATOR BY BOARD NAME

Board Name	Assembly Number	Diagram Number
Control Rectifier Board	A24	2,14
CRT Termination Board	A18	9
Follower Board (Horizontal)	A10	3
Follower Board (Trigger)	A7	3
Follower Board (Vertical)	A11	3
Follower Board (Vertical)	A12	3
Front Panel Board	A1	2,7,12
Graticule Light Board	A20	2
High-Voltage Board	A22	12,13
Horizontal Amplifier Board	A19	10,11
Interface Board	A6	3,13
Inverter Board	A23	14
Logic Board	A13	4
Mode Switch Board	A5	2,1
Readout System Board	A15	6
Regulator Board	A25	15
Trigger Selector Board	A14	5
Trigger Source Light Board	A3	2
Vertical Amplifier Board	A17	9
Vertical Channel Switch Board	A16	8
Z-Axis Board	A21	12,13

BOARD LOCATOR BY ASSEMBLY NUMBER

Assembly Number	Board Name	Diagram Number
A1	Front Panel Board	2,7,12
A3	Trigger Source Light Board	2
A5	Mode Switch Board	2,1
A6	Interface Board	3,13
A7	Follower Board (Trigger)	3
A10	Follower Board (Horizontal)	3
A11	Follower Board (Vertical)	3
A12	Follower Board (Vertical)	3
A13	Logic Board	4
A14	Trigger Selector Board	5
A15	Readout System Board	6
A16	Vertical Channel Switch Board	8
A17	Vertical Amplifier Board	9
A18	CRT Termination Board	9
A19	Horizontal Amplifier Board	10,11
A20	Graticule Light Board	2
A21	Z-Axis Board	12,13
A22	High-Voltage Board	12,13
A23	Inverter Board	14
A24	Control Rectifier Board	2,14
A25	Regulator Board	15

5039-801

Figure 8-1. Location of Circuit Boards in R7103.

NOTE
LEAD CONFIGURATIONS AND CASE STYLES ARE TYPICAL, BUT MAY VARY DUE TO VENDOR CHANGES OR INSTRUMENT MODIFICATIONS.

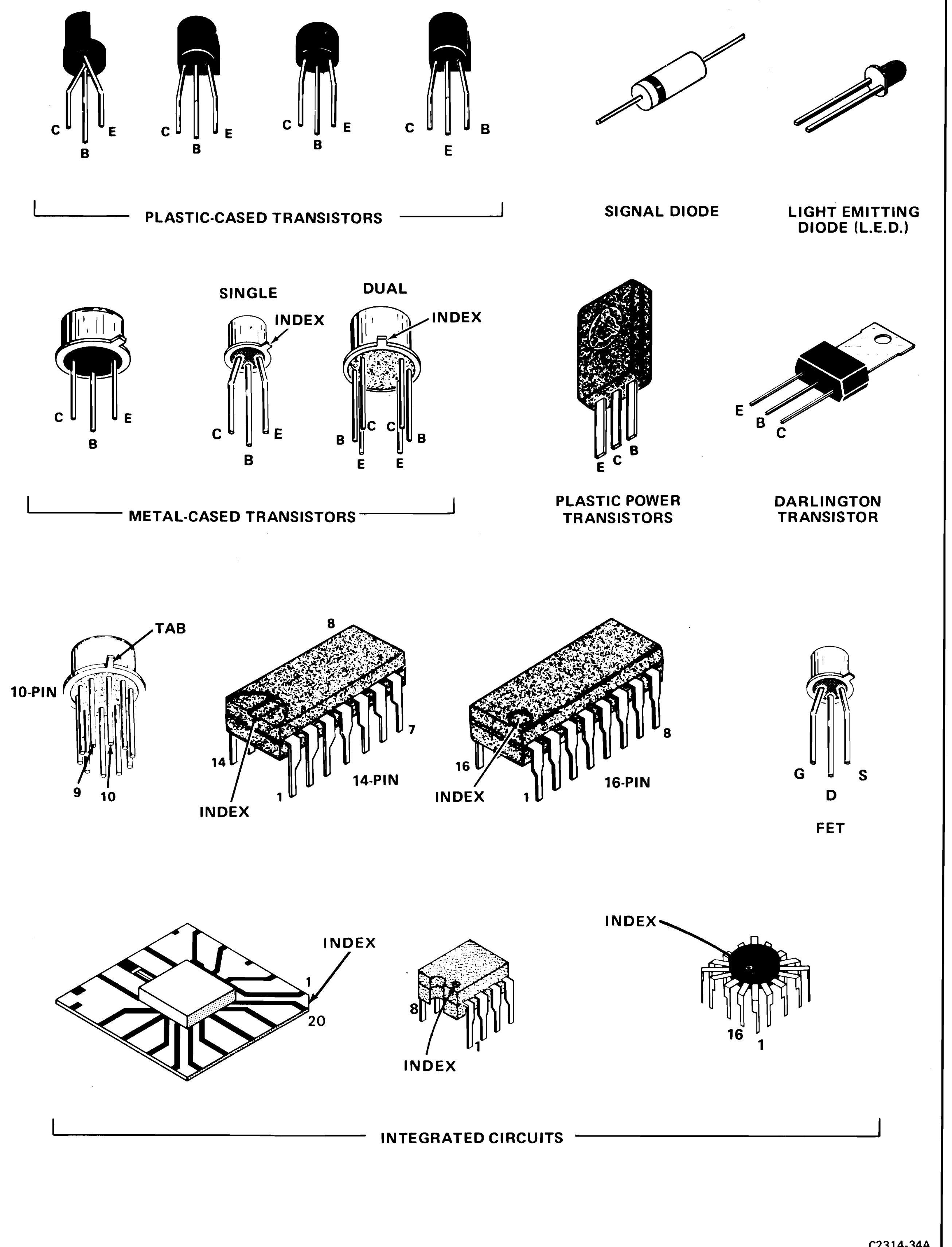
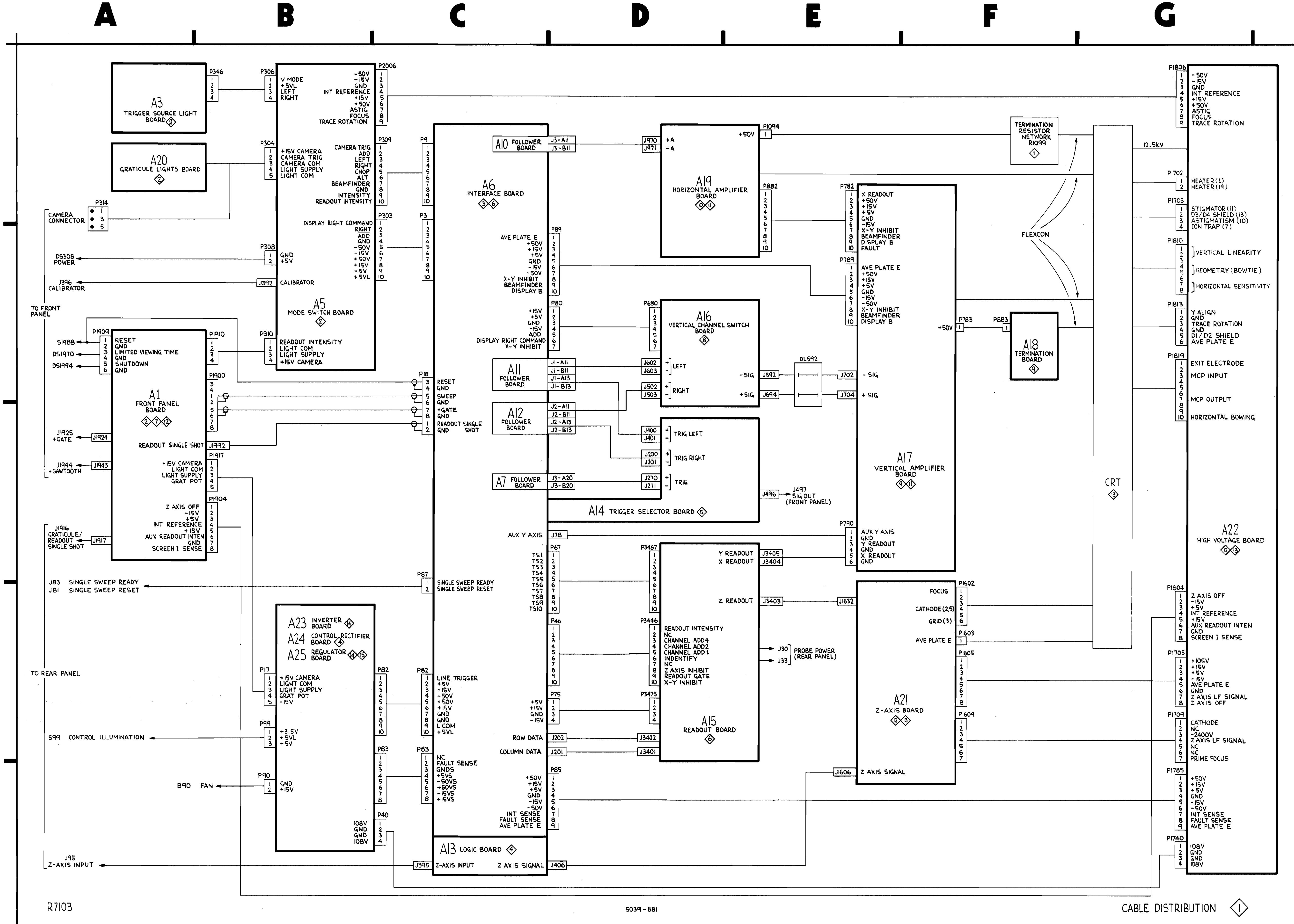


Figure 8-2. Semiconductor lead configurations.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION
B90	15	3A	J1944	7	1E	P1605	13	2E
			J1989	12	5D	P1609	13	E3
C37	14	1D				P1702	13	5F
C179	14	3F	L37	14	1D	P1703	13	4G
C1098	11	4G				P1705	13	2E
			LR1097	11	4G	P1709	13	E3
DL592	8	1B	LR1098	11	4G	P1740	13	4A
						P1785	13	2A
DS308	2	2A	P10	14	3A	P1804	13	1A
DS1970	12	3C	P11	14	3A	P1806	13	2A
DS1994	12	3E	P85	13	2D	P1810	13	2G
			P89	13	2C	P1813	13	3G
F10	14	3A	P314	2	1B	P2006	13	4D
			P680	8	4C			
FL10	14	3A	P782	11	4A	R90	15	3A
			P782	9	5B	R1099	11	4G
J30	6	4G	P783	9	3G			
J33	6	4G	P789	9	4A	S10	14	3A
J81	3	2G	P790	11	4A	S72	14	4E
J83	3	3G	P790	9	2A	S99	15	3C
J95	4	4A	P882	10	4C	S1988	12	4D
J396	2	5E	P882	11	4D			
J497	5	4F	P883	9	3G			
J1916	7	4B	P1602	13	3F			
J1925	7	1D	P1603	13	2F			



R7103

CABLE DISTRIBUTION 1

Reverse Side A1,A5

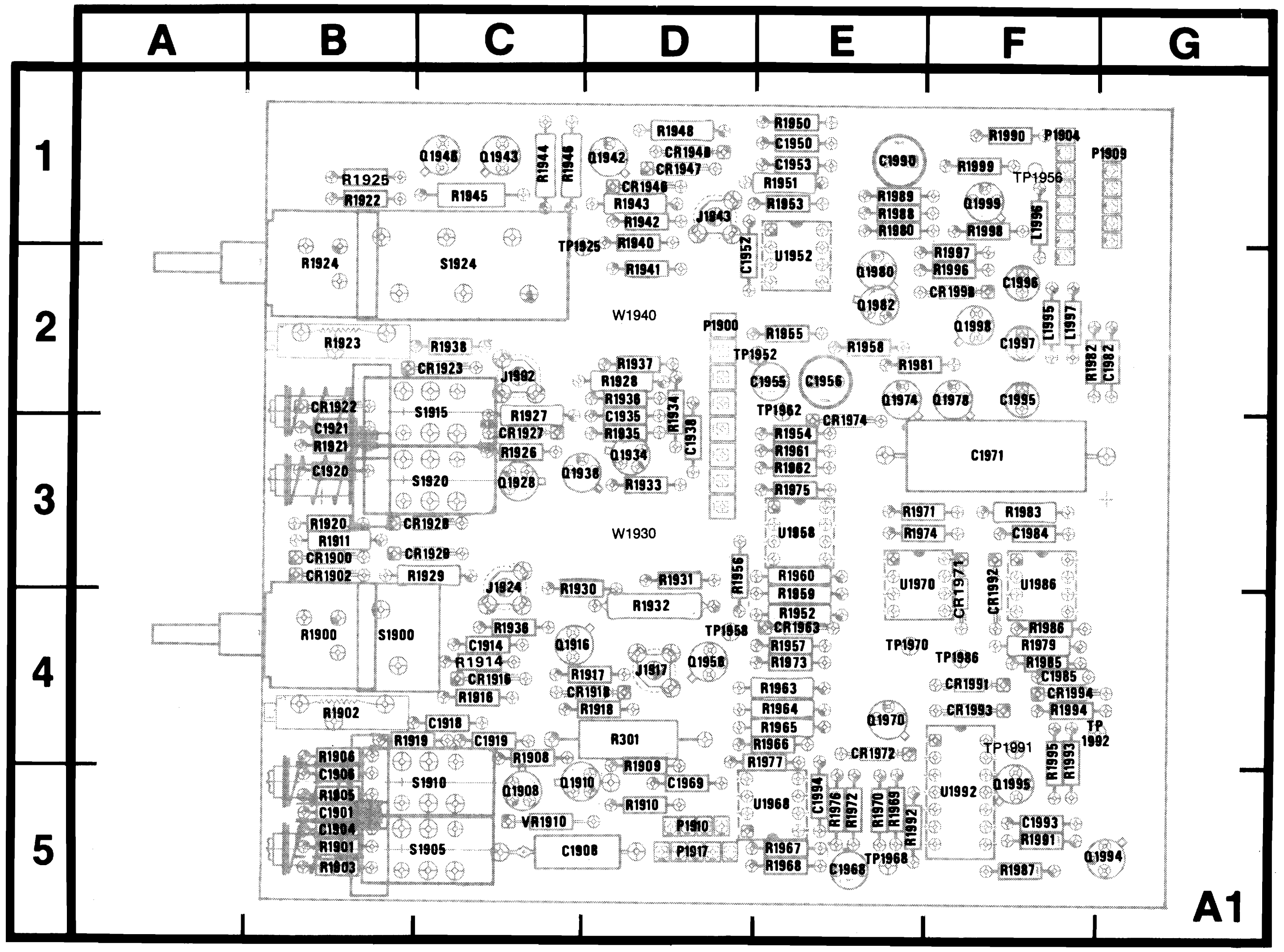


Figure 8-3. A1—Front Panel Board assembly.

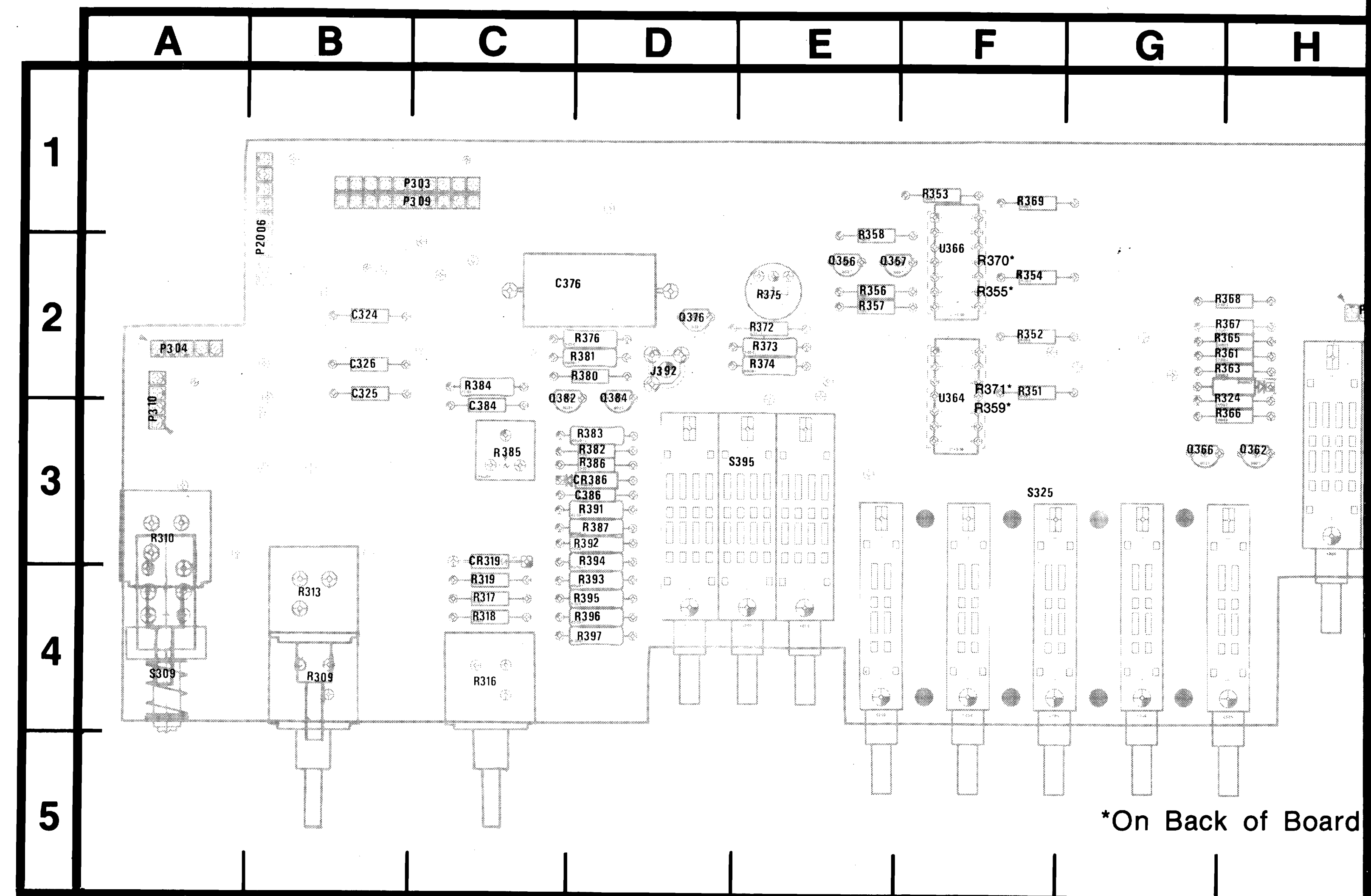
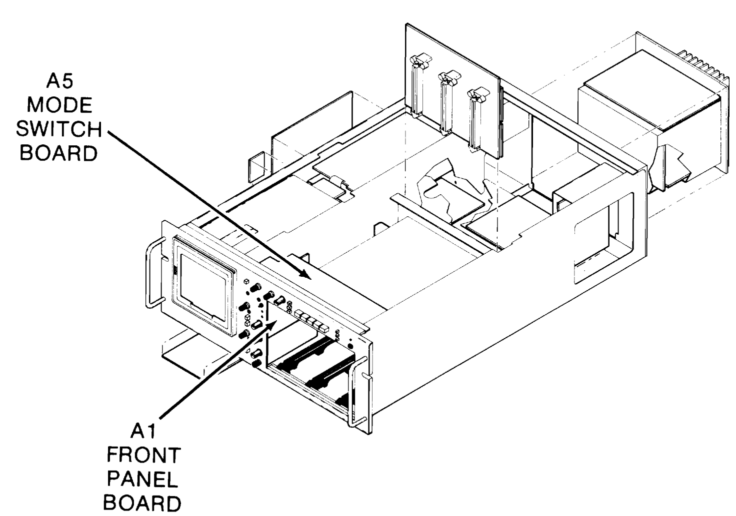


Figure 8-4. A5—Mode Switch Board assembly.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

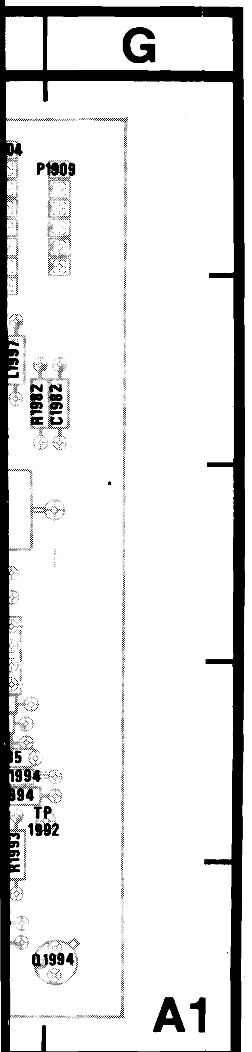
Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Assemblies A1, A5 & component locator



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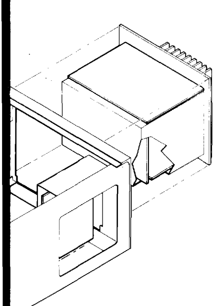

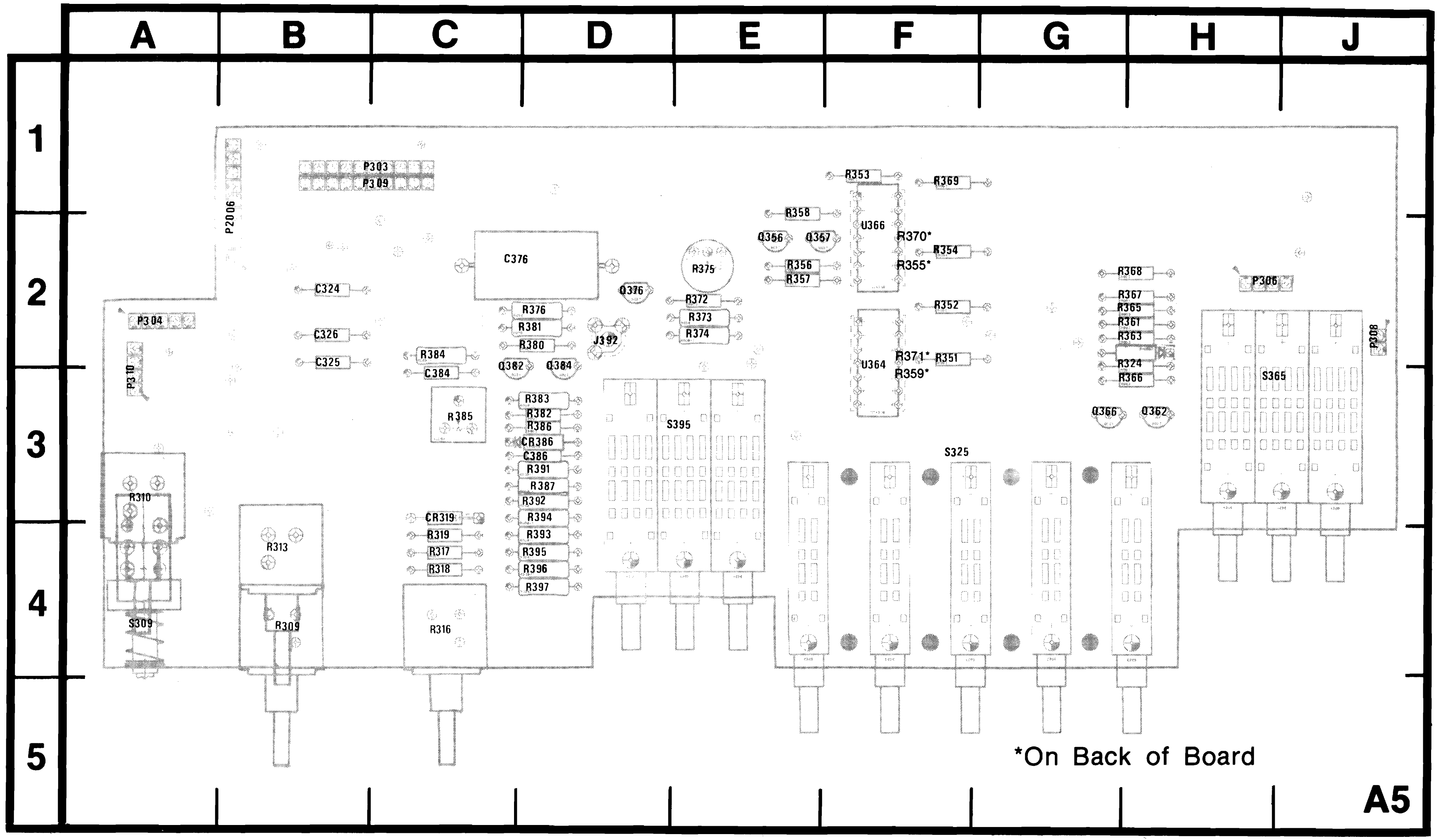

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Figure 8-4. A5—Mode Switch Board assembly.

MODE SWITCH AND CALIBRATOR DIAGRAM ⟨2⟩

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P1910	1C	5D	R1931	*	3D
P1917	1C	5D	R1941	*	2C
R301	1C	4D			

Partial A1 also shown on diagrams 7 and 12.

ASSEMBLY A3

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS342	3A	**	DS346	3A	**
DS345	3A	**	P346	3A	**

ASSEMBLY A20

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS304	1A	**	DS306	1A	**
DS305	1A	**			

ASSEMBLY A5

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C324	4D	2B	R309	1C	4B	R381	5B	2D
C325	4D	2B	R310	2C	3A	R382	4C	3D
C326	5D	2B	R313	2D	4B	R383	4C	3D
C376	5B	2D	R316	2D	4C	R384	4C	2C
C384	4C	3C	R317	2D	4C	R385	4C	3C
C386	4C	3D	R318	2D	4C	R386	4C	3D
			R319	2D	4C	R387	5C	3D
CR319	2E	3C	R324	3B	2H	R391	4C	3D
CR324	3B	2H	R351	3C	2F	R392	5C	3D
CR386	4C	3D	R352	3C	2F	R393	5C	4D
			R353	3D	1F	R394	5C	3D
J392	5E	2D	R354	3C	2F	R395	5C	4D
			R356	4D	2E	R396	5C	4D
P303	4E	1B	R357	4D	2E	R397	5C	4D
P304	1B	2A	R358	4D	1E			
P306	3A	2H	R361	3A	2H	S309	1C	4A
P308	2A	2J	R363	3B	2H	S325	2B	3F
P309	2E	1B	R365	3A	2H	S365	4B	3H
P310	1B	3A	R366	3B	3H	S395	5D	3E
P2006	1E	1B	R367	3A	2H			
			R368	4B	2H	U364A	3C	2F
Q356	4D	2E	R369	4B	1F	U364B	3B	2F
Q357	4D	2E	R372	4B	2E	U364C	3B	2F
Q362	3B	3H	R373	4B	2E	U364D	4C	2F
Q366	3B	3G	R374	4B	2E	U366A	4D	2F
Q376	5B	2D	R375	5B	2E	U366B	4D	2F
Q382	4B	2C	R376	5B	2D	U366C	3C	2F
Q384	4C	2D	R380	4B	2D			

Partial A5 also shown on diagram 13.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS308	2A	CHASSIS	J396	5E	CHASSIS	P314	1B	CHASSIS

*Not Active
**Board Not Shown

VOLTAGE CONDITIONS

Use a digital voltmeter with a 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series Power Module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltages shown were obtained with all R7103 front-panel variable controls, except INTENSITY and READOUT INTENSITY, set to midrange. INTENSITY and READOUT INTENSITY were set fully counterclockwise (off). Other R7103 controls were set as follows:

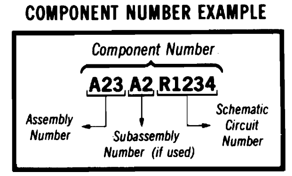
Front panel:
- VERTICAL MODE .... LEFT
- TRIGGER SOURCE .... VERT MODE

Rear panel:
- CONTROL ILLUMINATION .... HIGH

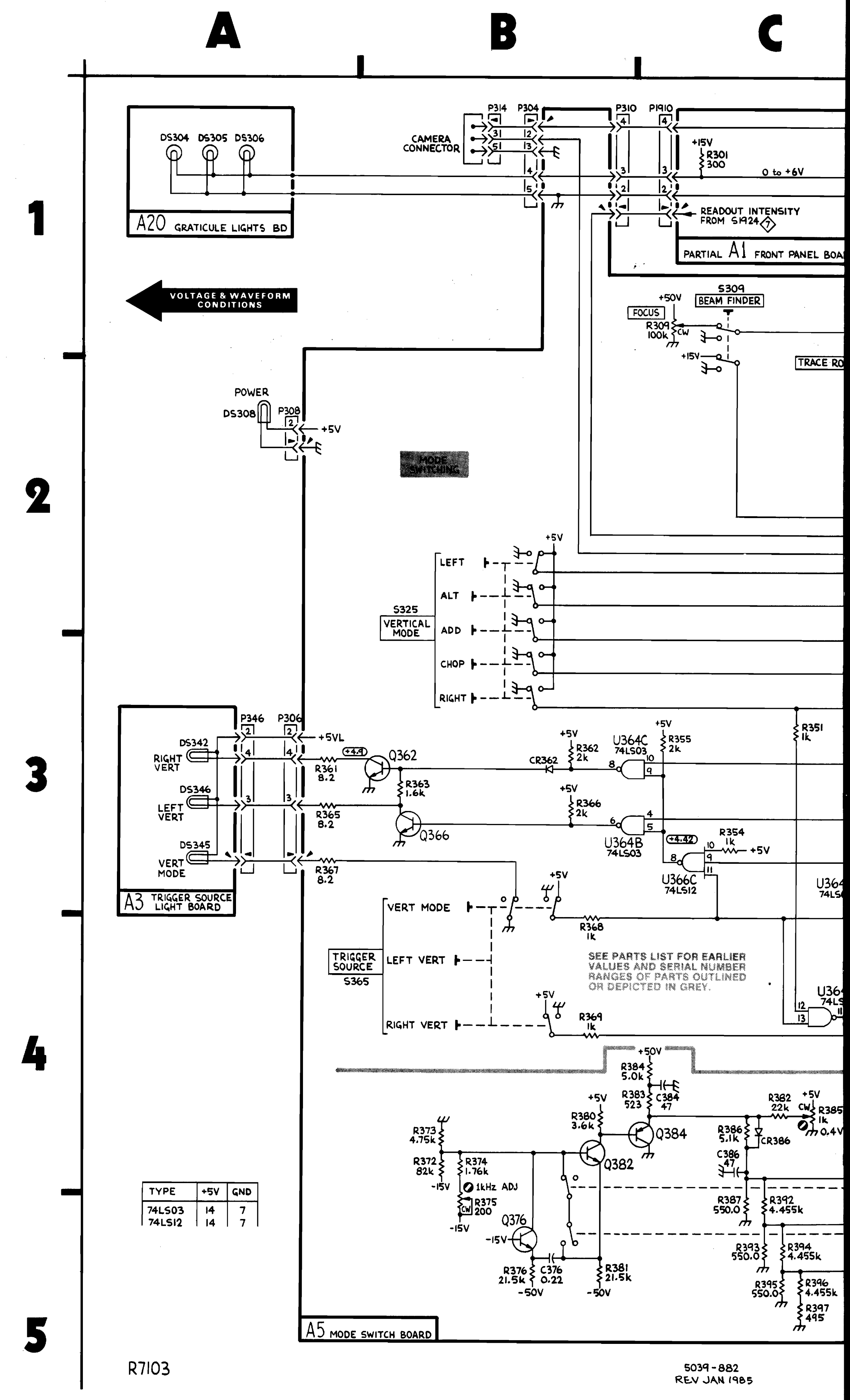
No plug-in units were installed.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



TYPE	+5V	GND
74LS03	14	7
74LS12	14	7

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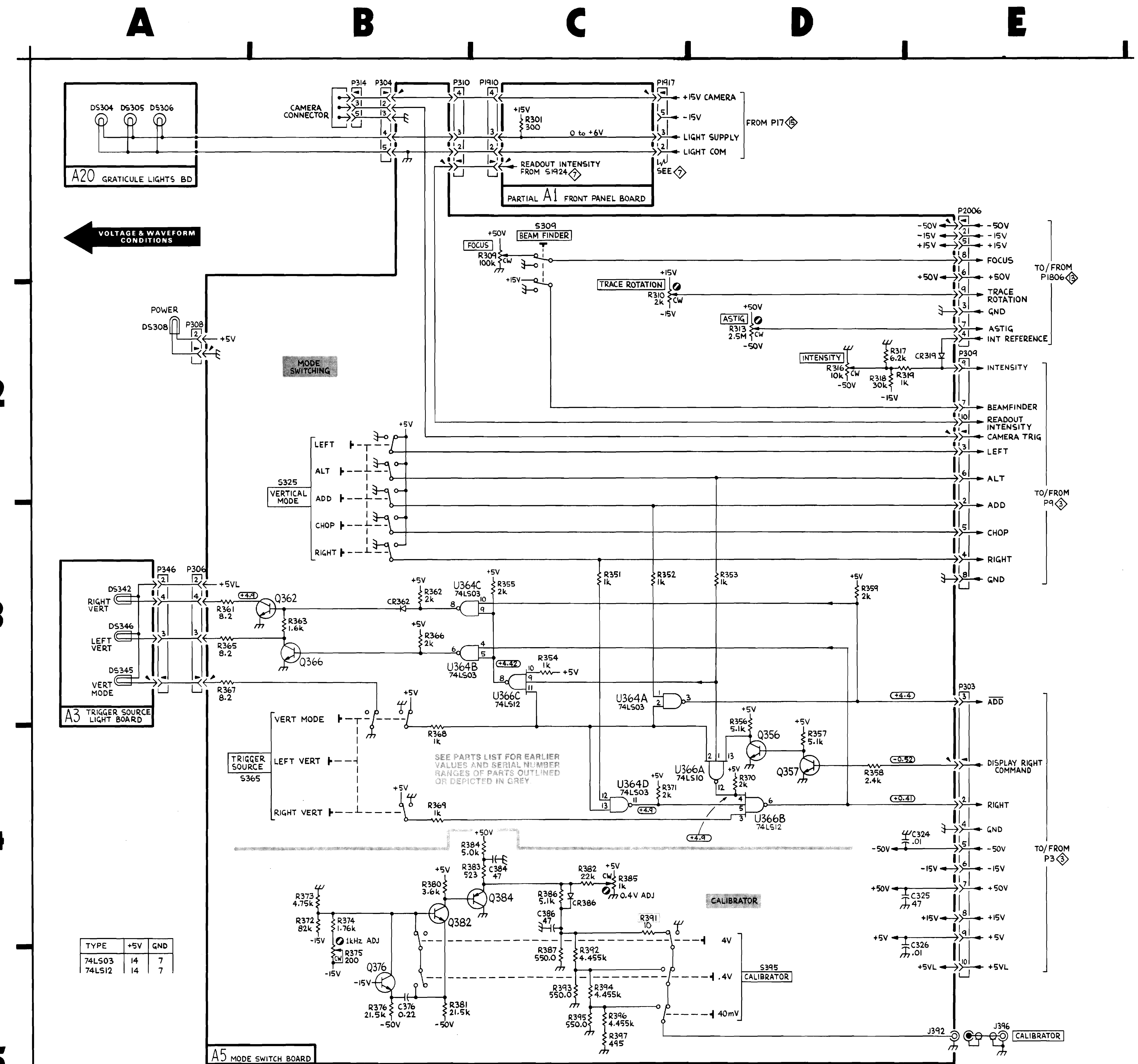
234
Schematic Circuit Number
d)
no Assembly Number
ectrical Parts List.



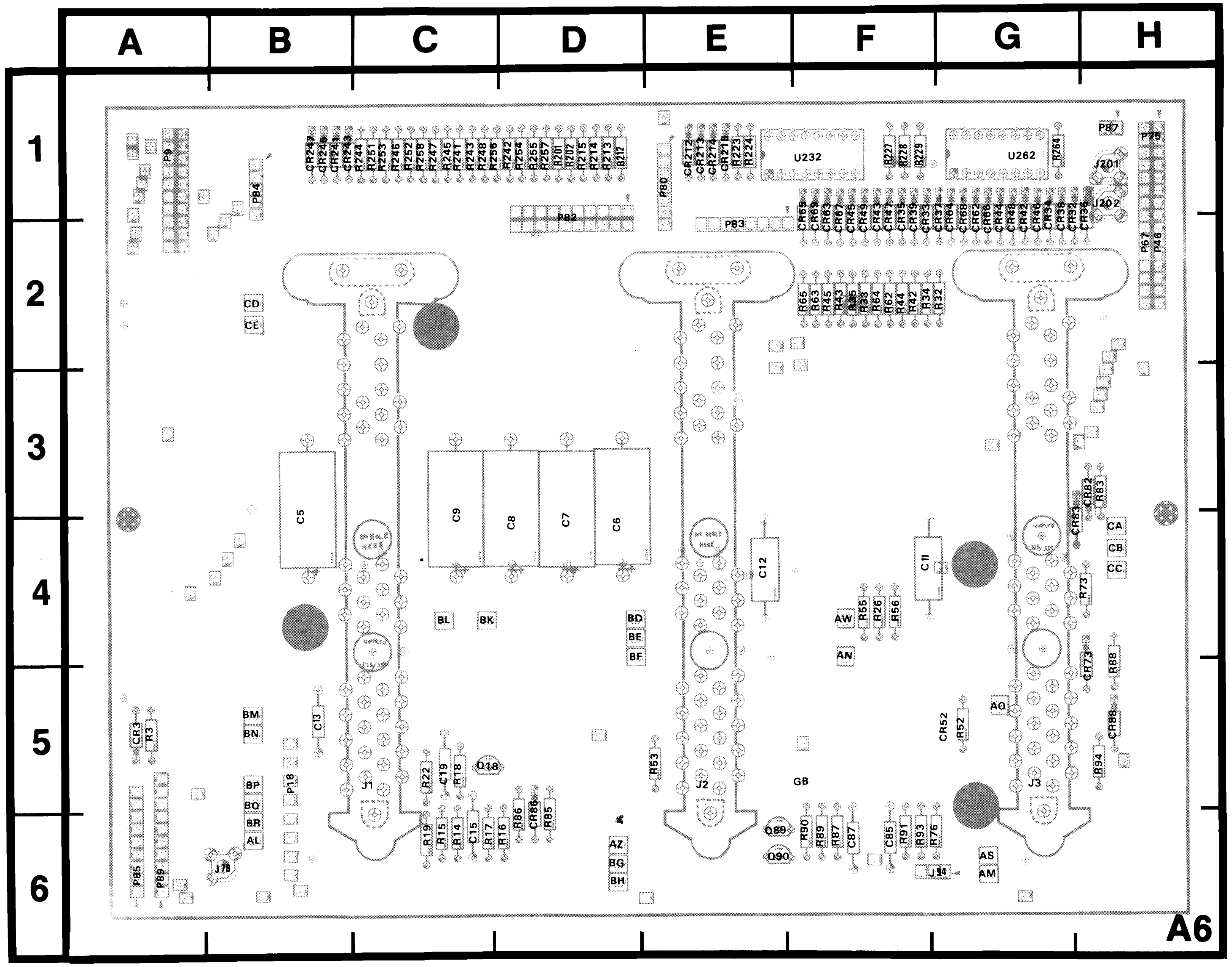
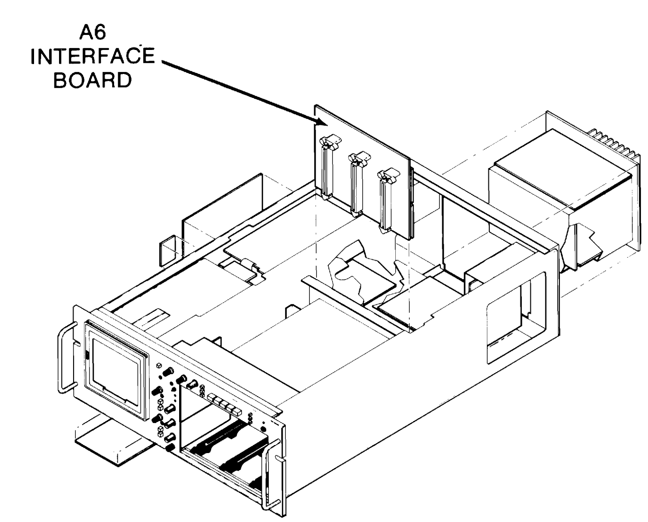


Figure 8-5. A6—Interface Board assembly.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

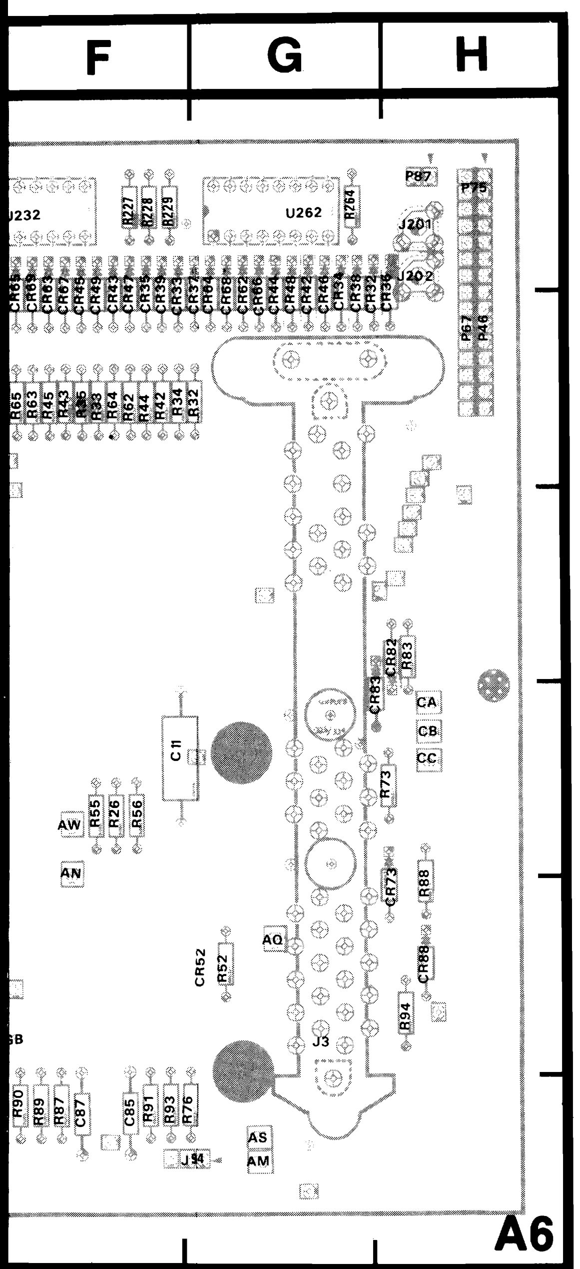
Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Assembly A6 & component locator



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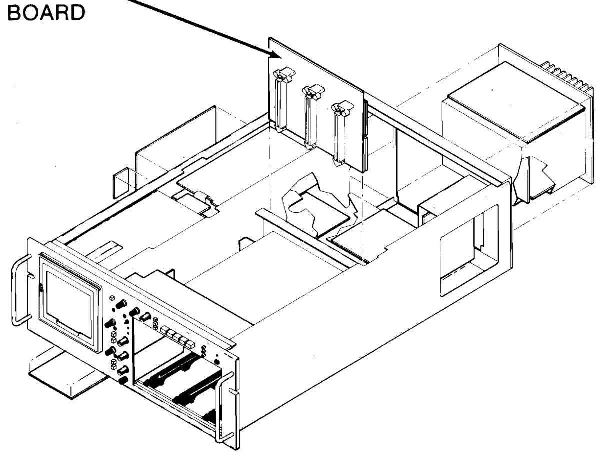

MAIN INTERFACE DIAGRAM 3

ASSEMBLY A6

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C5	3A	3B	CR66	1F	1G	R17	1B	6C
C6	3A	4D	CR67	1F	1F	R18	1B	5C
C7	3A	4D	CR68	1F	1G	R19	1B	6C
C8	3A	4D	CR69	1F	1F	R22	4C	5C
C9	3A	3C	CR73	3E	5H	R26	4C	4F
C11	3A	4F	CR82	2F	3H	R32	1C	2G
C12	3A	4E	CR83	2F	4G	R33	1C	2F
C13	3A	5B	CR86	5F	6D	R34	1C	2F
C15	1A	6C	CR88	2F	5H	R35	1C	2F
C19	1B	5C				R42	1D	2F
C85	5F	6F	J1	1C	5C	R43	1D	2F
C87	2F	6F	J2	1D	5E	R44	1D	2F
			J3	1E	5G	R45	1D	2F
CR3	2A	5A	J78	2G	6B	R52	4E	5G
CR32	1C	1G	J94	3F	6G	R53	4D	5E
CR33	1C	1F				R55	4D	4F
CR34	1C	1G	P9	5C	1A	R56	4E	4F
CR35	1C	1F	P67	1A	2H	R62	1E	2F
CR36	1C	1H	P75	5E	1H	R63	1F	2F
CR37	1C	1G	P80	4G	1E	R64	1F	2F
CR38	1C	1G	P82	3A	1D	R65	1E	2F
CR39	1C	1F	P83	4A	2E	R73	2F	4H
CR42	1D	1G	P84	2G	1B	R76	4F	6F
CR43	1D	1F	P85	4A	6A	R83	2F	3H
CR44	1E	1G	P87	2G	1H	R85	5F	6D
CR45	1E	1F	P89	2A	6A	R86	5F	6D
CR46	1D	1G				R87	2F	6F
CR47	1D	1F	Q18	1B	5C	R88	2F	5H
CR48	1E	1G	Q89	2F	6E	R89	2F	6F
CR49	1E	1F	Q90	2F	6E	R90	2F	6F
CR52	3E	5G				R91	4F	6F
CR62	1F	1G	R3	2A	5A	R93	4F	6F
CR63	1F	1F	R14	1A	6C	R94	2F	5H
CR64	1F	1G	R15	1A	6C	R58	3E	**
CR65	1F	1F	R16	1A	6D	R59	3E	**

Partial A6 also shown on diagram 6.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J81	2G	CHASSIS	J83	3G	CHASSIS

**Board Not Shown

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234
Schematic Circuit Number
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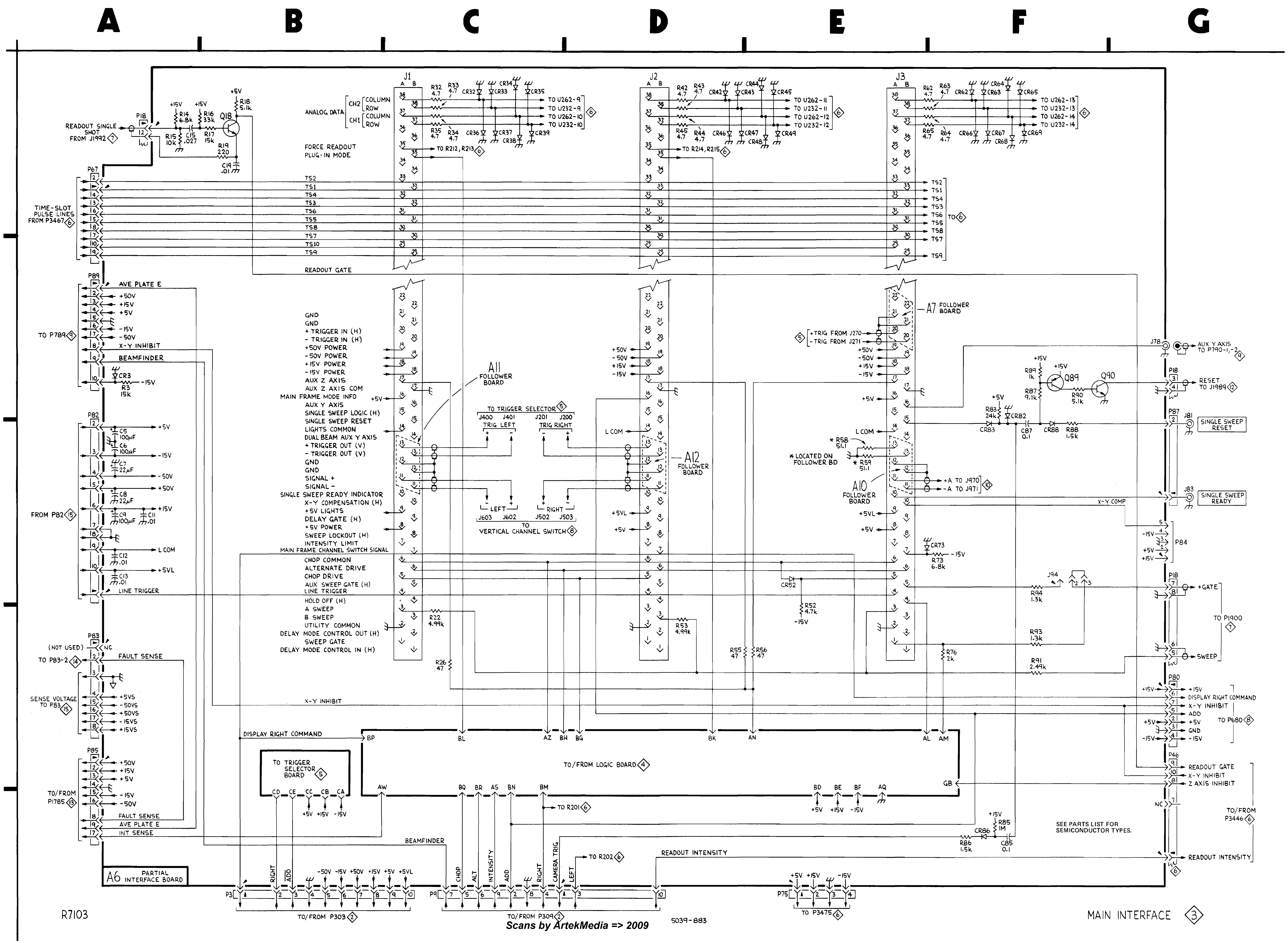
no Assembly Number
ectrical Parts List.



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Main Interface

Reverse Side A13

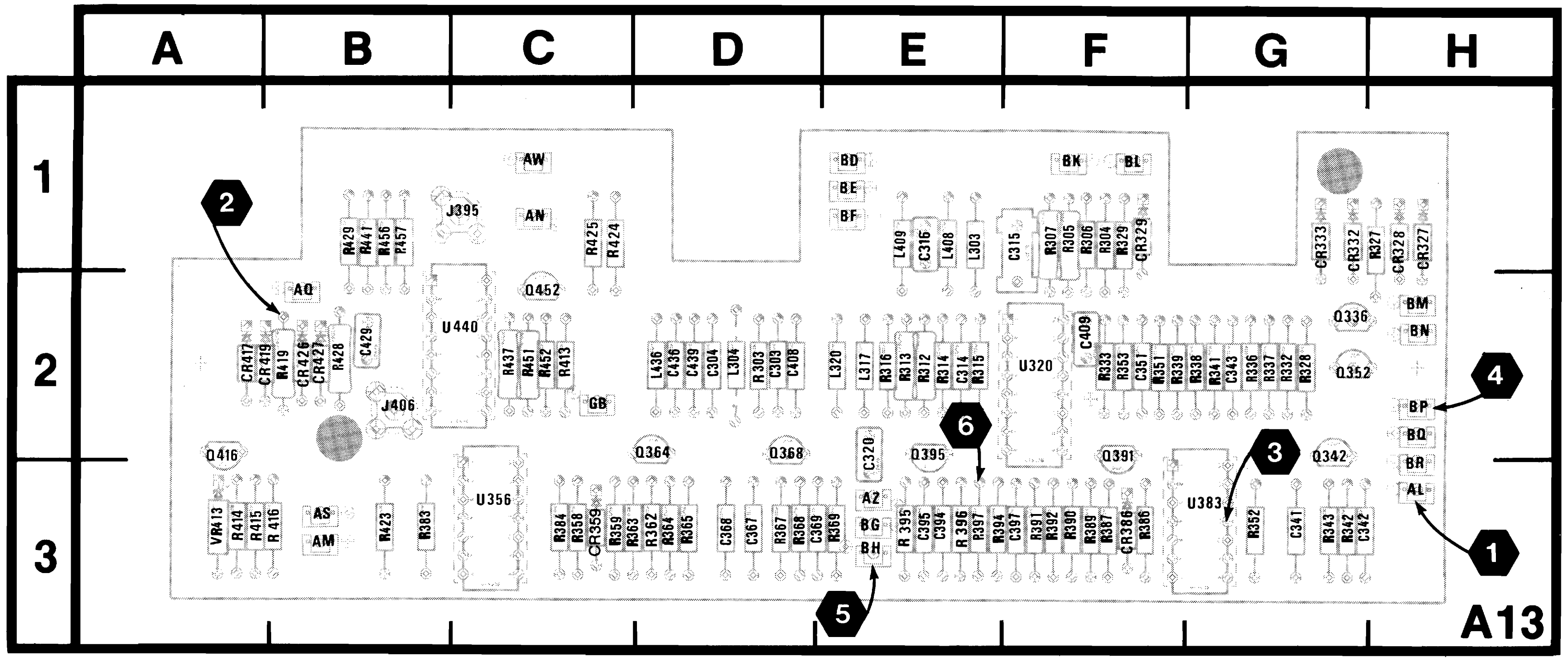

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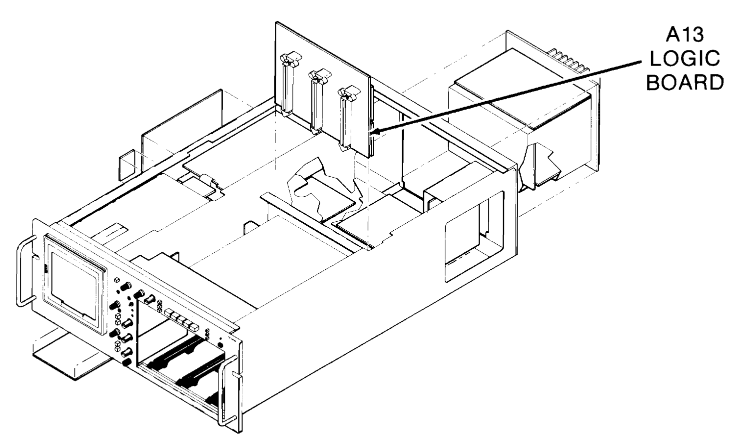
Figure 8-6. A13—Logic Board assembly.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Assembly A13 & component locator

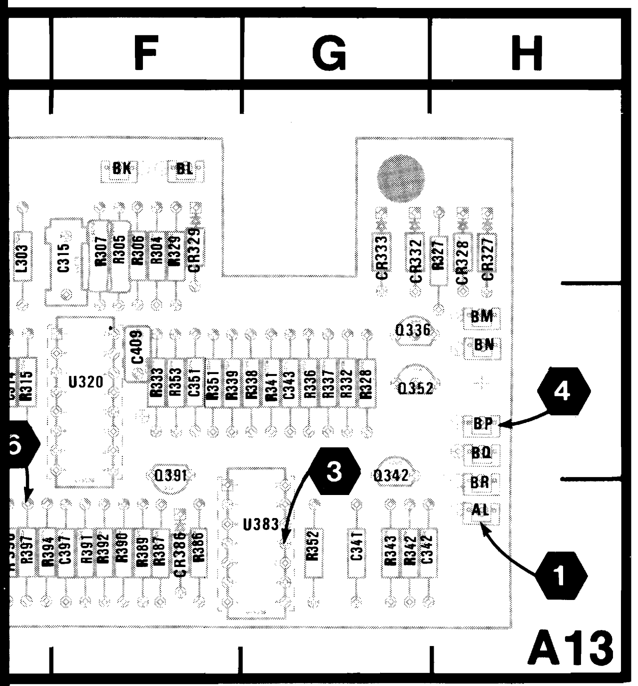
LOGIC DIAGRAM

ASSEMBLY A13

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
C303	2A	2D	L409	3A
C304	2B	2D	L436	3C
C314	3B	2E		
C315	3C	1F	Q336	1E
C316	3B	1E	Q342	1F
C320	2B	2E	Q352	2D
C341	1F	3G	Q364	2E
C342	1F	3G	Q368	2F
C343	1F	2G	Q391	3E
C351	2D	2F	Q395	3E
C367	2F	3D	Q416	3B
C368	2F	3D	Q452	4C
C369	2F	3D		
C394	3E	3E	R303	2B
C395	2E	3E	R304	2A
C397	3E	3F	R305	2A
C408	3A	2D	R306	2B
C409	3A	2F	R307	2B
C429	4B	2B	R312	3B
C436	3C	2D	R313	3B
C439	3C	2D	R314	3B
			R315	3C
CR327	1D	1H	R316	3B
CR328	1D	1H	R327	1C
CR329	1D	1F	R328	1C
CR332	1D	1G	R329	1D
CR333	1D	1G	R332	1D
CR359	2E	3C	R333	1D
CR386	2D	3F	R336	1E
CR417	3B	2A	R337	1E
CR419	3B	2A	R338	1E
CR426	4B	2B	R339	1E
CR427	4B	2B	R341	1F
			R342	1F
J395	4A	1C	R343	1F
J406	3D	2B	R351	1D
			R352	1D
L303	2A	1E	R353	2D
L304	2B	2D	R358	2E
L317	3B	2E	R359	2E
L320	2B	2E	R362	2E
L408	3A	1E	R363	2E

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J95	4A	CHASSIS



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A13
LOGIC
BOARD

LOGIC DIAGRAM ⟨4⟩

ASSEMBLY A13

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C303	2A	2D	L409	3A	1E	R364	2E	3D
C304	2B	2D	L436	3C	2D	R365	2E	3D
C314	3B	2E				R367	2F	3D
C315	3C	1F	Q336	1E	2G	R368	2F	3D
C316	3B	1E	Q342	1F	2G	R369	2F	3E
C320	2B	2E	Q352	2D	2G	R383	2C	3B
C341	1F	3G	Q364	2E	2D	R384	2C	3C
C342	1F	3G	Q368	2F	2D	R386	2D	3F
C343	1F	2G	Q391	3E	2F	R387	2E	3F
C351	2D	2F	Q395	3E	2E	R389	2D	3F
C367	2F	3D	Q416	3B	2A	R390	3D	3F
C368	2F	3D	Q452	4C	2C	R391	2E	3F
C369	2F	3D				R392	3E	3F
C394	3E	3E	R303	2B	2D	R394	3E	3E
C395	2E	3E	R304	2A	1F	R395	2E	3E
C397	3E	3F	R305	2A	1F	R396	3E	3E
C408	3A	2D	R306	2B	1F	R397	3E	3E
C409	3A	2F	R307	2B	1F	R413	3A	2C
C429	4B	2B	R312	3B	2E	R414	3B	3A
C436	3C	2D	R313	3B	2E	R415	3B	3A
C439	3C	2D	R314	3B	2E	R416	3B	3B
			R315	3C	2E	R419	3B	2B
CR327	1D	1H	R316	3B	2E	R423	4A	3B
CR328	1D	1H	R327	1C	1H	R424	4A	1C
CR329	1D	1F	R328	1C	2G	R425	4A	1C
CR332	1D	1G	R329	1D	1F	R428	4B	2B
CR333	1D	1G	R332	1D	2G	R429	4B	1B
CR359	2E	3C	R333	1D	2F	R437	3D	2C
CR386	2D	3F	R336	1E	2G	R441	3C	1B
CR417	3B	2A	R337	1E	2G	R451	4C	2C
CR419	3B	2A	R338	1E	2G	R452	4C	2C
CR426	4B	2B	R339	1E	2F	R456	4C	1B
CR427	4B	2B	R341	1F	2G	R457	4C	1B
			R342	1F	3G			
J395	4A	1C	R343	1F	3G	U320	2B	2F
J406	3D	2B	R351	1D	2F	U356A	2D	3C
			R352	1D	3G	U356B	2E	3C
L303	2A	1E	R353	2D	2F	U383A	2D	3G
L304	2B	2D	R358	2E	3C	U383B	2C	3G
L317	3B	2E	R359	2E	3C	U440	4D	2C
L320	2B	2E	R362	2E	3D			
L408	3A	1E	R363	2E	3C	VR413	3B	3A

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J95	4A	CHASSIS

VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

Set the R7103 as follows:

INTENSITY	Fully counterclockwise (off)
FOCUS	Fully counterclockwise
READOUT	Fully counterclockwise (off)
GRAT ILLUM	Fully counterclockwise (off)
VERTICAL MODE	LEFT
TRIGGER SOURCE	VERT MODE

No plug-in units are to be installed when measuring voltages.

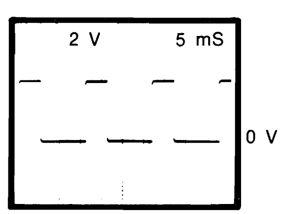
Waveform Conditions: Use a TEKTRONIX 7704A Oscilloscope with a 7A26 Dual Trace Amplifier and a 7B80 Time Base, or equivalent.

Install a 7A18A Dual Trace Amplifier in the R7103 LEFT VERT plug-in compartment and a 7B15 Delaying Time Base in the R7103 HORIZ plug-in compartment.

Set the R7103 and its plug-in units as follows:

INTENSITY, FOCUS	Set to produce clear, well-defined display of low-to-medium brightness.
CALIBRATOR	
4 V	Pressed in.
READOUT	For clear, well-defined readout display.
VERTICAL MODE	LEFT
TRIGGER SOURCE	VERT MODE
Left Vertical Plug-In Unit (7A18A)	
Volts/Div	1
Horizontal Plug-In Unit (7B15)	
Time/Div	1 ms
Trigger Mode	Auto

1



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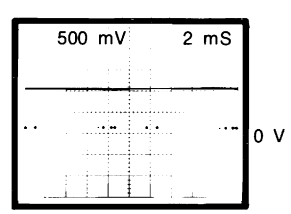
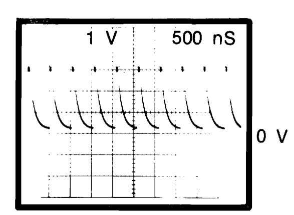
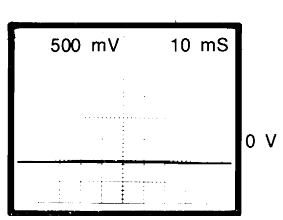


3



4



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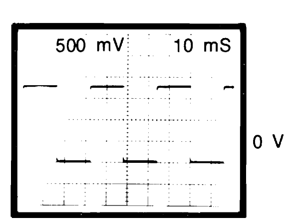

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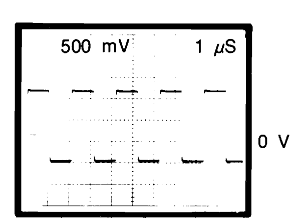
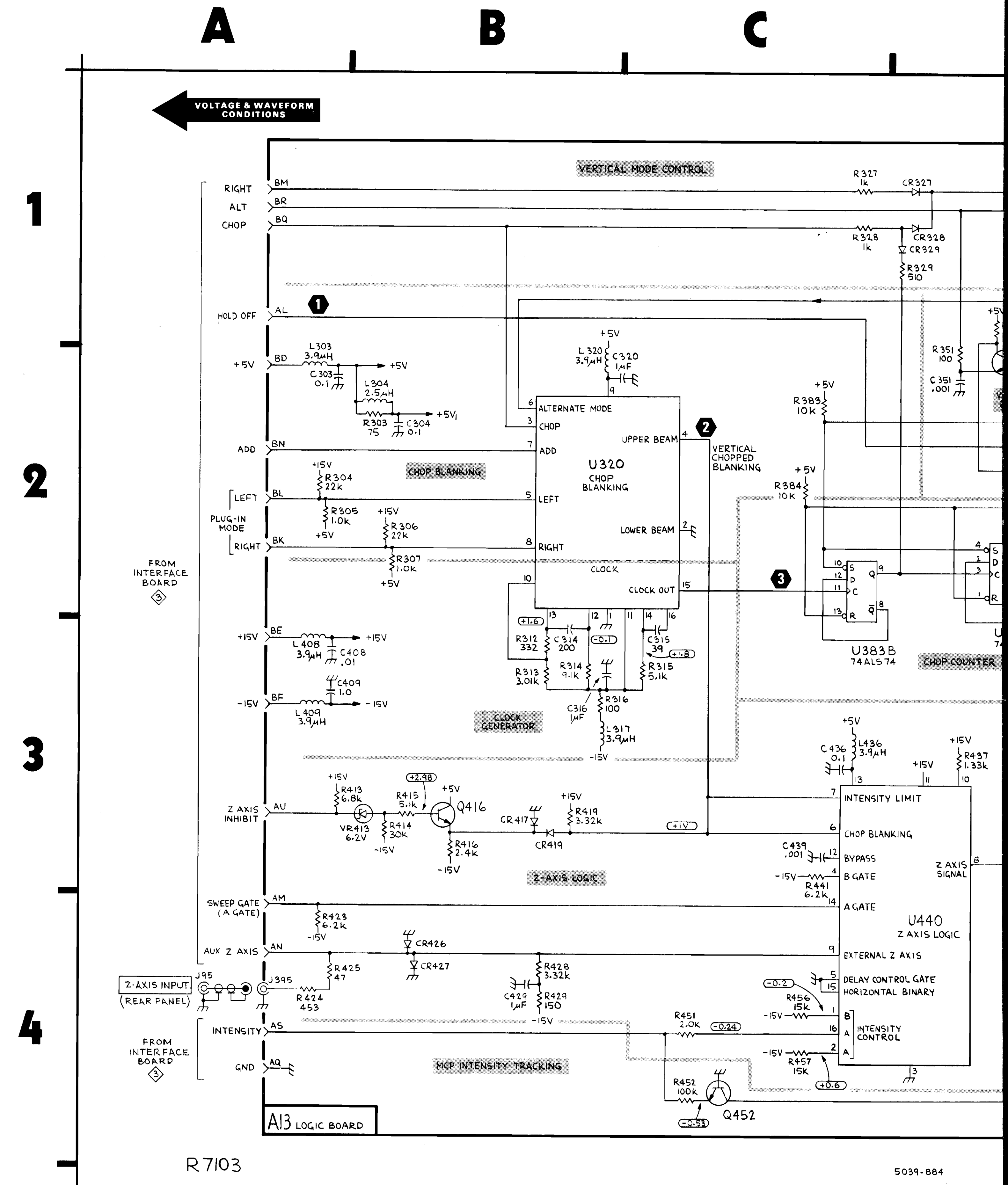


Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

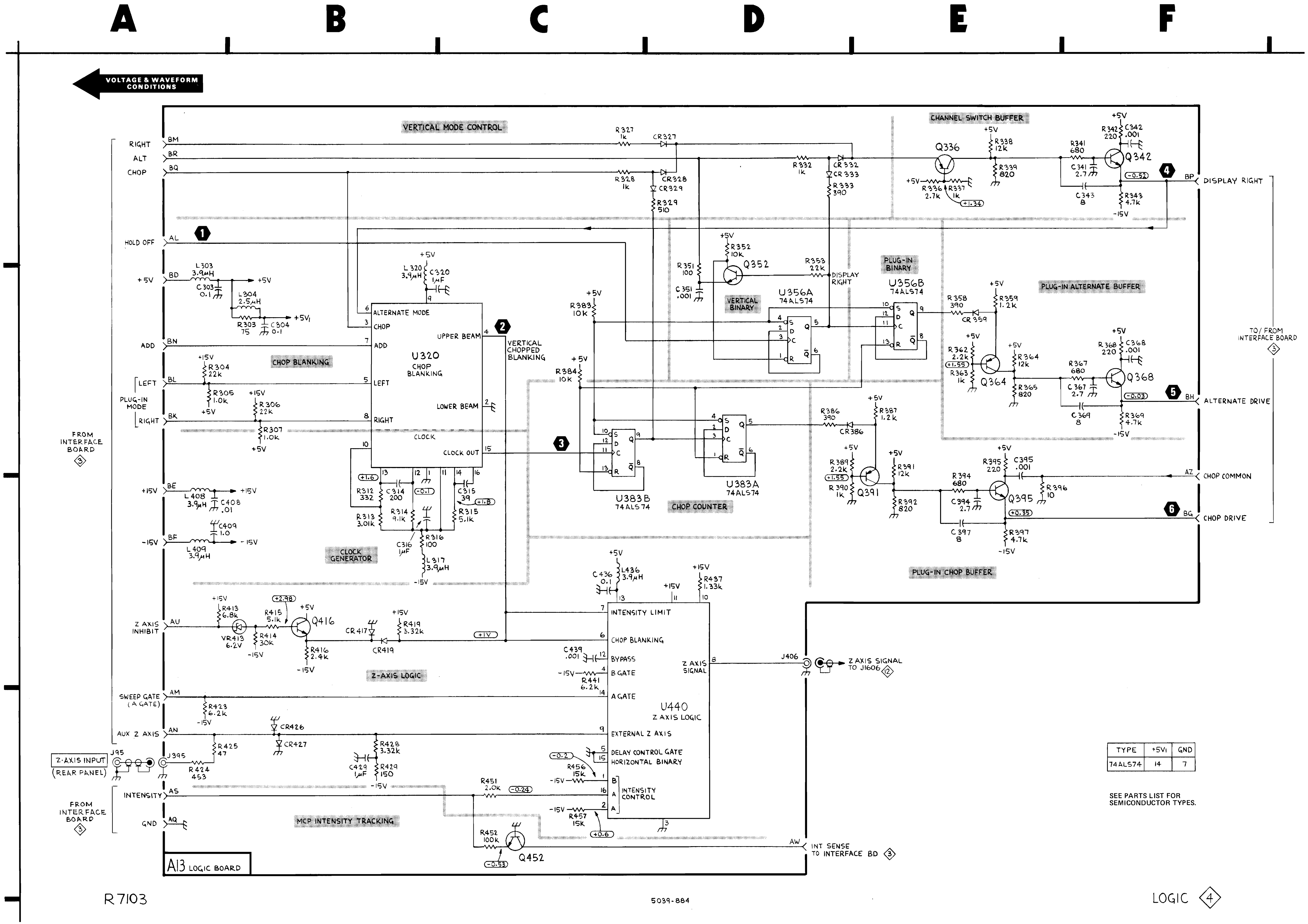
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



Multimeter
a readout-

ne Base, or

Base in the



TYPE	+5Vi	GND
74ALS74	14	7

R7103

5039-884

Sensitive Devices
Maintenance Section
NUMBER EXAMPLE
Component Number
A2 R1234
Subassembly Number (if used)
Schematic Circuit Number
Components have no Assembly Number
Replaceable Electrical Parts List.

Assembly A14 & component locator

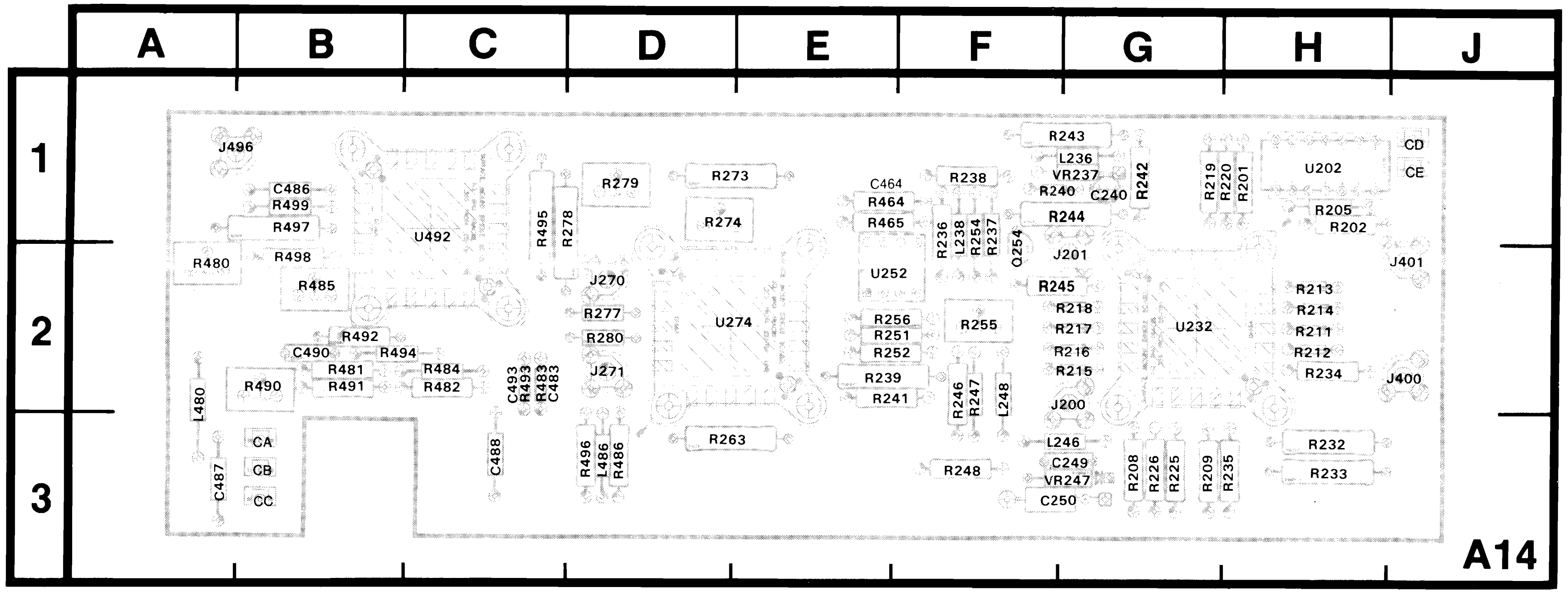
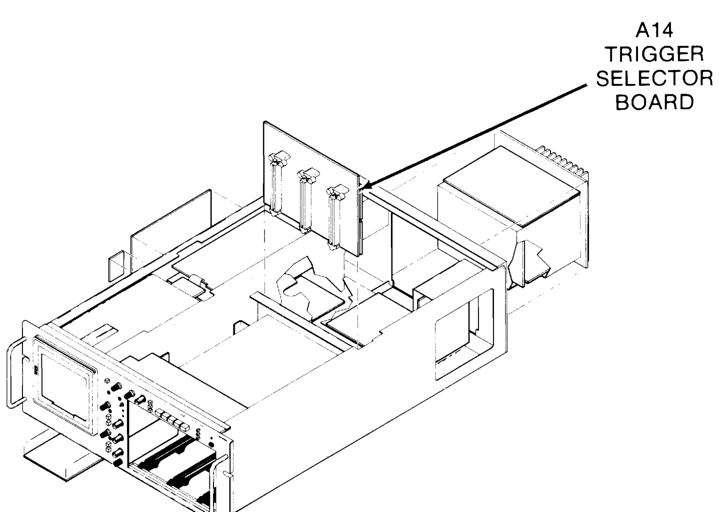


Figure 8-7. A14—Trigger Selector Board assembly.

5039-807B



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number

Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List

TRIGGER SELECTOR DIA

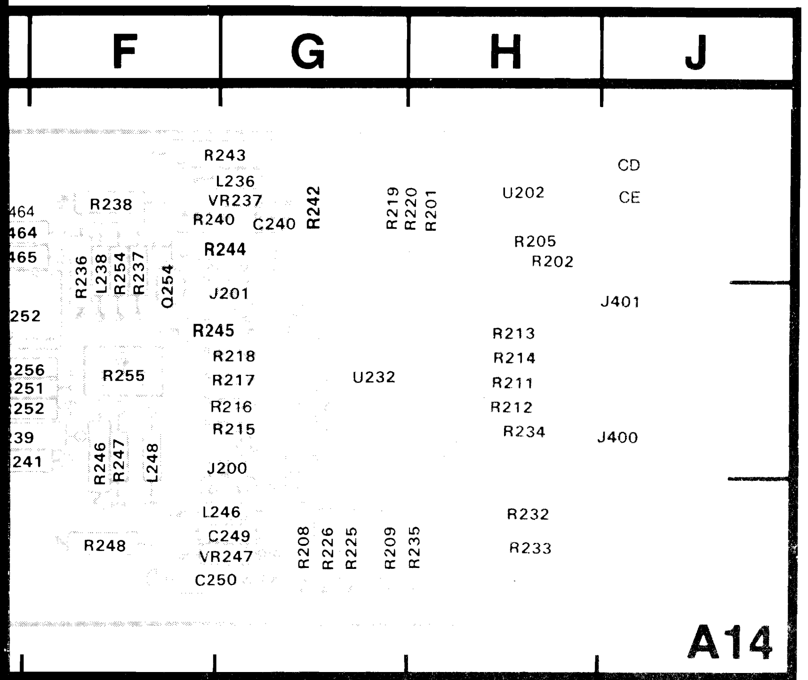
ASSEMBLY A14

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C240	1D	1G
C249	2D	3G
C250	3D	3F
C254	C2	2F
C464 *	3E	1E
C483	3D	2C
C486	4C	1B
C487	4C	3A
C488	4C	3C
C490	4E	2B
C493	4D	2C
J200	2A	2G
J201	3A	2G
J270	1F	2D
J271	3F	2D
J400	1A	2J
J401	1A	2J
J496	4F	1A
L236	2D	1G
L238	2D	1F
L246	2D	3G
L248	2D	2F
L480	4D	2A
L486	4D	3D
Q254	2C	1F
R201	2A	1H
R202	2A	1H
R205	2A	1H
R208	2B	3G
R209	2B	3G
R211	1A	2H
R212	1A	2H

CIRCUIT NUMBER	SCHEM LOCATION	BO LOC
R213	1A	
R214	1A	
R215	2A	
R216	2A	
R217	3A	
R218	3A	
R219	2B	
R220	2B	
R225	2B	
R226	2B	
R232	1C	
R233	1B	
R234	1B	
R235	1C	
R236	2C	
R237	2D	
R238	2D	
R239	2C	
R240	1D	
R241	2C	
R242	3C	
R243	3B	
R244	3B	
R245	3C	
R246	2C	
R247	2D	
R248	2D	
R251	2D	
R252	2D	
R254	2C	
R255	2D	
R256	2D	
R263	2D	
R273	1E	
R274	1E	
R277	2E	

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J497	4F	CHASSIS



5039-807B

Board assembly.

A14
TRIGGER
SELECTOR
BOARD

TRIGGER SELECTOR DIAGRAM ⟨5⟩

ASSEMBLY A14

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C240	1D	1G	R213	1A	2H	R278	2F	1C
C249	2D	3G	R214	1A	2H	R279	2F	1D
C250	3D	3F	R215	2A	2G	R280	2E	2D
C254	C2	2F	R216	2A	2G	R464	3E	1E
C464*	3E	1E	R217	3A	2G	R465	3E	1E
C483	3D	2C	R218	3A	2G	R480	4D	2A
C486	4C	1B	R219	2B	1G	R481	4E	2B
C487	4C	3A	R220	2B	1H	R482	4E	2C
C488	4C	3C	R225	2B	3G	R483	3D	2C
C490	4E	2B	R226	2B	3G	R484	3E	2C
C493	4D	2C	R232	1C	3H	R485	4E	2B
			R233	1B	3H	R486	4D	3D
J200	2A	2G	R234	1B	2H	R490	4F	2B
J201	3A	2G	R235	1C	3H	R491	4E	2B
J270	1F	2D	R236	2C	1F	R492	4E	2B
J271	3F	2D	R237	2D	1F	R493	4D	2C
J400	1A	2J	R238	2D	1F	R494	4E	2B
J401	1A	2J	R239	2C	2E	R495	4E	1C
J496	4F	1A	R240	1D	1F	R496	4D	3D
			R241	2C	2E	R497	4F	1B
L236	2D	1G	R242	3C	1G	R498	4F	2B
L238	2D	1F	R243	3B	1G	R499	4F	1B
L246	2D	3G	R244	3B	1F			
L248	2D	2F	R245	3C	2C	U202A	2B	1H
L480	4D	2A	R246	2C	2F	U202B	2A	1H
L486	4D	3D	R247	2D	2F	U232	2C	2G
			R248	2D	3F	U252A	2C	2E
Q254	2C	1F	R251	2D	2E	U252B	3E	2E
			R252	2D	2E	U274	2E	2D
R201	2A	1H	R254	2C	1F	U492	4E	1C
R202	2A	1H	R255	2D	2F			
R205	2A	1H	R256	2D	2E	VR237	1D	1G
R208	2B	3G	R263	2D	3D	VR247	2D	3G
R209	2B	3G	R273	1E	1D			
R211	1A	2H	R274	1E	1D			
R212	1A	2H	R277	2E	2D			

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J497	4F	CHASSIS

*See Parts List for serial number ranges.

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VOLTAGE CONDITIONS

Use a digital voltmeter with a 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series Power Module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltages shown were obtained with all R7103 front-panel variable controls, except INTENSITY and READOUT INTENSITY, set to midrange. INTENSITY and READOUT INTENSITY were set fully counterclockwise (off). Other R7103 front-panel controls were set as follows:

VERTICAL MODE ....LEFT
TRIGGER SOURCE ....VERT MODE

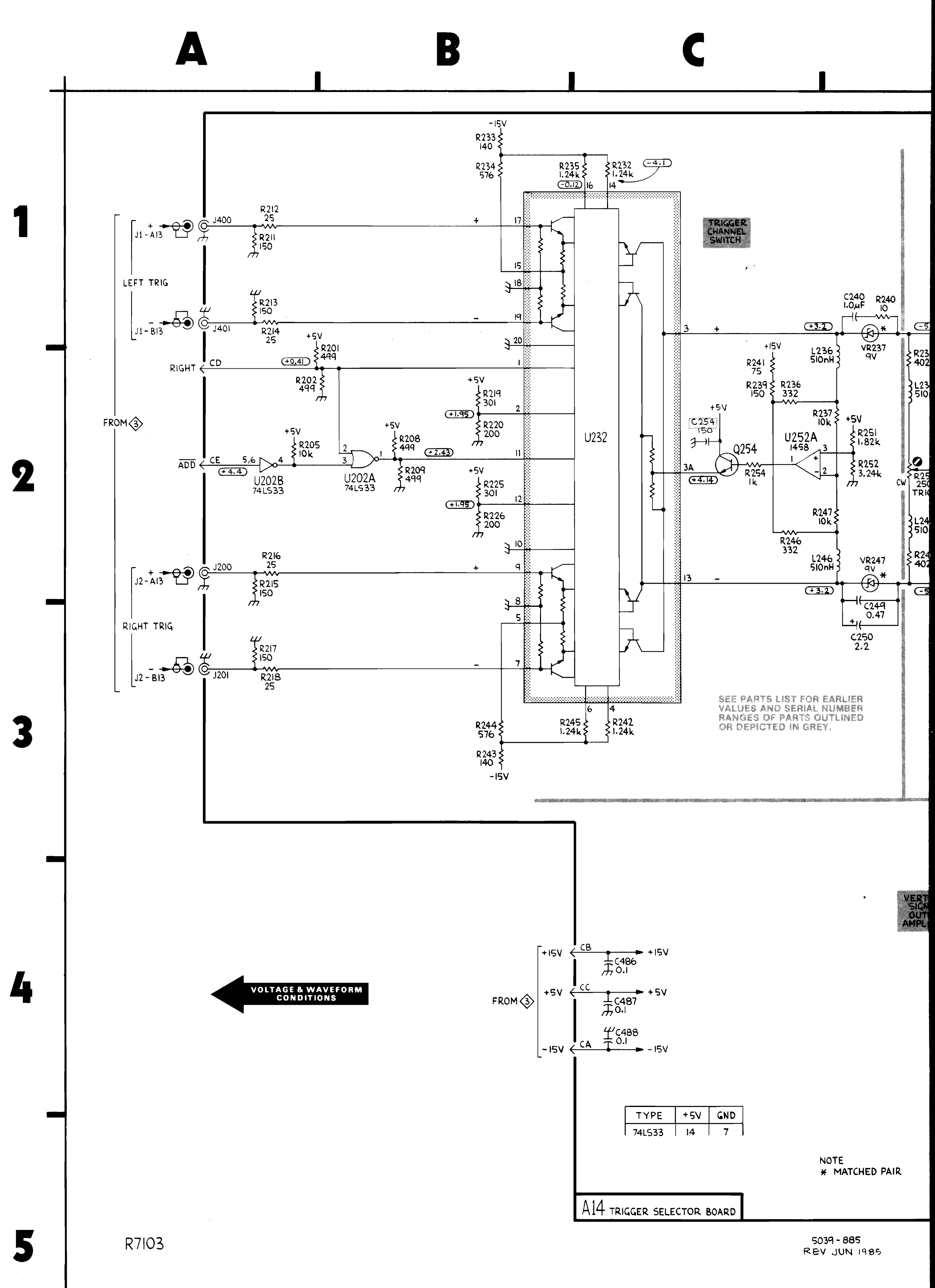
No plug-in units were installed.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

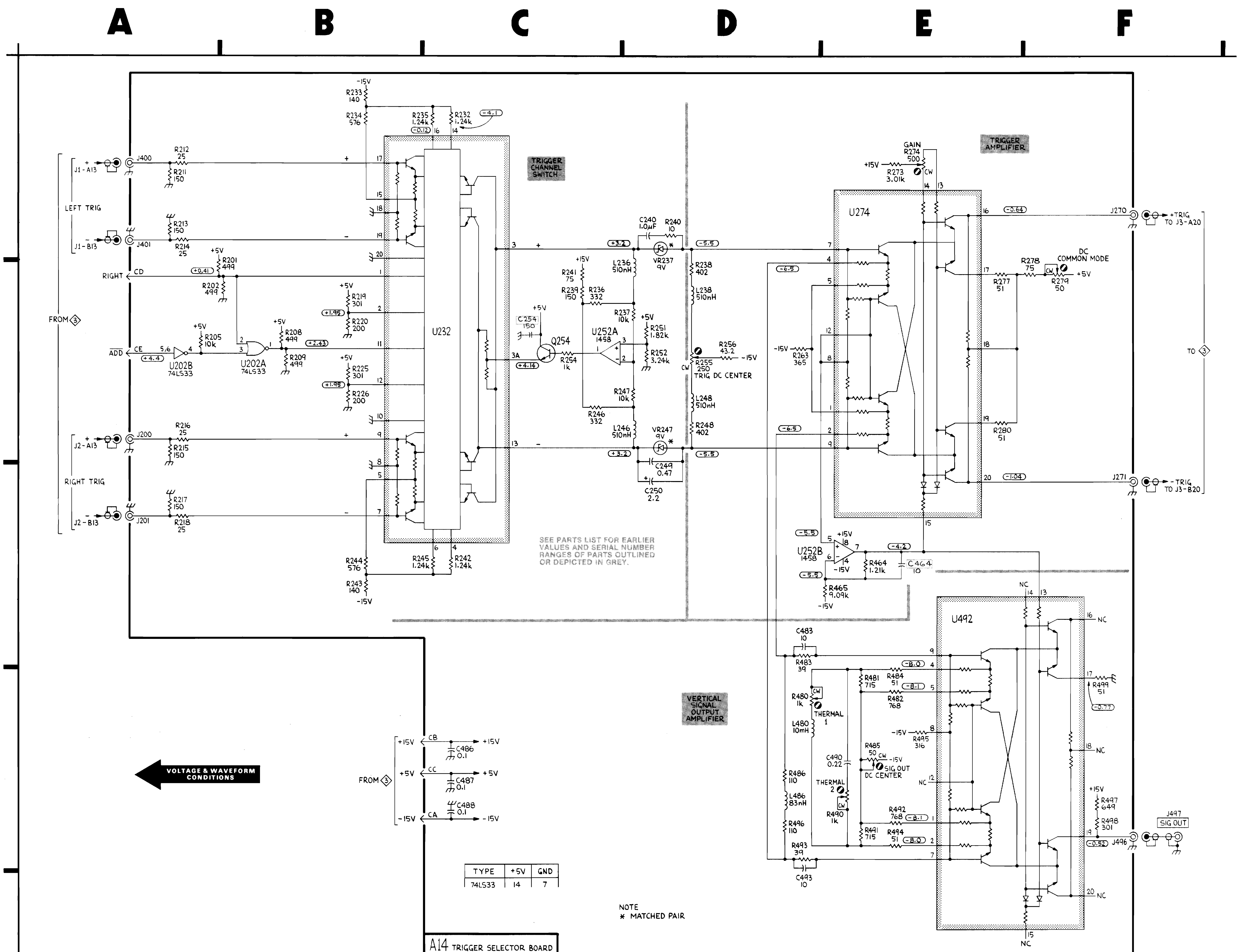
Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



alled in a TM
d 7000-series

INTENSITY,
3 front-panel



sitive Devices
enance Section
MBER EXAMPLE
t Number
R1234
Schematic Circuit Number
mbly (if used)
s have no Assembly Number
ble Electrical Parts List.

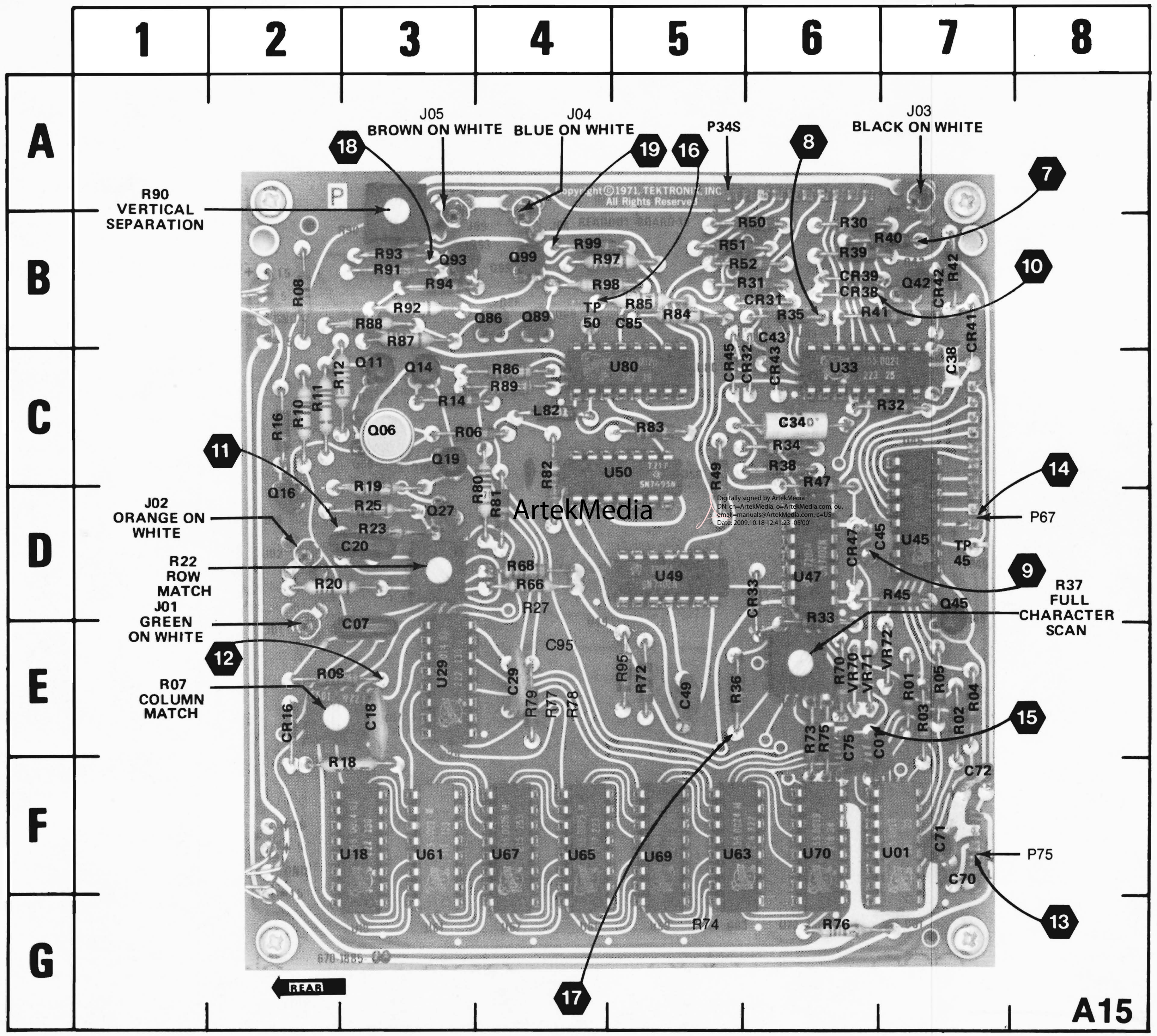
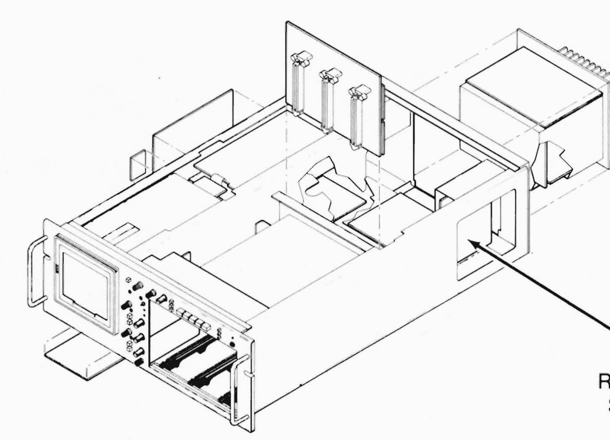


Figure 8-8. A15—Readout System Board assembly.

5039-808

Note: Circuit Numbers on the Readout Board correspond to the last two digits on the schematic. Example U80 on the Readout Board appears as U3480 on the schematic.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

RE

ASSEMBLY A6

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRC NUM
CR00212	4A	1E	J201	4C	1H	R21
CR213	4A	1E	J202	3C	1H	R22
CR214	4A	1E				R22
CR215	4B	1E	R201	4A	1D	R22
CR241	5A	1B	R202	4B	1D	R22
CR243	5B	1B	R212	4A	1D	R22
CR245	5B	1B	R213	4A	1D	R24
CR247	5B	1B	R214	4A	1D	R24

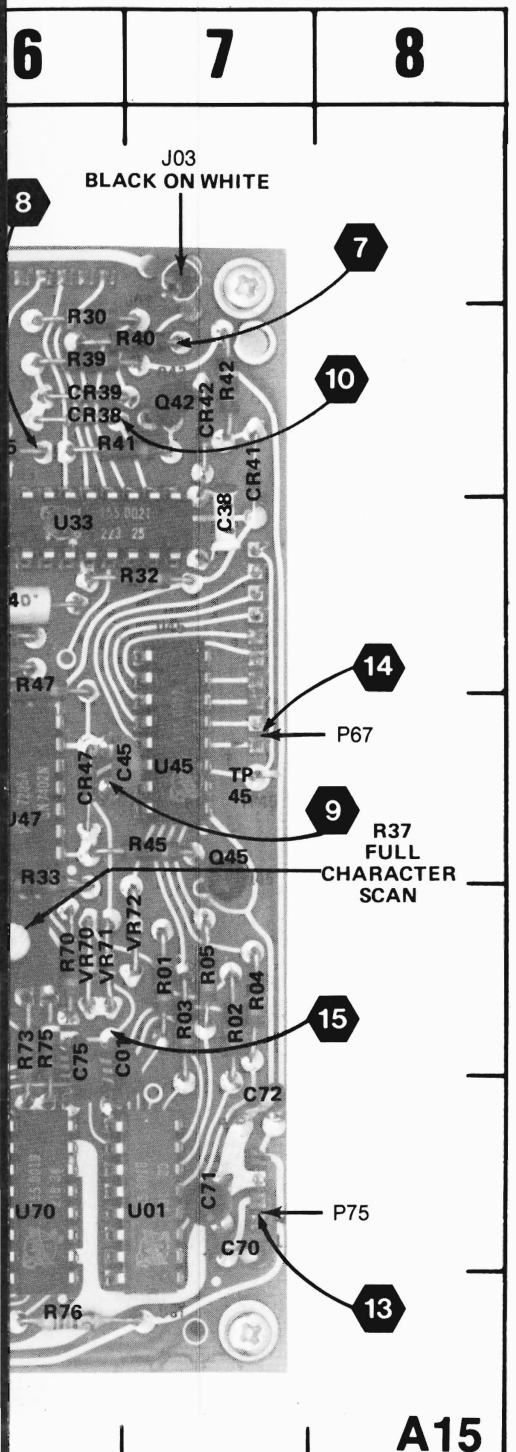
Partial A6 also shown on diagram 3.

ASSEMBLY A15

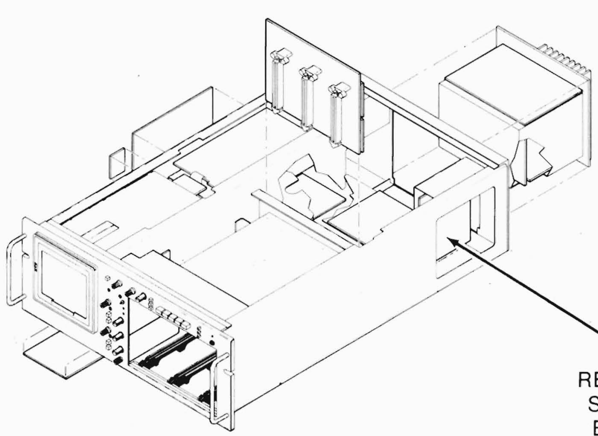
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRC NUM
C1	5D	6E	CR45	2E	5C	R1
C7	4D	3E	CR47	2D	6D	R2
C18	4E	3E				R3
C20	3D	3D	J1	4D	2E	R4
C29	3D	4E	J2	3D	2D	R5
C34	1B	6C	J3	1B	7A	R6
C38	2B	7C	J4	3H	4A	R7
C43	1D	5B	J5	2H	3A	R8
C45	2C	5D				R9
C49	1A	5E	L82	3G	4C	R10
C70	5F	7F				R11
C71	5F	7F	P67	1H	7D	R12
C72	5F	7F	P75	5F	7F	R14
C75	3F	6E				R16
C85	3F	5C	Q6	4D	3C	R18
C95	2G	4E	Q11	4E	3C	R19
			Q14	4E	3C	R20
CR16	4E	2E	Q16	4E	2D	R22
CR31	2A	6B	Q19	5E	3C	R23
CR32	2B	6C	Q27	3D	3D	R25
CR33	1B	6D	Q42	1D	7B	R27
CR38	2B	6B	Q45	2E	7D	R30
CR39	2B	6B	Q86	2G	4B	R31
CR41	1C	7B	Q89	3G	4B	R32
CR42	1D	7B	Q93	2G	3B	R33
CR43	1D	6C	Q99	3G	4B	R34

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J30	4G	CHASSIS	J33	4G	CHASSIS



Note: Circuit Numbers on the Readout Board correspond to the last two digits on the schematic. Example U80 on the Readout Board appears as U3480 on the schematic.



READOUT SYSTEM DIAGRAM ⟨6⟩

ASSEMBLY A6

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR00212	4A	1E
CR213	4A	1E
CR214	4A	1E
CR215	4B	1E
CR241	5A	1B
CR243	5B	1B
CR245	5B	1B
CR247	5B	1B
J201	4C	1H
J202	3C	1H
R201	4A	1D
R202	4B	1D
R212	4A	1D
R213	4A	1D
R214	4A	1D
R215	4B	1D
R223	3B	1E
R224	3B	1E
R227	3B	1F
R228	3B	1F
R229	3B	1F
R241	4A	1C
R242	5A	1D
R243	4B	1C
R244	4B	1C
R245	4B	1C
R246	5B	1C
R247	4B	1C
R248	5B	1C
R251	5C	1C
R252	5B	1C
R253	5C	1C
R254	5B	1D
R255	5C	1D
R256	5B	1C
R257	5C	1D
R258	5B	1C
R264	4C	1G
U232	3C	1F
U262	4B	1G

Partial A6 also shown on diagram 3.

ASSEMBLY A15

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1	5D	6E
C7	4D	3E
C18	4E	3E
C20	3D	3D
C29	3D	4E
C34	1B	6C
C38	2B	7C
C43	1D	5B
C45	2C	5D
C49	1A	5E
C70	5F	7F
C71	5F	7F
C72	5F	7F
C75	3F	6E
C85	3F	5C
C95	2G	4E
CR16	4E	2E
CR31	2A	6B
CR32	2B	6C
CR33	1B	6D
CR38	2B	6B
CR39	2B	6B
CR41	1C	7B
CR42	1D	7B
CR43	1D	6C
CR45	2E	5C
CR47	2D	6D
J1	4D	2E
J2	3D	2D
J3	1B	7A
J4	3H	4A
J5	2H	3A
L82	3G	4C
P67	1H	7D
P75	5F	7F
Q6	4D	3C
Q11	4E	3C
Q14	4E	3C
Q16	4E	2D
Q19	5E	3C
Q27	3D	3D
Q42	1D	7B
Q45	2E	7D
Q86	2G	4B
Q89	3G	4B
Q93	2G	3B
Q99	3G	4B
R1	5D	7E
R2	5D	7E
R3	5D	7E
R4	5D	7E
R5	5D	7E
R6	4D	3C
R7	4E	2E
R8	4D	2B
R9	4E	2E
R10	4D	2C
R11	4D	2C
R12	4D	2C
R14	4E	3C
R16	4E	2C
R18	4E	2E
R19	5E	3C
R20	3D	2D
R22	3D	3D
R23	3D	3D
R25	3D	3D
R27	2D	5E
R30	2A	6B
R31	2A	6B
R32	2B	7C
R33	1B	6D
R34	1B	6C
R35	2B	6B
R36	1C	5E
R37	1B	6E
R38	2B	6C
R39	2B	6B
R40	1B	7B
R41	1C	6B
R42	1C	7B
R45	2E	7D
R47	2C	6C
R49	1A	5C
R50	3F	6B
R51	3F	5B
R52	3F	6B
R66	1G	4D
R68	1G	4D
R70	4F	6E
R72	4F	5E
R73	4F	6E
R74	4F	5G
R75	4F	6E
R76	4F	6G
R77	2F	4E
R78	2F	4E
R79	2F	4E
R80	2G	3E
R81	2F	4D
R82	2G	4C
R83	3F	5C
R84	3G	5B
R85	3G	5B
R86	2G	4C
R87	3G	3B
R88	3G	3B
R89	3G	4C
R90	2G	3A
R91	2G	3B
R92	2G	3B
R93	2G	3B
R94	2G	3B
R95	2G	4E
R97	3G	4B
R98	3G	4B
R99	3G	4B
TP45	2E	7D
TP50	3F	4B
U1	5D	7F
U18	4E	3F
U29	3D	3E
U33	1B	6C
U45	2E	7D
U47A	2D	6D
U47B	2D	6D
U47C	2E	6D
U47D	2E	6D
U49A	1A	5D
U49B	1A	5D
U49C	1A	5D
U49D	1A	5D
U50	3E	5C
U61	1D	3F
U63	1E	5F
U65	1E	4F
U67	1F	4F
U69	1F	5F
U70	3F	6F
U80	3G	5C
VR70	4F	6E
VR71	4F	6E
VR72	4F	7E

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J30	4G	CHASSIS
J33	4G	CHASSIS

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VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltages shown on the diagram were obtained with the following plug-in units installed in the R7103 and set as follows:

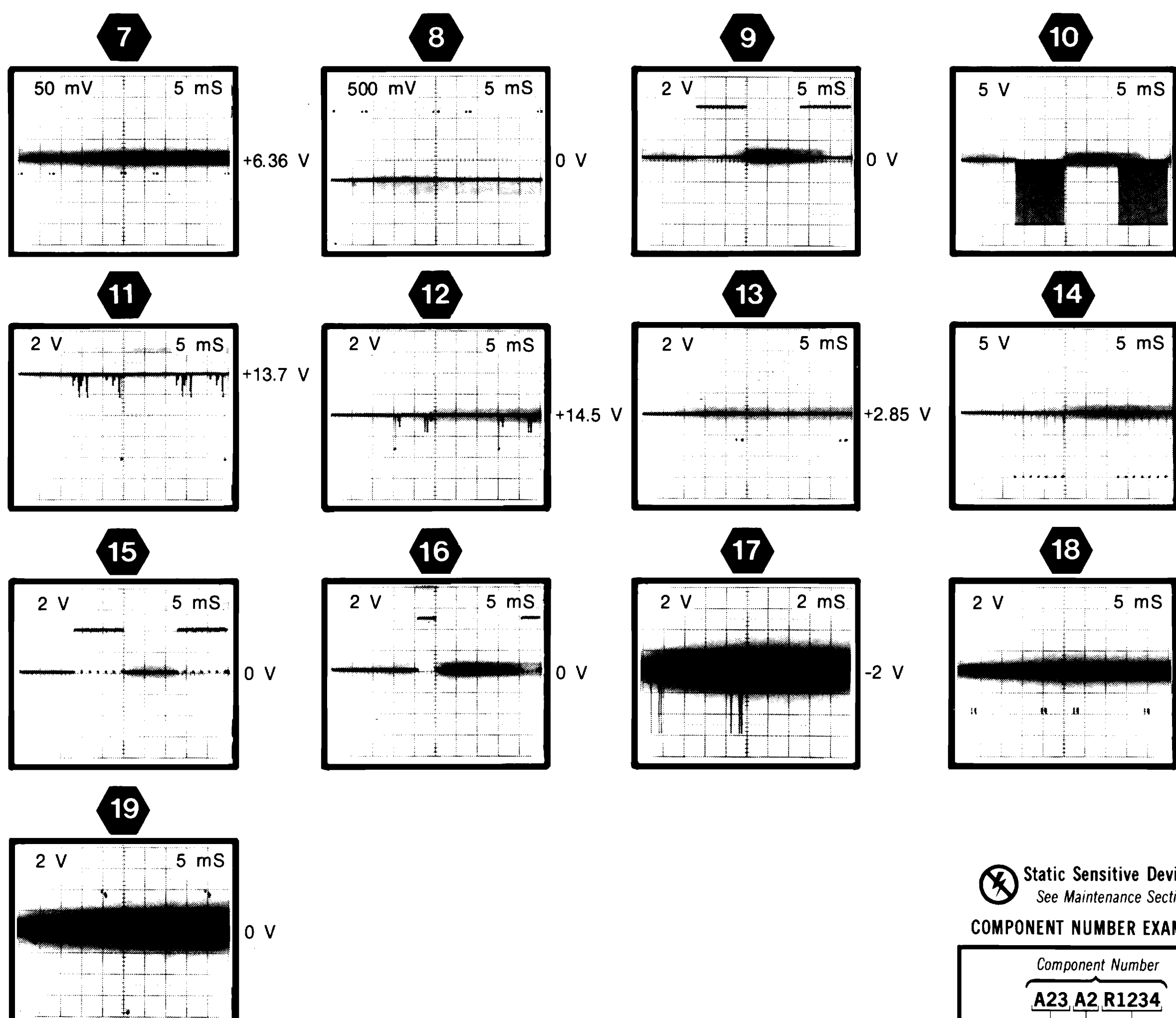
R7103
- INTENSITY .... Fully counter-clockwise (off)
- FOCUS .... Midrange
- READOUT .... Midrange
- GRAT ILLUM .... Midrange
- VERT MODE .... LEFT
- TRIGGER SOURCE .... VERT MODE
- READOUT .... PULSED
  - PULSED +GATE -EXT .... +GATE
  - PRESET .... Set for a read-out of moderate brightness

7A26 (installed in R7103 LEFT VERT)
- Display Mode .... Ch 1
- Volts/Div 1

7B10 (installed in R7103 HORIZ)
- Triggering
  - Mode .... Auto
  - Coupling .... AC
  - Source .... Int
- Time/Div .... 2 ms

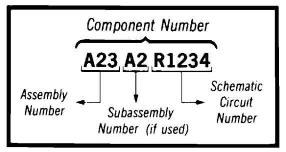
Waveform Conditions: The waveforms shown below were taken with the same plug-in units installed and the same settings as for the Voltage Conditions.

The test oscilloscope (TEKTRONIX 7904, 7B15 Time Base, and 7A13 Differential Comparator with P6053 10X Probe) was externally triggered via a 1X probe connected to TP 3450 on the R7103 A15 Readout System.

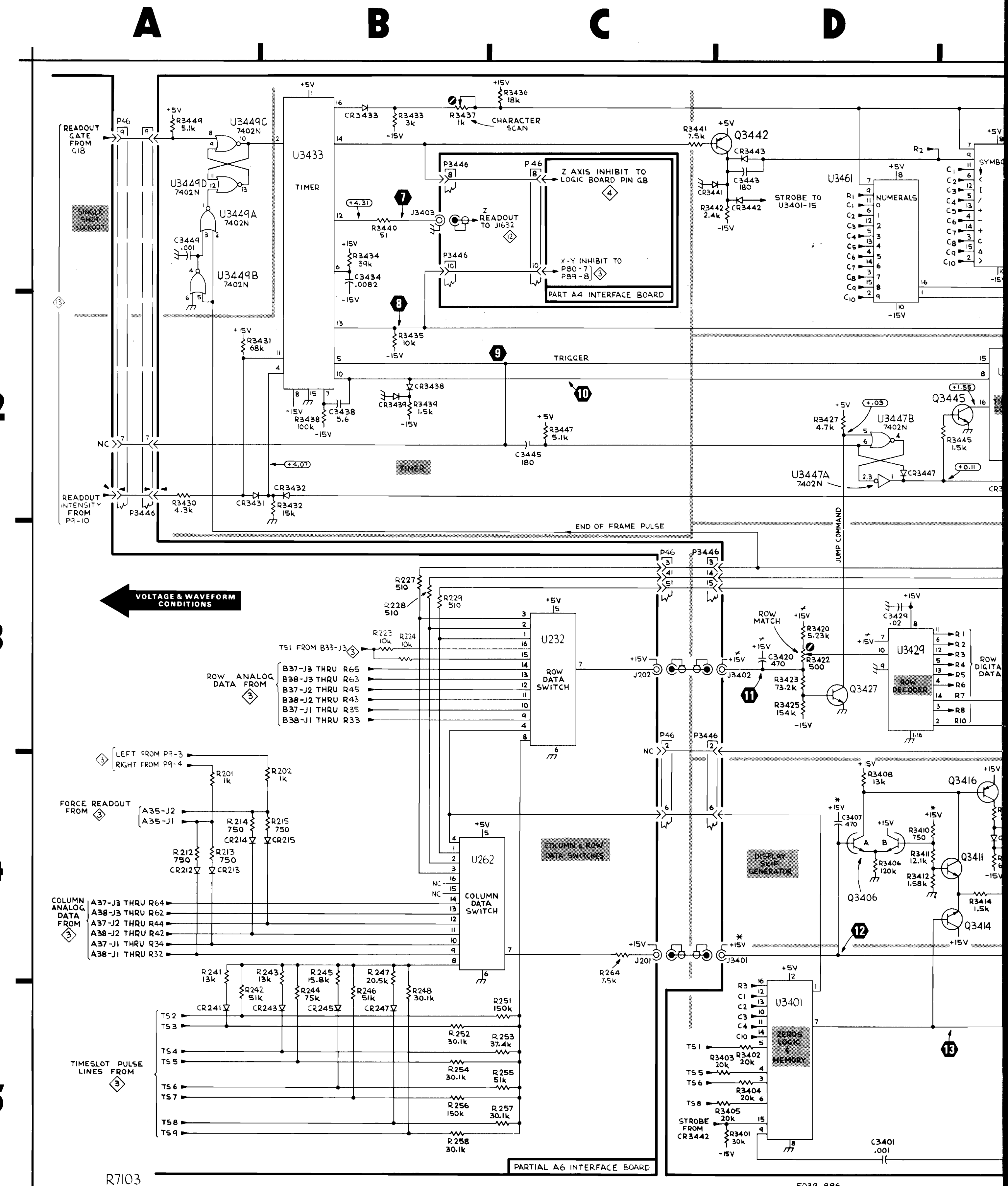


Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



REV JUN 1985

l Multimeter
n a readout-

as follows:

...Ch 1
...1

...Auto
...AC
...Int
...2 ms

settings as

Probe) was

mS 0 V

mS 0 V

mS 0 V

ve Devices
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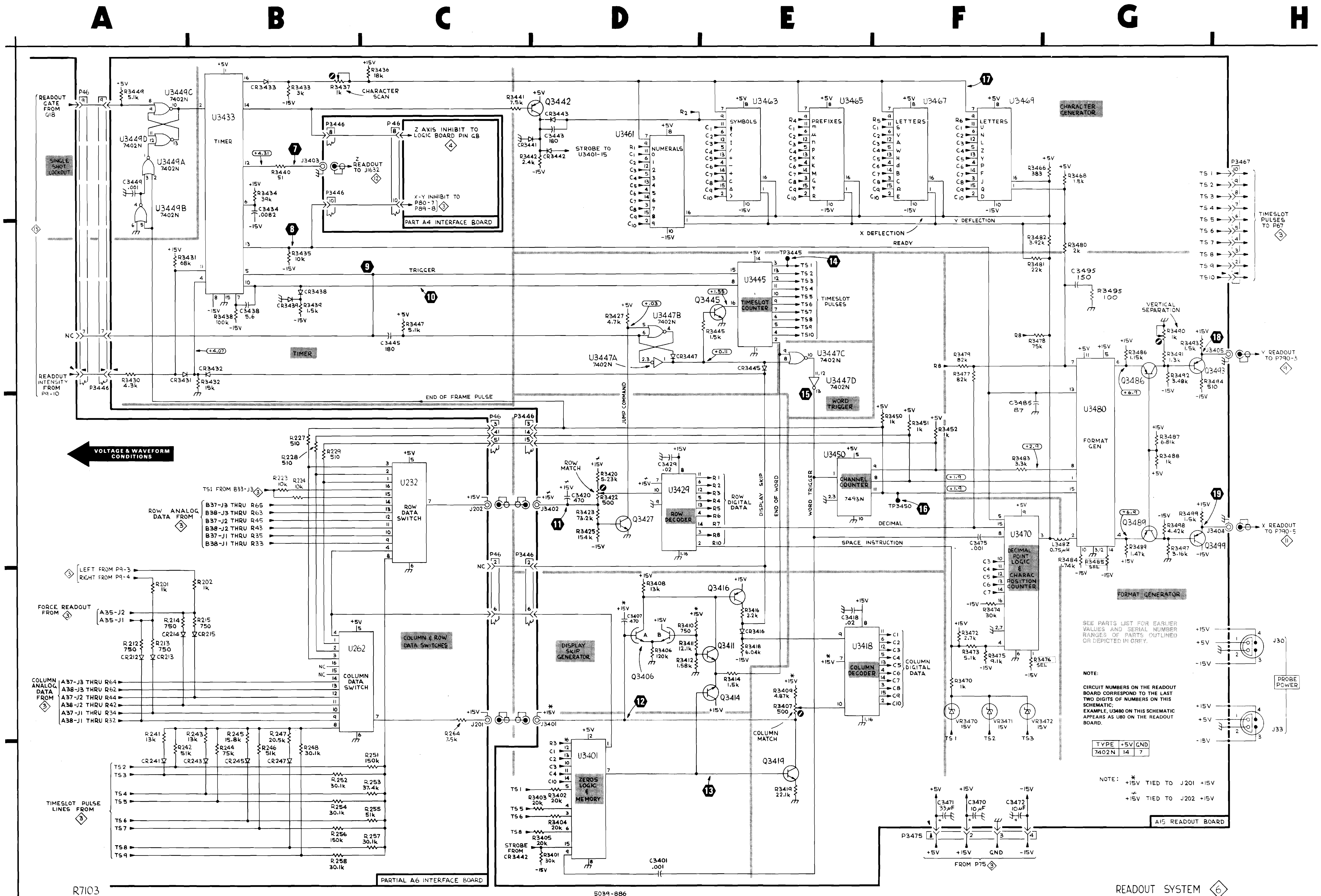
R EXAMPLE
mber
234
Schematic Circuit Number
e no Assembly Number
ectrical Parts List.



REV JUN 1985

Scans by ArtekMedia => 2009

6 Readout System

Reverse Side A1

SIGNALS OUT DIAGRAM ⟨7⟩

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1901	3A	5B	Q1910	2A	5C	R1928	2D	2D
C1904	3A	5B	Q1916	3B	5C	R1929	1D	3C
C1906	2B	5B	Q1928	2D	3C	R1930	3D	3C
C1908	2A	5C	Q1934	3D	3D	R1932	3D	4D
C1914	3B	4C	Q1938	3D	3C	R1933	3D	3D
C1918	3B	4C	Q1942	3D	1D	R1934	3D	3D
C1919	3B	4C	Q1943	3E	1C	R1935	3D	3D
C1920	3C	3B	Q1946	3E	1C	R1936	3D	2D
C1921	3C	3B				R1937	2D	2D
C1935	3D	2D	R1900	3A	4B	R1938	2D	2C
C1938	3D	3D	R1901	3A	5B	R1940	3E	2C
			R1902	3A	4B	R1942	3E	1D
CR1900	2A	3B	R1903	3A	5B	R1943	3D	1D
CR1902	2A	3B	R1905	2A	5B	R1944	3E	1C
CR1916	3B	4C	R1906	2B	4B	R1945	3E	1C
CR1918	3B	4D	R1908	2A	4C	R1946	3D	1C
CR1922	2C	2B	R1909	2A	5D	R1948	2E	1D
CR1923	2C	2C	R1910	2A	5D			
CR1927	2D	3C	R1911	3D	3B	S1900	1A	4B
CR1928	2D	3C	R1914	3D	4C	S1905	3A	5C
CR1929	1D	3C	R1915	3B	4C	S1910	2B	5C
CR1946	3D	1D	R1916	3B	4C	S1915	2C	3C
CR1947	2E	1D	R1917	3B	4D	S1920	3C	3C
CR1948	2E	1D	R1918	3B	4D	S1924	1C	2C
			R1919	3B	4B	S1924	2C	2C
J1917	4B	4D	R1920	3C	3B			
J1924	1D	3C	R1921	3C	3B	TP1925	2C	2C
J1943	1E	1D	R1922	3C	1B			
J1992	1C	2C	R1923	3C	2B	VR1910	2A	5C
			R1924	3C	2B			
P1900	4D	2D	R1925	3C	1B	W1930	3D	3D
			R1926	2D	3C	W1940	3E	2D
Q1908	2A	5C	R1927	2D	3C			

Partial A1 also shown on diagrams 2 and 12.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J1916	4B	CHASSIS	J1925	1D	CHASSIS	J1944	1E	CHASSIS

	A	B	C
1	*SEE ASSEMBLY A1 CIRCUIT BOARD ILLUSTRATION ADJACENT TO DIAGRAM ⟨2⟩*		

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Signals Out
component locator (A1)

VOLTAGE CONDITIONS

Use a digital voltmeter with a 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series Power Module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltage readings were taken with no plug-in units installed in the R7103.

Set the R7103 as follows:

INTENSITY	Fully counterclockwise (off)
READOUT INTENSITY	Fully counterclockwise (off)
VERTICAL MODE	LEFT
TRIGGER SOURCE	VERT MODE

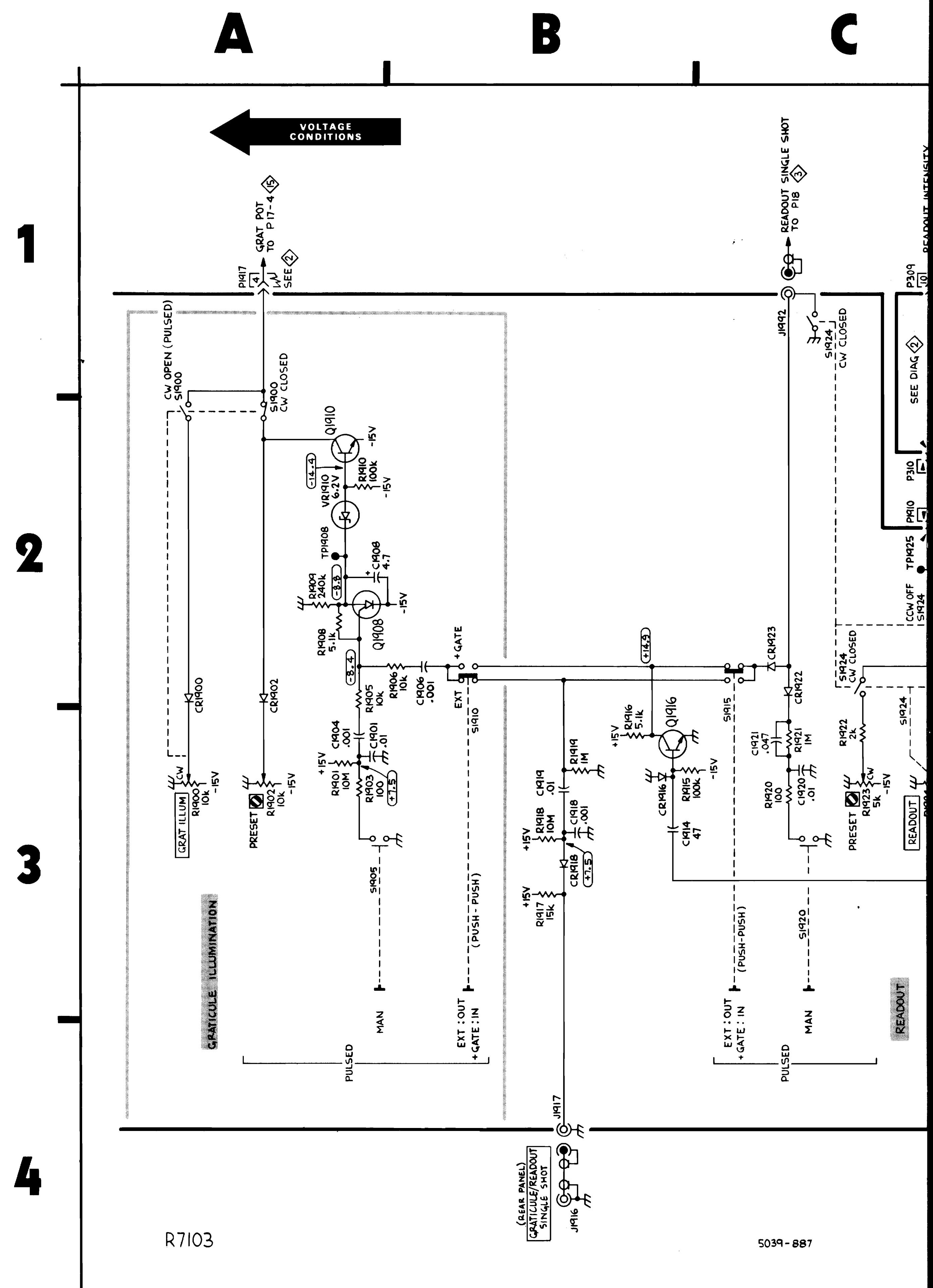
Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

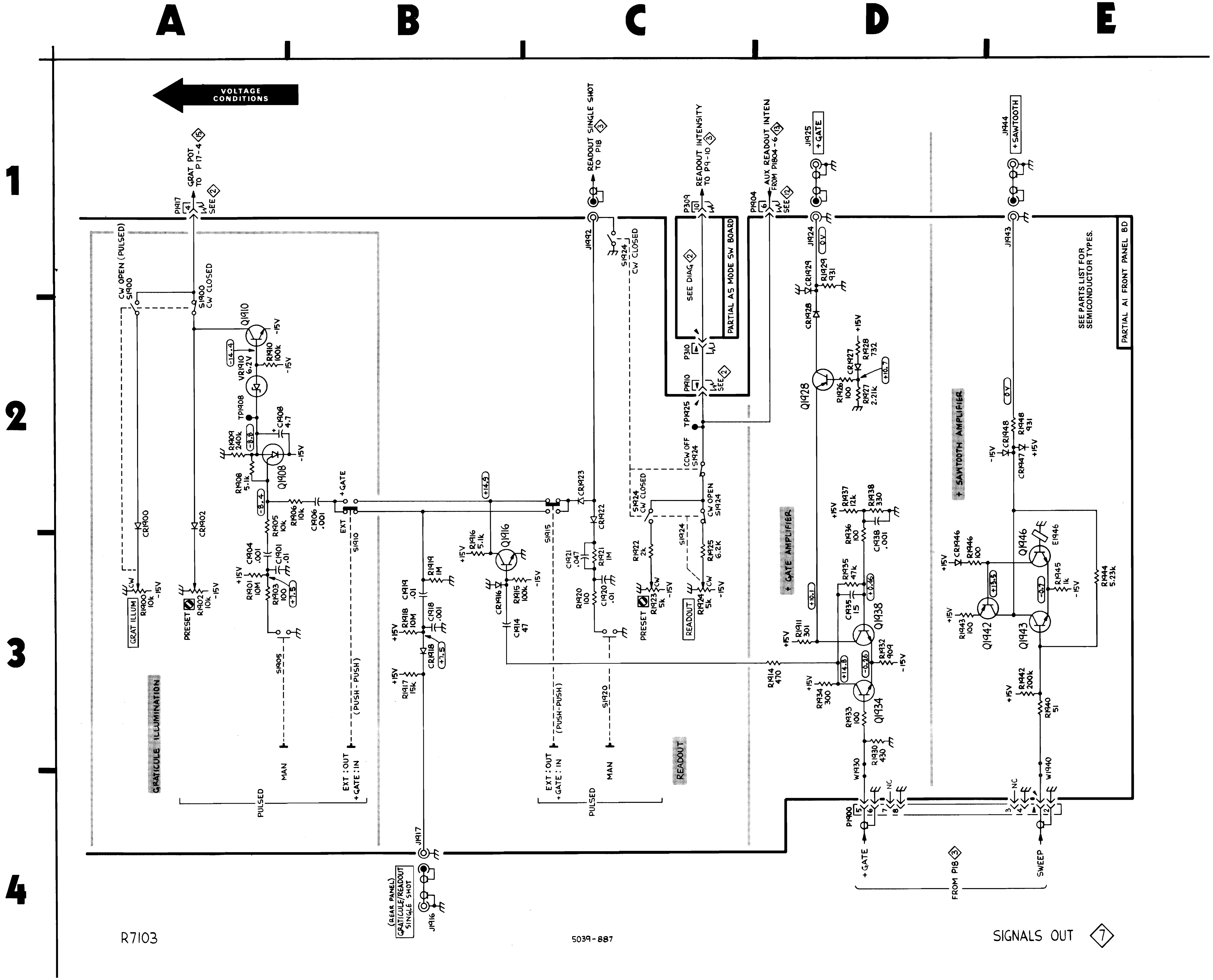
Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Scans by ArtekMedia => 2009



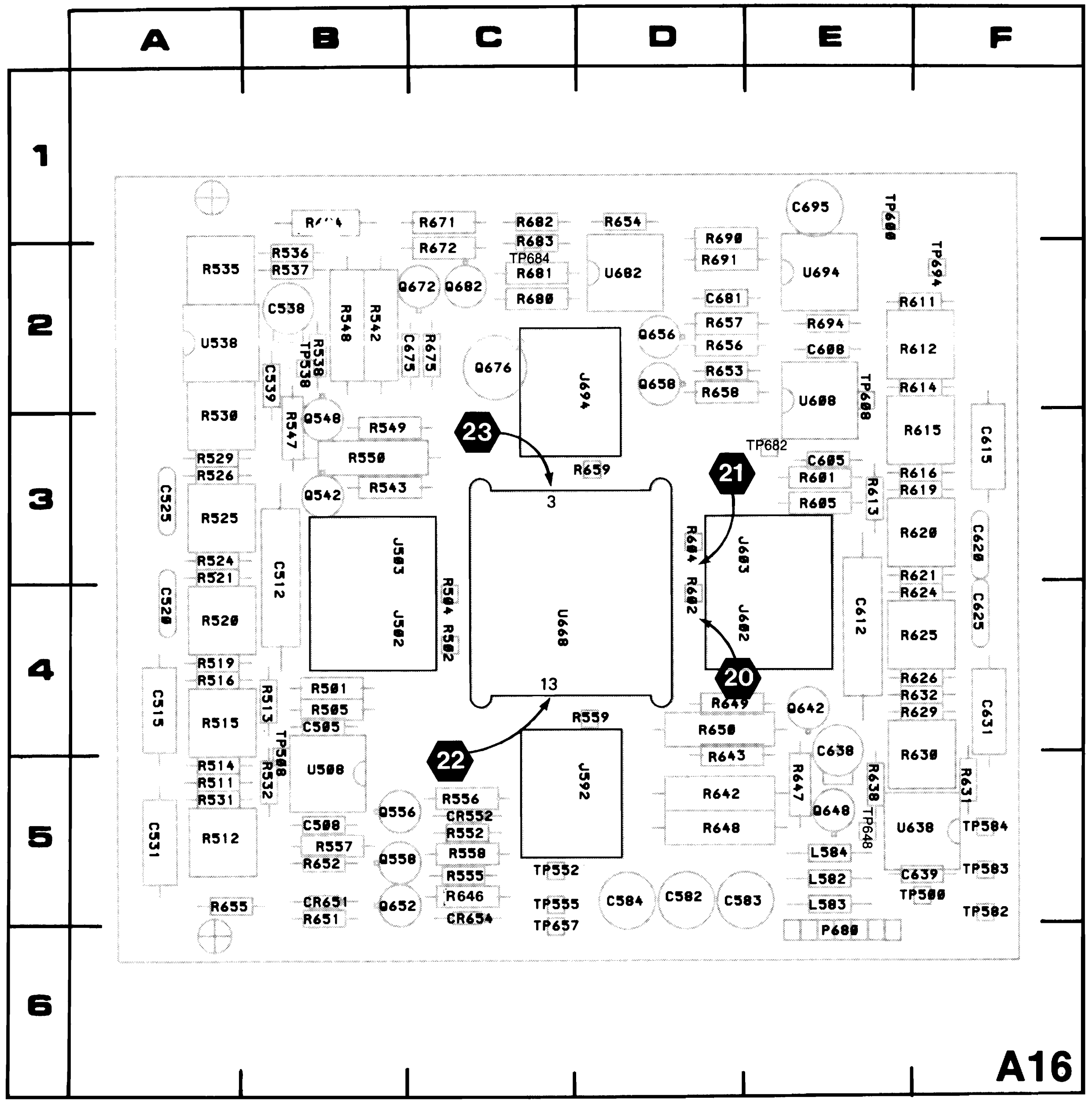
led in a TM
7000-series



sitive Devices
enance Section
BER EXAMPLE
Number
R1234
Schematic Circuit Number
mbly f used)
have no Assembly Number
le Electrical Parts List.

7 Signals Out

Reverse Side A16



5039-809

Figure 8-9. A16—Vertical Channel Switch Board assembly.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

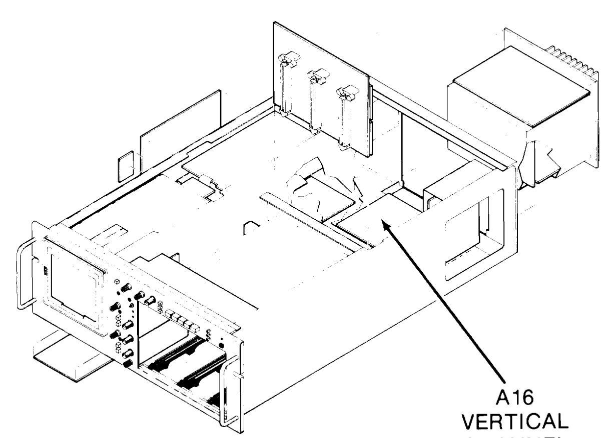
Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Assembly A16 & component locator



VERTICAL CHANNEL SWITCH

ASSEMBLY A16

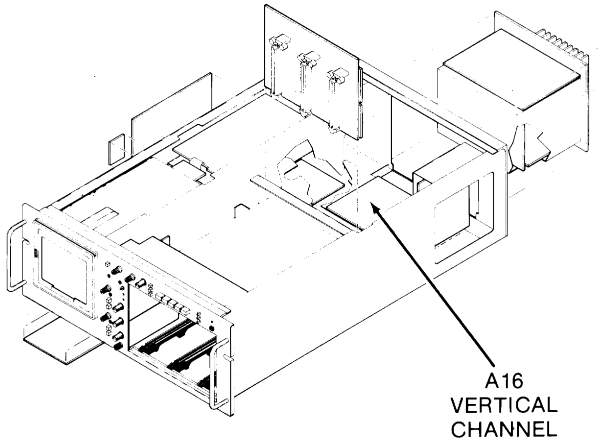
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
C505	4B	4B	R502	4B
C508	1A	5B	R504	4B
C512	4A	3B	R505	4B
C515	3A	4A	R511	3A
C520	3A	4A	R512	3A
C525	3A	3A	R513	3A
C531	2A	5A	R514	3A
C538	2A	2B	R515	3A
C539	1A	2B	R516	3A
C582	4E	5D	R519	3A
C583	4E	5D	R520	3A
C584	4F	5D	R521	3A
C605	4D	3E	R524	3A
C608	1E	2E	R525	3A
C612	4E	4E	R526	3A
C615	3E	3F	R529	2A
C620	3E	3F	R530	3A
C625	3E	4F	R531	2A
C631	2E	4F	R532	2A
C638	2E	4F	R535	4A
C639	1E	5E	R536	4A
C675	1C	2B	R537	4A
C681	1C	2D	R538	2A
C695	1E	1E	R542	2A
			R543	1B
CR552	3C	5C	R547	2A
CR651	4C	5B	R548	2A
CR654	3C	5C	R549	1B
			R550	1B
J502	4B	4B	R552	4C
J503	4B	3B	R555	3C
J592	1B	5D	R556	3C
J602	4D	4D	R557	3C
J603	4D	3E	R558	3B
J694	1D	2D	R559	1B
			R601	4D
L582	4E	5E	R602	4D
L583	4E	5E	R604	4D
L584	4F	5E	R605	4D
			R611	3E
Q542	2A	3B	R612	3E
Q548	2A	3B	R613	4D
Q556	3C	5B	R614	3E
Q558	3B	5B	R615	3E
Q642	2E	4E	R616	3D
Q648	2E	5E	R619	3E
Q652	3C	5B	R620	3E
Q656	3C	2D	R621	3D
Q658	3C	2D	R624	3E
Q672	1C	2C	R625	3E
Q676	1C	2C	R626	3D
Q682	1C	2C	R629	2E
			R630	3E
R501	4A	4B	R631	2E

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
DL592	1B	CHASSIS	P680	4C

A16

5039-809



VERTICAL CHANNEL SWITCH DIAGRAM 8

ASSEMBLY A16

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C505	4B	4B	R502	4B	4C	R632	D2	4E
C508	1A	5B	R504	4B	4C	R638	2E	5E
C512	4A	3B	R505	4B	4B	R642	2E	5D
C515	3A	4A	R511	3A	5A	R643	D2	5D
C520	3A	4A	R512	3A	5A	R646	3C	5C
C525	3A	3A	R513	3A	4B	R647	2E	5E
C531	2A	5A	R514	3A	5A	R648	2E	5D
C538	2A	2B	R515	3A	4A	R649	D2	5D
C539	1A	2B	R516	3A	4A	R650	D2	4D
C582	4E	5D	R519	3A	4A	R651	4C	5B
C583	4E	5D	R520	3A	4A	R652	3C	5B
C584	4F	5D	R521	3A	3A	R653	4C	2D
C605	4D	3E	R524	3A	3A	R654	3C	1D
C608	1E	2E	R525	3A	3A	R655	3C	5A
C612	4E	4E	R526	3A	3A	R656	3C	2D
C615	3E	3F	R529	2A	3A	R657	3C	2D
C620	3E	3F	R530	3A	2A	R658	3C	2D
C625	3E	4F	R531	2A	5A	R659	1D	3D
C631	2E	4F	R532	2A	5B	R671	1C	1C
C638	2E	4F	R535	4A	2A	R672	1C	1C
C639	1E	5E	R536	4A	2B	R675	1C	2C
C675	1C	2B	R537	4A	2B	R680	1C	2C
C681	1C	2D	R538	2A	2B	R681	1C	2C
C695	1E	1E	R542	2A	2B	R682	1C	1C
			R543	1B	3B	R683	1C	1C
CR552	3C	5C	R547	2A	3B	R684	1C	1B
CR651	4C	5B	R548	2A	2B	R690	2E	1D
CR654	3C	5C	R549	1B	3B	R691	2E	2D
			R550	1B	3B	R694	1F	2E
J502	4B	4B	R552	4C	5C			
J503	4B	3B	R555	3C	5C	TP500	4E	5E
J592	1B	5D	R556	3C	5C	TP508	3B	4B
J602	4D	4D	R557	3C	5B	TP538	2A	2B
J603	4D	3E	R558	3B	5C	TP552	4C	5C
J694	1D	2D	R559	1B	4D	TP555	4C	5C
			R601	4D	3E	TP582	4E	5E
L582	4E	5E	R602	4D	4D	TP583	4E	5E
L583	4E	5E	R604	4D	3D	TP584	4F	5E
L584	4F	5E	R605	4D	3E	TP600	4F	1E
			R611	3E	2F	TP608	3D	2E
Q542	2A	3B	R612	3E	2F	TP648	2E	5E
Q548	2A	3B	R613	4D	3E	TP657	4C	6C
Q556	3C	5B	R614	3E	2F	TP682	1C	3E
Q558	3B	5B	R615	3E	3F	TP684	1C	2C
Q642	2E	4E	R616	3D	3F	TP694	1E	2F
Q648	2E	5E	R619	3E	3F			
Q652	3C	5B	R620	3E	3F	U508	4B	5B
Q656	3C	2D	R621	3D	4E	U538	2A	2A
Q658	3C	2D	R624	3E	4E	U608	4D	2E
Q672	1C	2C	R625	3E	4E	U638	2E	5E
Q676	1C	2C	R626	3D	4E	U668	1B	4C
Q682	1C	2C	R629	2E	4E	U682	1C	2D
			R630	3E	5E	U694	1E	2E
R501	4A	4B	R631	2E	5E			

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DL592	1B	CHASSIS	P680	4C	CHASSIS

VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

When the voltage readings were taken, a Signal Standardizer (Tektronix Part 067-0587-02) was installed in the R7103 LEFT VERT plug-in compartment. The R7103 and the Signal Standardizer were set as follows:

R7103:
- INTENSITY................................Fully counterclockwise (off)
- VERTICAL MODE..........................LEFT
- TRIGGER SOURCE........................VERT MODE

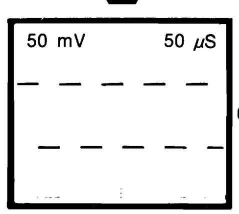
Signal Standardizer:
- Test..Vert or Horiz Com Mode

Waveform Conditions: The waveforms shown below were obtained with a TEKTRONIX 7904 Oscilloscope, 7B10 Time Base, and 7A13 Differential Comparator equipped with a P6053 10X Probe. (Any oscilloscope with 10 MΩ impedance and at least 60 MHz bandwidth will suffice.) The test oscilloscope was externally triggered by the signal from the Pretrig Out connector of a Signal Standardizer installed in the R7103 LEFT VERT plug-in compartment. The Signal Standardizer was set as follows:

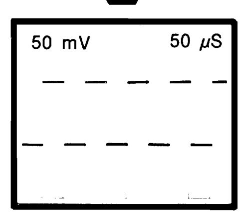
- Test..Vert or Horiz +Step Resp
- Rep Rate..................................10 kHz
- Position / Amplitude } ....Set to produce a six-division display centered around zero volts.

A 7B-series time base, set for a free-running (not triggered) sweep, was installed in the R7103 HORIZ plug-in compartment.

20



21



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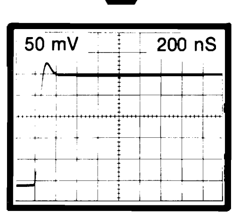
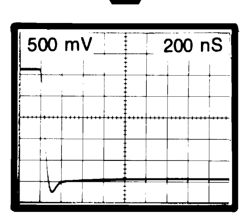


23



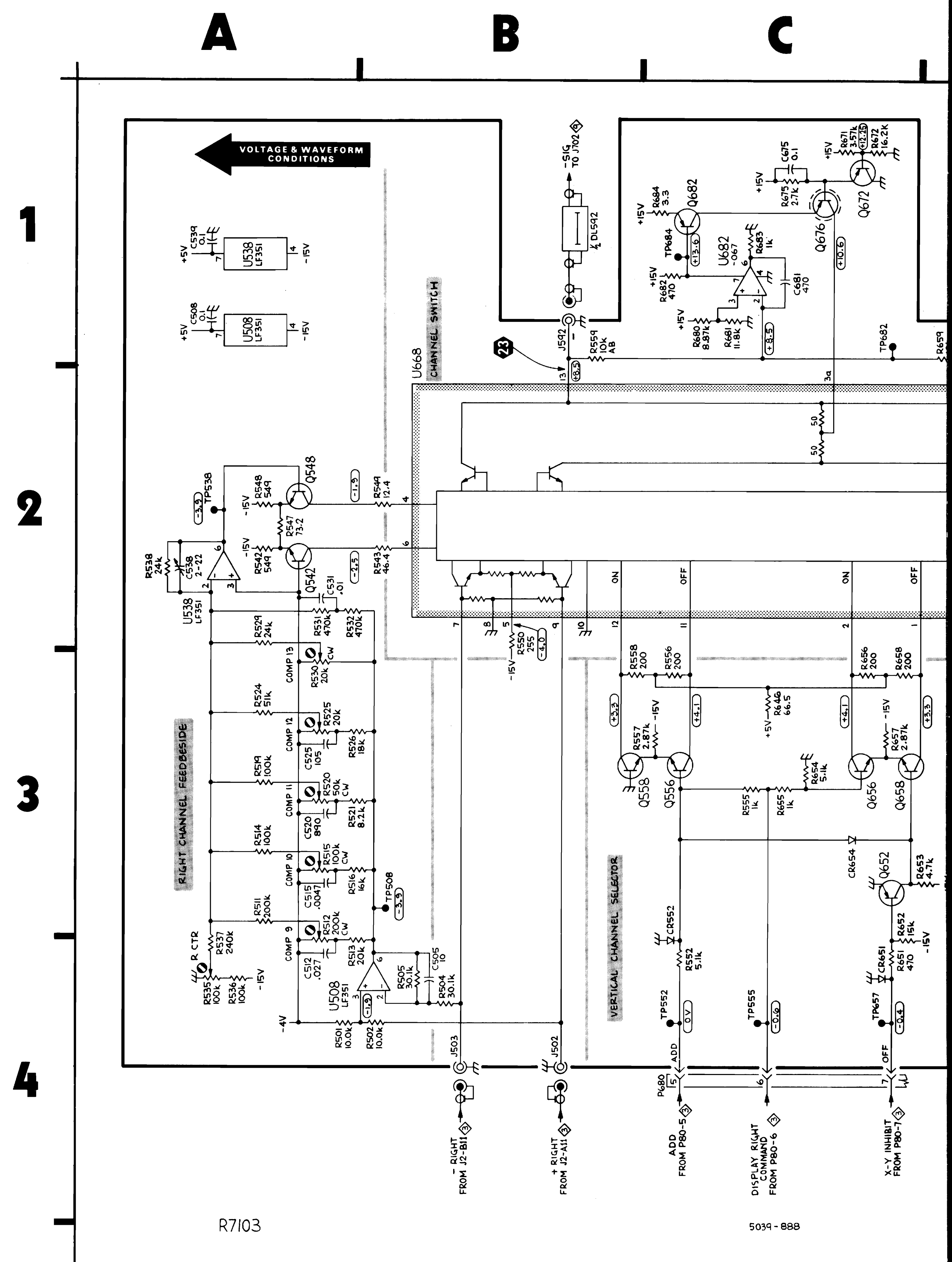
Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Scans by ArtekMedia => 2009



l Multimeter
n a readout-

R7103 LEFT

Time Base,
d at least 60
nnector of a
as follows:

mpartment.

sitive Devices
enance Section

BER EXAMPLE

Number
R1234
Schematic Circuit Number
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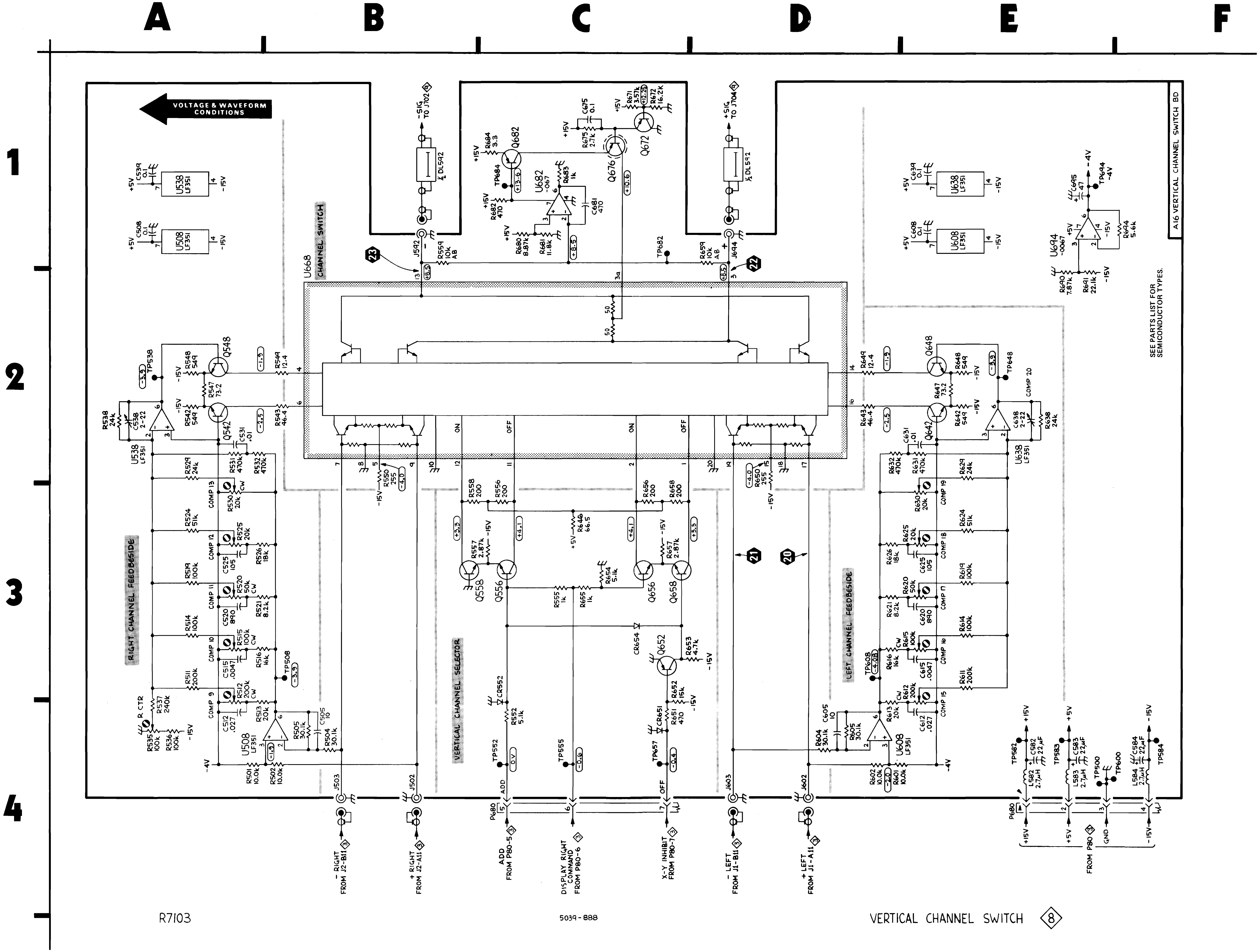
d used)

have no Assembly Number
le Electrical Parts List.



R7103

5039-888

VERTICAL CHANNEL SWITCH ⟨8⟩

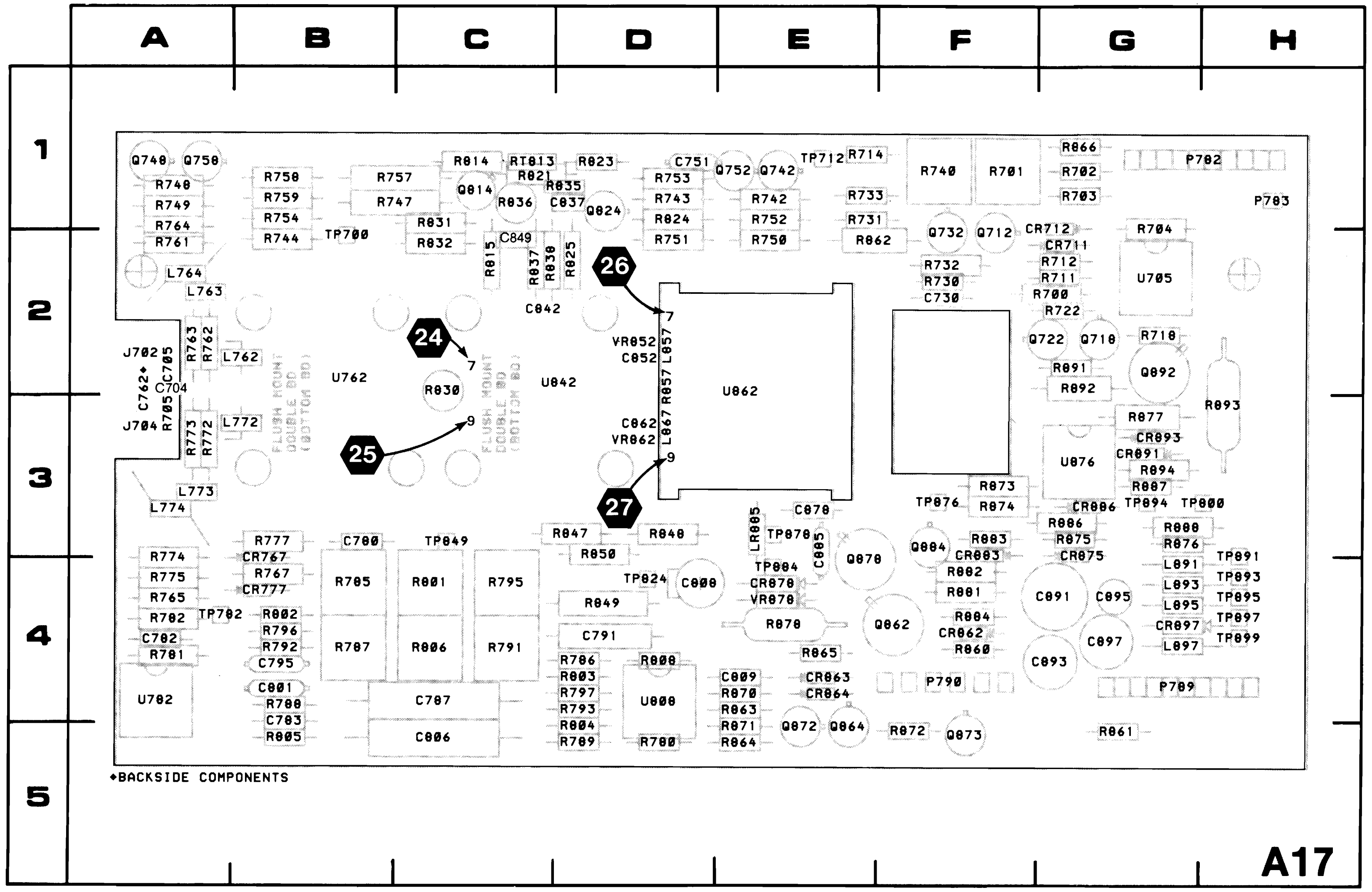


Figure 8-10. A17—Vertical Amplifier Board assembly.

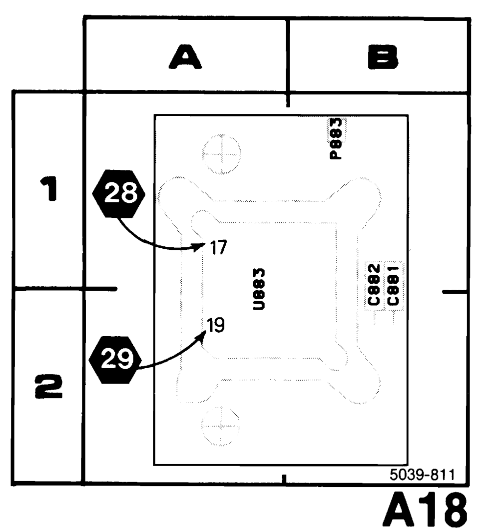
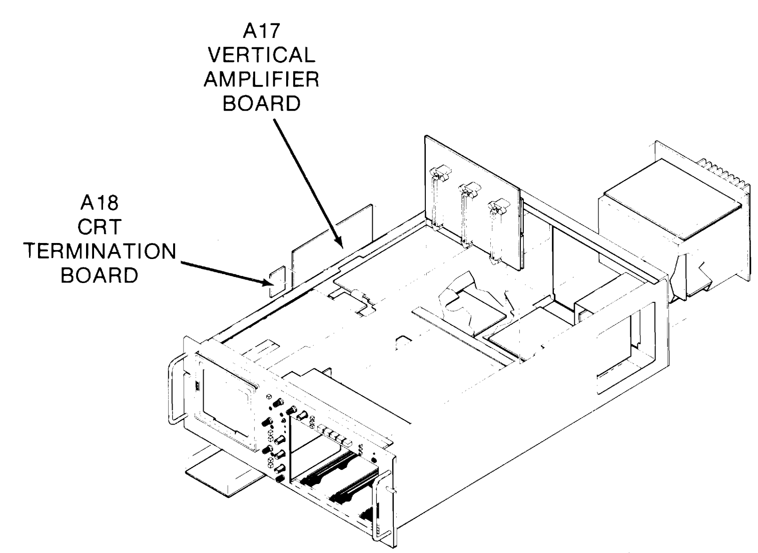
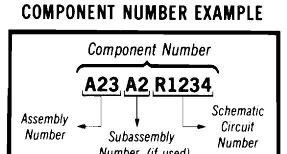


Figure 8-11. A18—CRT Termination Board assembly.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

VERTIC

ASSEMBLY A17

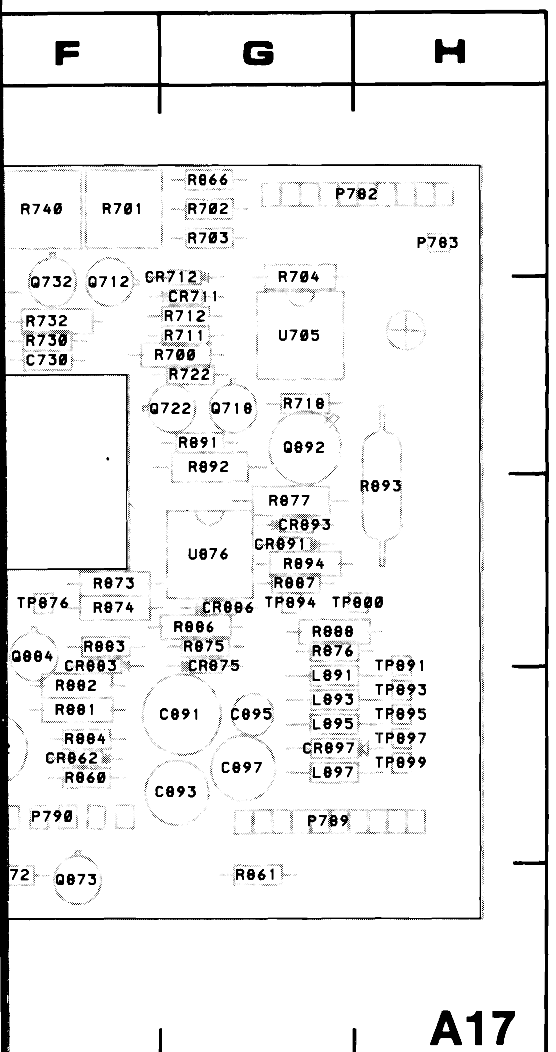
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	S LO
C704	3A	2A	CR886	1G	3G	Q872	
C705	2A	2A	CR891	1F	3G	Q873	
C730	3A	2F	CR893	1F	3G	Q878	
C751	2B	1D	CR897	4F	4G	Q884	
C762	3C	3A				Q892	
C780	3E	3B	J702	2A	2A		
C782	2C	4A	J704	3A	3A	R700	
C783	2C	5B				R701	
C787	3D	4C	L762	2C	2B	R702	
C791	3D	4D	L763	2C	2A	R703	
C795	3D	4B	L764	2C	2A	R704	
C801	3D	4B	L772	3C	3B	R705	
C806	3D	5C	L773	3C	3A	R711	
C808	2E	4D	L774	3C	3A	R712	
C809	2D	4E	L857	3F	2D	R714	
C837	3E	1D	L867	3F	3D	R718	
C838	3E	2C	L891	4E	4G	R722	
C849	3E	2C	L893	4E	4G	R730	
C852	2F	2D	L895	4E	4G	R731	
C862	3F	3D	L897	4F	4G	R732	
C878	4G	3E				R733	
C885	4G	4E	LR885	4G	3E	R740	
C891	4E	4G				R742	
C893	4E	4G	P783	2G	1H	R743	
C895	4E	4G				R744	
C897	4F	4G	Q712	2B	2F	R747	
			Q718	4A	2G	R748	
CR711	2A	2G	Q722	4A	2G	R749	
CR712	2A	2G	Q732	3B	2F	R750	
CR767	3C	4B	Q742	2B	1E	R751	
CR777	3C	4B	Q748	3B	1A	R752	
CR862	4F	4F	Q752	2B	1E	R753	
CR863	4B	4E	Q758	3B	1A	R754	
CR864	4C	4E	Q814	3E	1C	R757	
CR875	5G	4G	Q824	2E	1D	R758	
CR878	4G	4E	Q862	4F	4F	R759	
CR883	4G	4F	Q864	4C	5E	R761	

ASSEMBLY A18

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	S LO
C881	3G	2B	C882	3G	2B	P883	

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	S LO
P782	5B	CHASSIS	P783	3G	CHASSIS	P789	



5039-810

ply.

VERTICAL AMPLIFIER DIAGRAM 9

ASSEMBLY A17

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C704	3A	2A
C705	2A	2A
C730	3A	2F
C751	2B	1D
C762	3C	3A
C780	3E	3B
C782	2C	4A
C783	2C	5B
C787	3D	4C
C791	3D	4D
C795	3D	4B
C801	3D	4B
C806	3D	5C
C808	2E	4D
C809	2D	4E
C837	3E	1D
C838	3E	2C
C849	3E	2C
C852	2F	2D
C862	3F	3D
C878	4G	3E
C885	4G	4E
C891	4E	4G
C893	4E	4G
C895	4E	4G
C897	4F	4G
CR711	2A	2G
CR712	2A	2G
CR767	3C	4B
CR777	3C	4B
CR862	4F	4F
CR863	4B	4E
CR864	4C	4E
CR875	5G	4G
CR878	4G	4E
CR883	4G	4F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR886	1G	3G
CR891	1F	3G
CR893	1F	3G
CR897	4F	4G
J702	2A	2A
J704	3A	3A
L762	2C	2B
L763	2C	2A
L764	2C	2A
L772	3C	3B
L773	3C	3A
L774	3C	3A
L857	3F	2D
L867	3F	3D
L891	4E	4G
L893	4E	4G
L895	4E	4G
L897	4F	4G
LR885	4G	3E
P783	2G	1H
Q712	2B	2F
Q718	4A	2G
Q722	4A	2G
Q732	3B	2F
Q742	2B	1E
Q748	3B	1A
Q752	2B	1E
Q758	3B	1A
Q814	3E	1C
Q824	2E	1D
Q862	4F	4F
Q864	4C	5E

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
Q872	4C	5E
Q873	5C	5F
Q878	4G	4E
Q884	4G	3F
Q892	1F	2G
R700	2A	2G
R701	2A	1F
R702	2A	1G
R703	2A	1G
R704	2A	2G
R705	3A	3A
R711	2A	2G
R712	2A	2G
R714	2B	1E
R718	4A	2G
R722	4A	2G
R730	2A	2F
R731	3A	1E
R732	2B	2F
R733	3B	1E
R740	2B	1F
R742	2B	1E
R743	3B	1D
R744	3B	2B
R747	3B	1B
R748	3B	1A
R749	3B	1A
R750	2B	2E
R751	2B	2D
R752	2B	1E
R753	3B	1D
R754	3B	1B
R757	3B	1B
R758	3B	1B
R759	2B	1B
R761	2C	2A

CIRCUIT N BER	SCHEM LOCATION	BOARD LOCATION
R762	2C	2A
R763	2C	2A
R764	3C	1A
R765	3C	4A
R767	3C	4B
R772	3C	3A
R773	3C	3A
R774	3C	4A
R775	3C	4A
R777	3C	3B
R780	3E	5D
R781	3C	4A
R782	2C	4A
R785	3C	4B
R786	2C	4D
R787	3D	4B
R788	3D	4B
R789	2D	5D
R791	3D	4C
R792	3D	4B
R793	2D	4D
R795	3D	4C
R796	3D	4B
R797	2D	4D
R801	3D	4D
R802	3D	4B
R803	2D	4D
R804	2D	5D
R805	3D	5B
R806	3D	4C
R808	2E	4D
R814	3E	1C
R815	3E	2C
R821	3E	1C
R823	3E	1D
R824	2E	1D
R825	2E	2D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R830	2D	3C
R831	2E	1C
R832	3E	2C
R835	2E	1D
R836	2E	1C
R837	3E	2C
R838	2E	2C
R847	1E	3D
R848	1E	3D
R849	3E	4D
R850	1E	3D
R857	3F	3D
R860	4F	4F
R861	4F	5G
R862	4F	2E
R863	4B	4E
R864	4C	5E
R865	4C	4E
R866	4B	1G
R870	3E	4E
R870	4C	4E
R871	4C	5E
R872	5C	5F
R873	4G	3F
R874	4G	3F
R875	5G	3G
R876	5G	3G
R877	4G	3G
R878	4G	4E
R881	4G	4F
R882	4G	4F
R883	4G	3F
R884	4G	4F
R886	1G	3G
R887	1F	3G
R888	1F	3G
R891	1F	2G

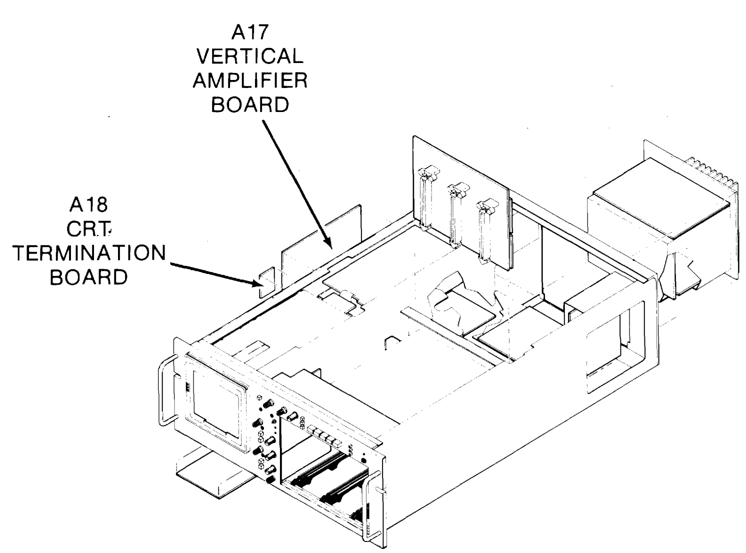
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R892	1F	3G
R893	1F	3H
R894	1F	3G
RT813	3E	1C
TP700	5E	2B
TP712	2B	1E
TP782	3C	4A
TP800	5E	3G
TP824	2E	4D
TP849	3E	3C
TP876	4G	3F
TP878	4F	3E
TP884	4G	4E
TP891	5E	4H
TP893	5E	4H
TP894	1F	3G
TP895	5E	4H
TP897	5F	4H
TP899	5F	4H
U705	2A	2G
U762	1B	2B
U782	3C	4A
U808	2E	4D
U842	4E	2C
U862	4G	3E
U876A	4G	3G
U876B	1F	3G
VR852	1F	2D
VR862	4F	3D
VR878	4G	4E

ASSEMBLY A18

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C881	3G	2B	C882	3G	2B	P883	2G	1B	U883	2G	1A

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P782	5B	CHASSIS	P783	3G	CHASSIS	P789	4A	CHASSIS	P790	2A	CHASSIS	P883	3G	CHASSIS



VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

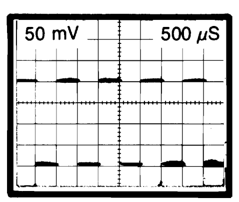
The voltages shown on the diagram were obtained with all R7103 front-panel variable controls, except INTENSITY, set to midrange; INTENSITY was set fully counterclockwise. Other R7103 front-panel controls were set as follows:

VERTICAL MODE .... LEFT
TRIGGER SOURCE .... VERT MODE
CALIBRATOR .... 4 V

A Signal Standardizer (Tektronix Part 067-0587-02), set to Vert or Horiz Com Mode, was installed in the R7103 LEFT VERT.

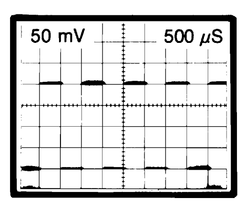
Waveform Conditions: The waveforms shown below were obtained with a test oscilloscope system with a 1 MΩ input impedance and at least 60 MHz bandwidth (in this case, a TEKTRONIX 7904 Oscilloscope, 7B10 Time Base, and 7A13 Differential Comparator with a P6053 10X Probe). The R7103 had a 7A-series amplifier plug-in unit in its LEFT VERT compartment and a 7B-series time base in its HORIZ compartment. The output of the R7103 CALIBRATOR was connected to the input of the 7A-amplifier, and the amplifier was set to produce a six- to eight-division display on the R7103 crt. The test oscilloscope was externally triggered with the R7103 CALIBRATOR signal.

24



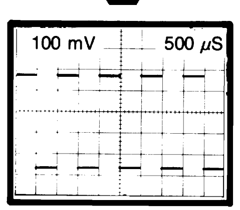
+8.65 V

25



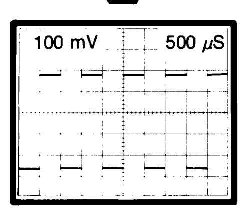
+8.66 V

26



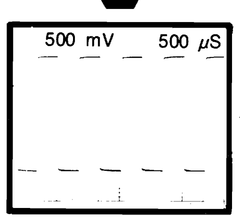
+24.0 V

27



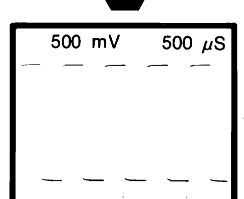
+23.6 V

28



+35.8 V

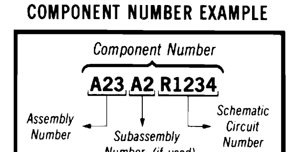
29



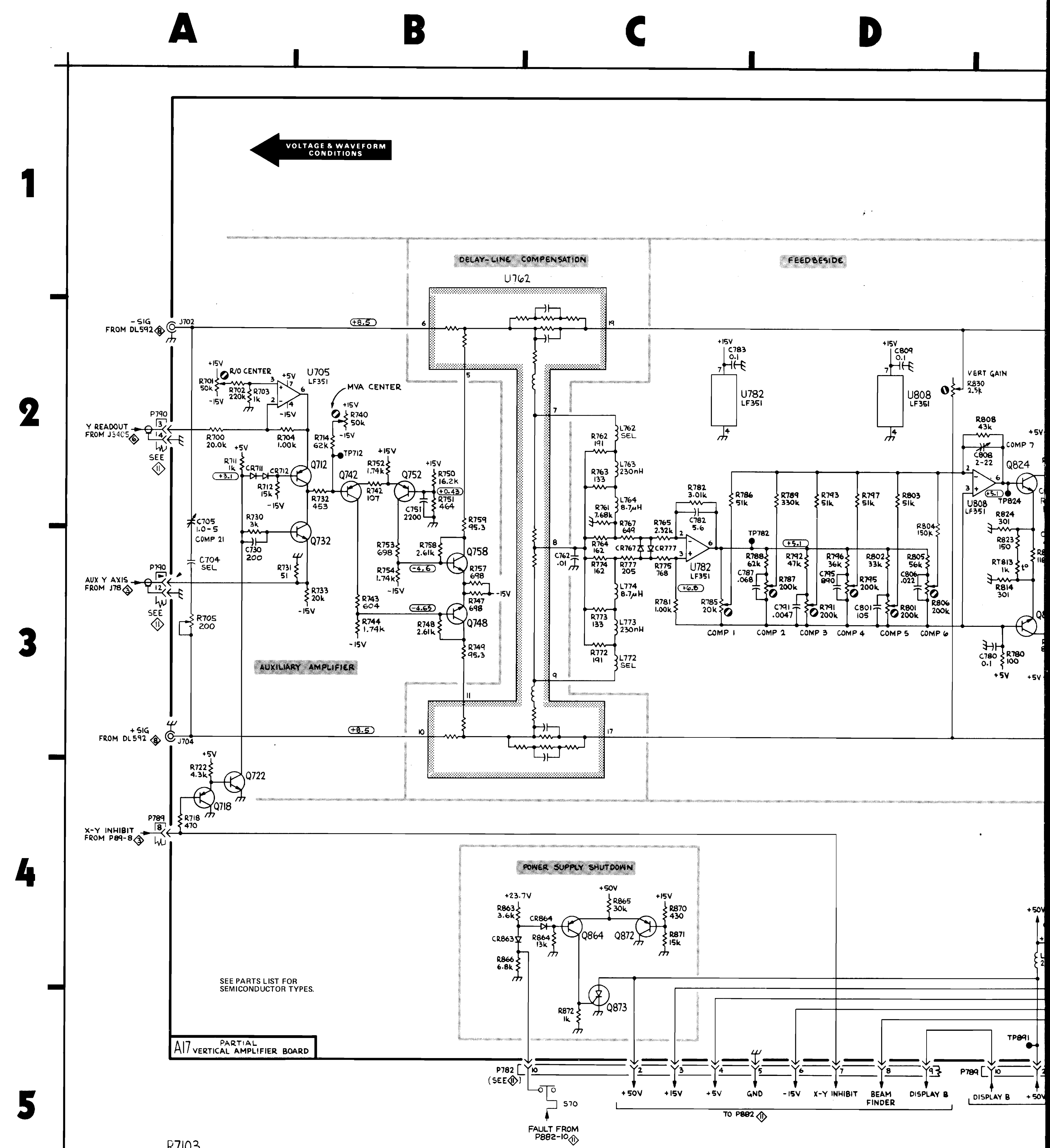
+35.8 V

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

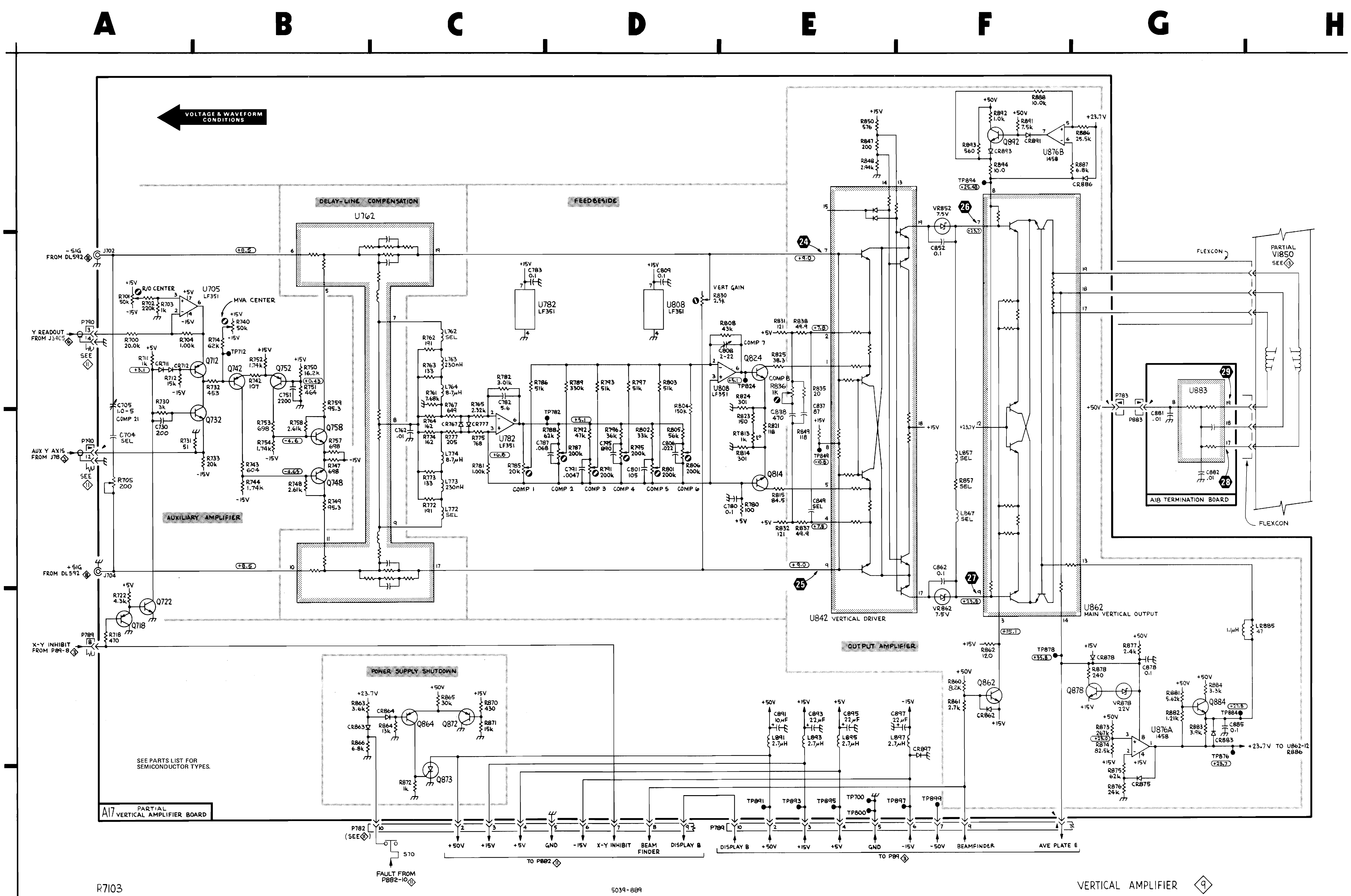


Multimeter
a readout-

ITY, set to

EFT VERT.

MΩ input
and 7A13
EFT VERT
nnected to
t. The test



R7103

5039-889

VERTICAL AMPLIFIER 9

sitive Devices
enance Section

MBER EXAMPLE

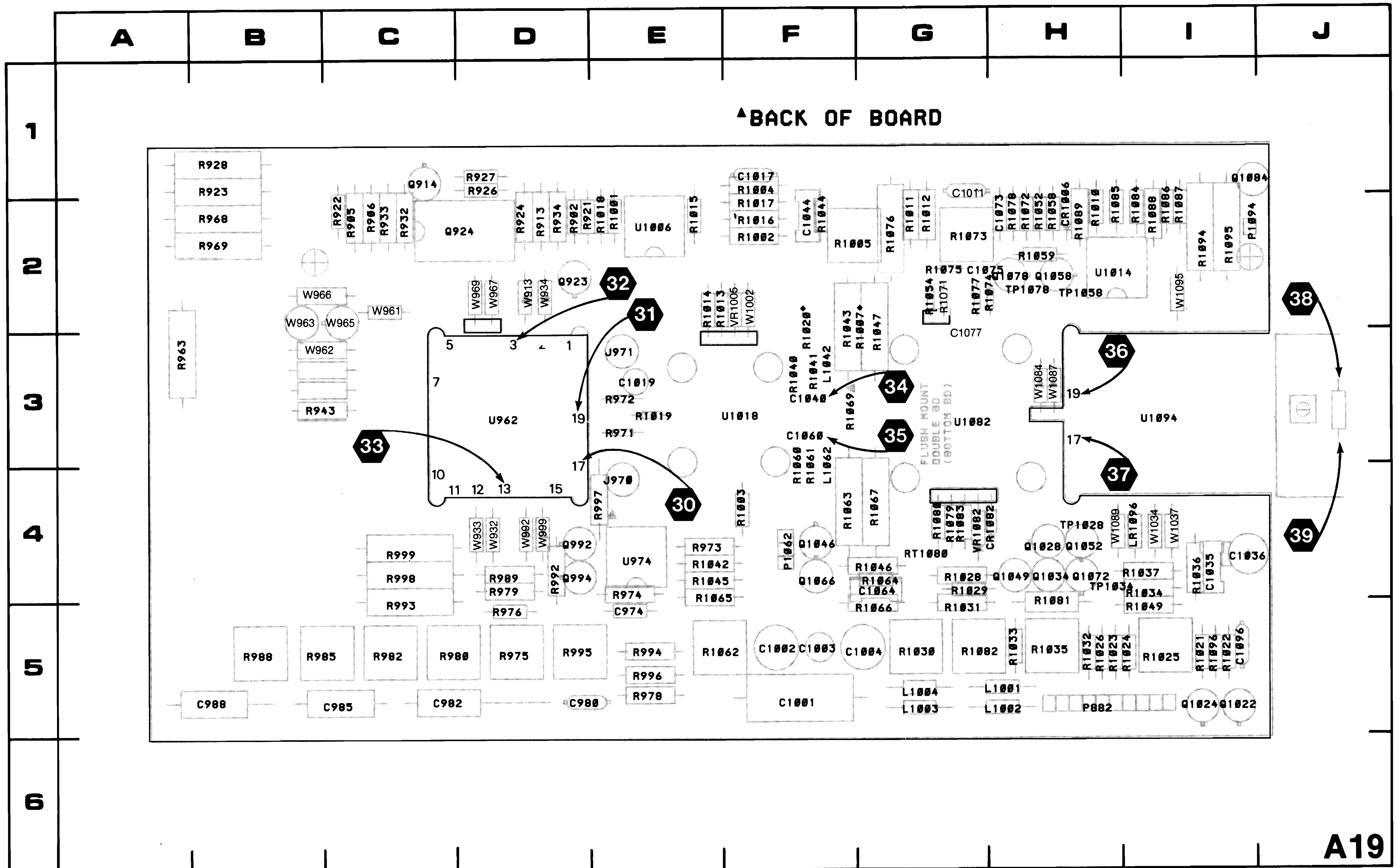
t Number
R1234
Schematic Circuit Number
mbly (if used)

s have no Assembly Number
ble Electrical Parts List.

9 Vertical Amplifier

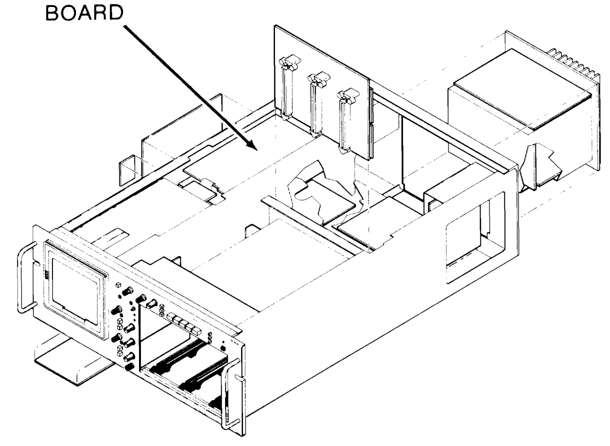
Reverse Side A19

Assembly A19 & component locator



5039-812

Figure 8-12. A19—Horizontal Amplifier Board assembly.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

HORIZONTAL CHANNEL SWITC

ASSEMBLY A19

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BO LOCA
C974	3E	3E	R922	4C	
C980	3D	5D	R923	3C	
C982	2D	5C	R924	3C	
C985	2D	5C	R926	3B	
C988	2D	5B	R927	3B	
			R928	3B	
J942	4B	4C	R932	2B	
J943	4B	3C	R933	2B	
J970	4D	4E	R934	2C	
J971	4D	3E	R963	2A	
			R968	2B	
Q914	2C	1C	R969	2B	
Q923	3C	2D	R971	3D	
Q924A	3C	2D	R972	3E	
Q924B	3B	2D	R973	3D	
Q924C	3C	2D	R974	3E	
Q924D	3C	2D	R975	3D	
Q924E	3B	2D	R976	3E	
Q992	2D	4D	R978	3D	
Q994	1D	4D	R979	3D	
			R980	3D	
R902	3C	2D	R982	2D	
R905	2C	2C	R985	2D	
R906	2C	2C	R988	2D	
R913	2C	2D	R989	2D	
R921	3C	2D	R992	2D	

Partial A19 also shown on diagram 11.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P882	4C	CHASSIS

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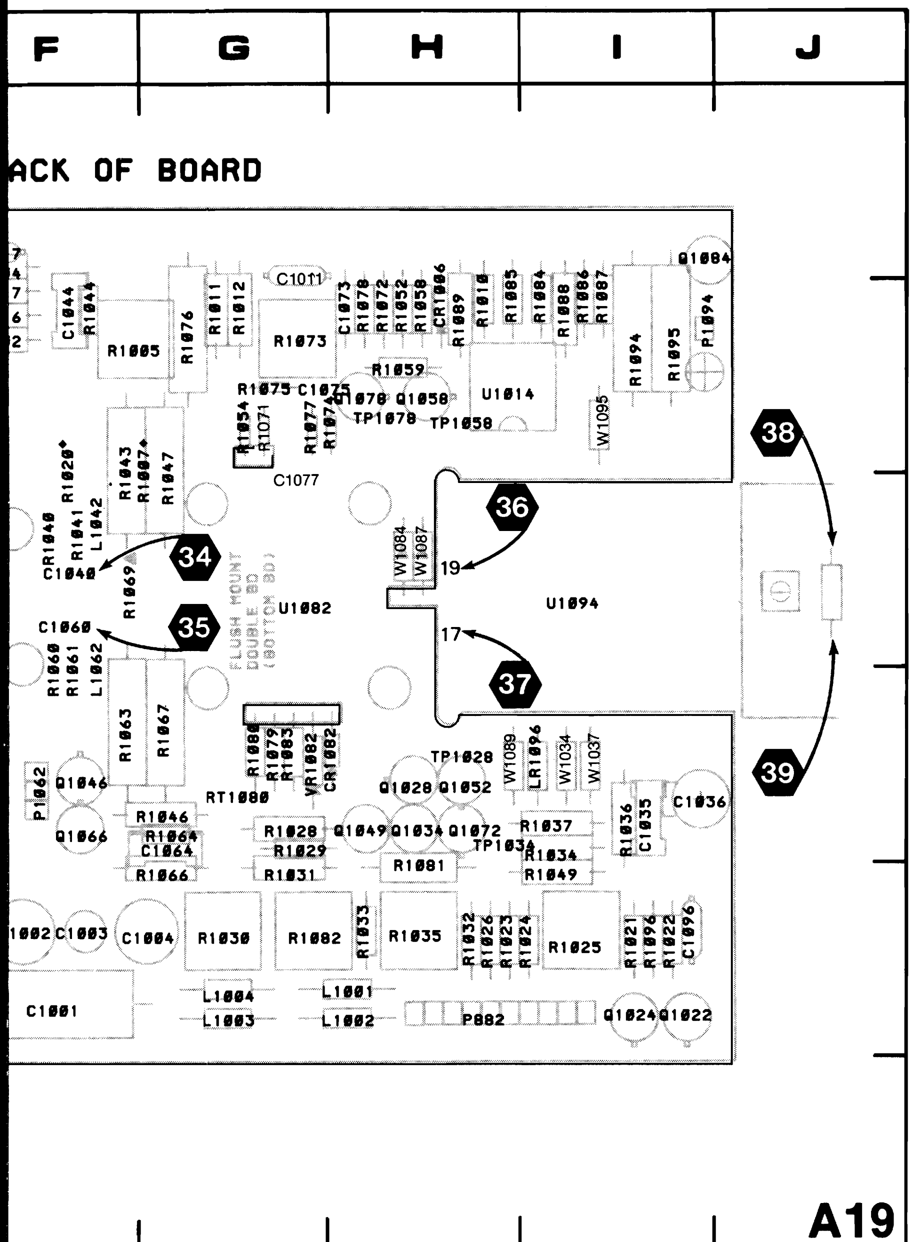
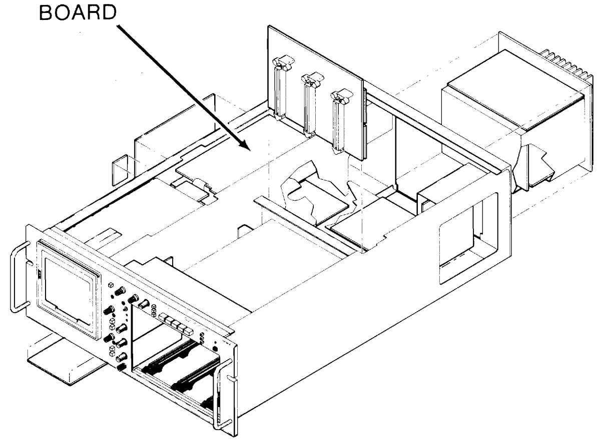


5039-812

fier Board assembly.



HORIZONTAL CHANNEL SWITCH DIAGRAM ⟨10⟩

ASSEMBLY A19

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C974	3E	3E	R922	4C	2C	R993	2E	5C
C980	3D	5D	R923	3C	1B	R994	1E	5E
C982	2D	5C	R924	3C	2D	R995	1D	5D
C985	2D	5C	R926	3B	1D	R996	1D	5E
C988	2D	5B	R927	3B	1D	R997	2D	4E
			R928	3B	1B	R998	2D	4C
J942	4B	4C	R932	2B	2C	R999	2D	4C
J943	4B	3C	R933	2B	2C			
J970	4D	4E	R934	2C	2D	U962	1A	3D
J971	4D	3E	R963	2A	3A	U974	3D	4E
			R968	2B	3A			
Q914	2C	1C	R969	2B	3A	W913	2C	2D
Q923	3C	2D	R971	3D	3E	W932	2B	4D
Q924A	3C	2D	R972	3E	3E	W933	2B	4D
Q924B	3B	2D	R973	3D	4E	W934	2C	4D
Q924C	3C	2D	R974	3E	4E	W961	2A	3C
Q924D	3C	2D	R975	3D	5D	W962	2A	3B
Q924E	3B	2D	R976	3E	5D	W963	2A	2B
Q992	2D	4D	R978	3D	5E	W965	2A	2B
Q994	1D	4D	R979	3D	4D	W966	2A	2B
			R980	3D	5C	W967	2A	2D
R902	3C	2D	R982	2D	5C	W969	2B	2D
R905	2C	2C	R985	2D	5B	W992	2D	4D
R906	2C	2C	R988	2D	5B	W999	2D	4D
R913	2C	2D	R989	2D	4D			
R921	3C	2D	R992	2D	4D			

Partial A19 also shown on diagram 11.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P882	4C	CHASSIS

VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

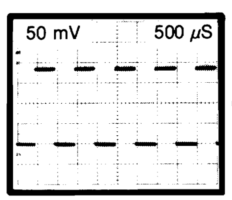
The voltages shown on the diagram were obtained with the R7103 front-panel variable controls, except INTENSITY and READOUT INTENSITY, set to midrange (INTENSITY and READOUT INTENSITY were set fully counterclockwise). Other R7103 front-panel controls were set as follows:

VERTICAL MODE .... LEFT
TRIGGER SOURCE .... VERT MODE
CALIBRATOR .... 4 V

A Signal Standardizer was installed in the R7103 LEFT VERT plug-in compartment; it was set to Vert or Horiz Com Mode.

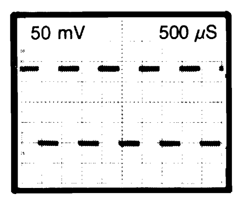
Waveform Conditions: The R7103 had a 7A-series amplifier plug-in unit in its LEFT VERT compartment and a 7B-series time base in its HORIZ compartment. The output of the R7103 CALIBRATOR was connected to the input of the 7A-amplifier, and the amplifier was set to produce a six- to eight-division display on the R7103 crt. The test oscilloscope was externally triggered with the R7103 CALIBRATOR signal.

30



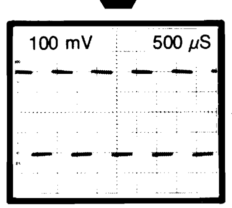
0 V

31



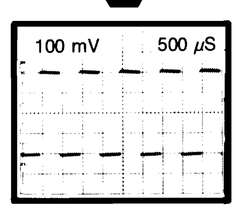
0 V

32



+4.73 V

33



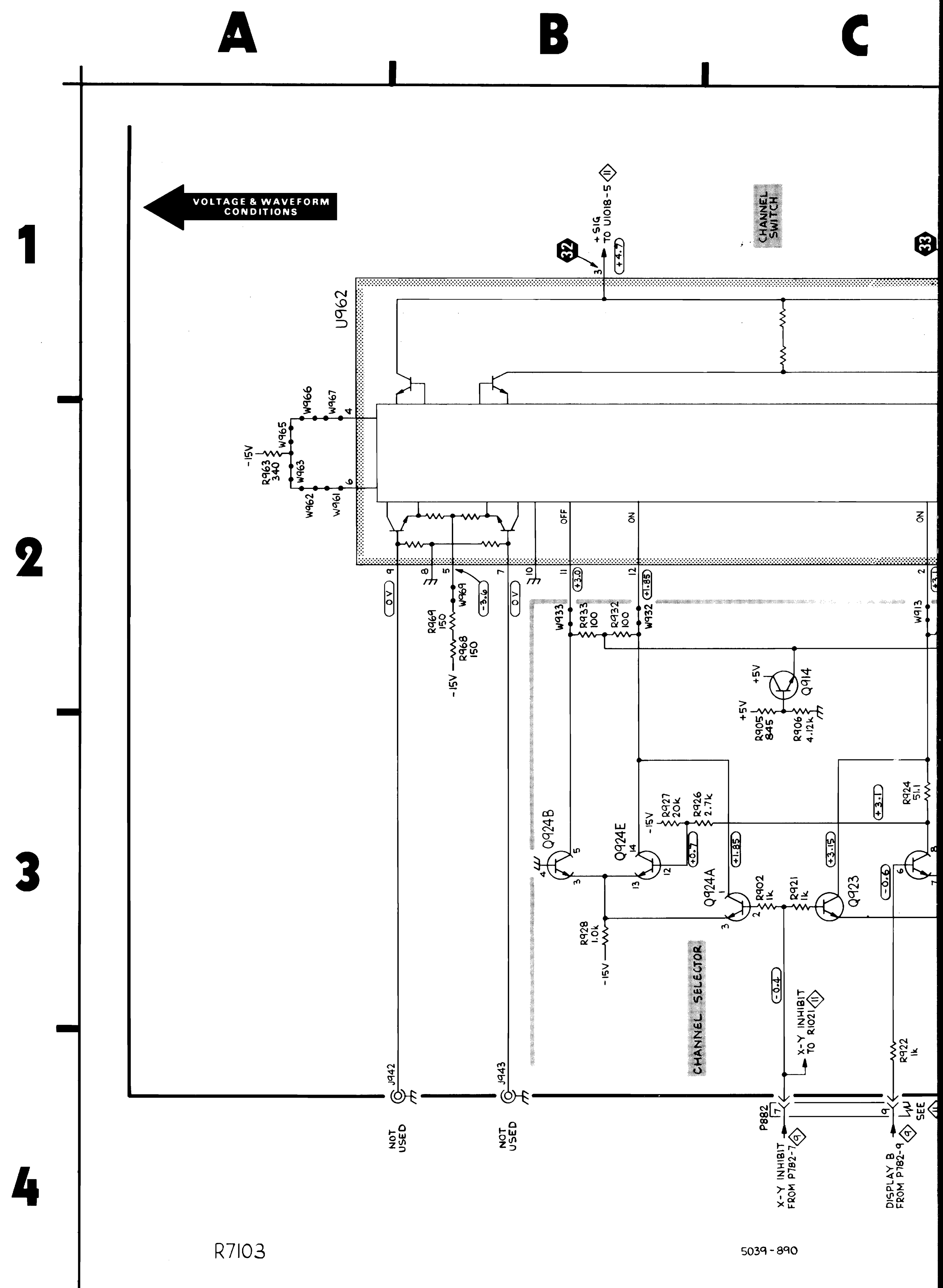
+4.75 V

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



Multimeter
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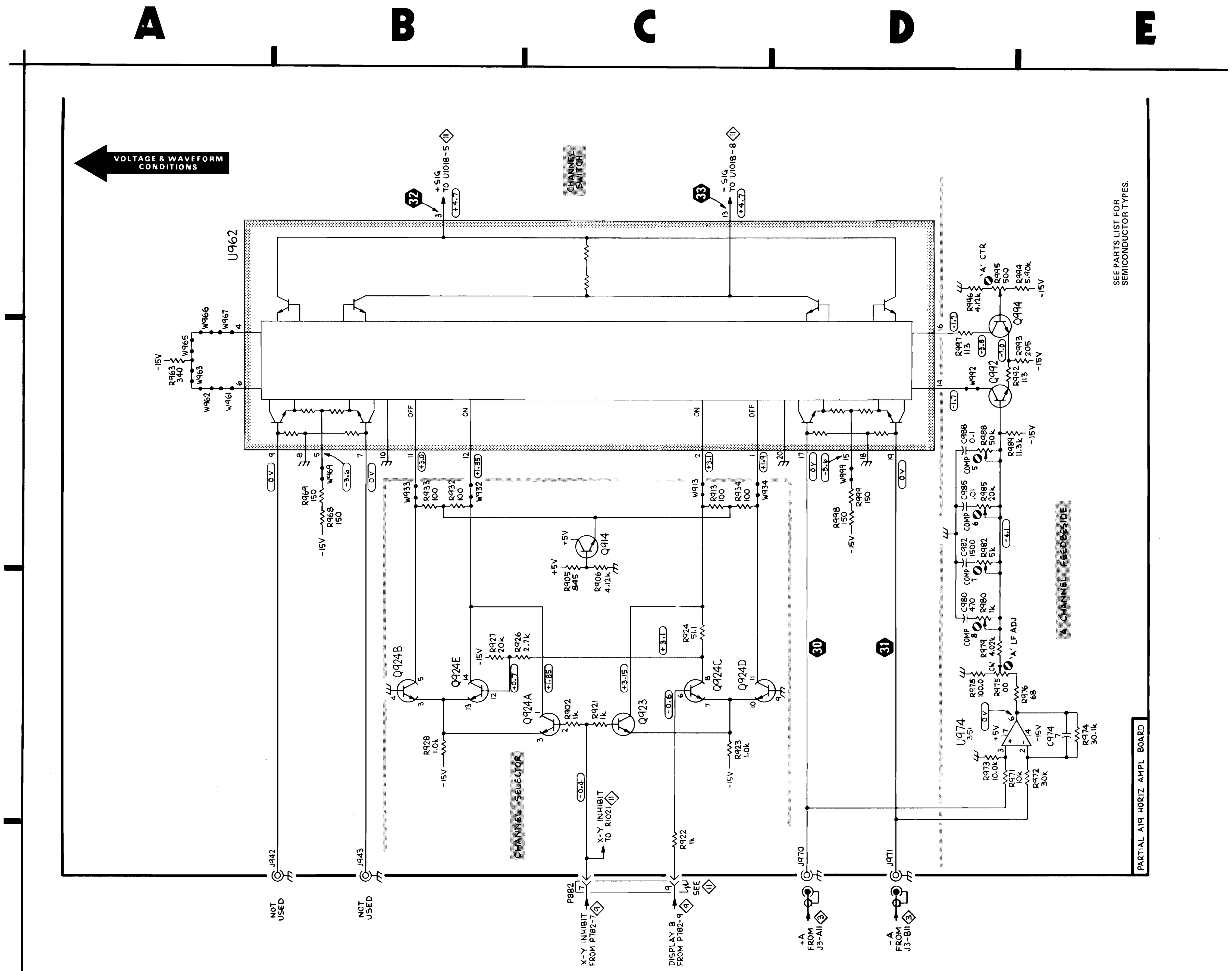

R7103

5039-890

HORIZONTAL CHANNEL SWITCH 10

10 Horizontal Channel Switch

Reverse Side A19

itive Devices
nance Section

BER EXAMPLE

Number
R1234
Schematic Circuit Number
mbly
used)

have no Assembly Number
e Electrical Parts List.

HORIZONTAL AMPLIFIER DIAGRAM 11

ASSEMBLY A19

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1001	4D	5F
C1002	4D	5F
C1003	5D	5F
C1004	5D	5G
C1011	3E	2G
C1017	3A	1F
C1019	2B	3E
C1035	4F	4I
C1036	4F	4I
C1040	1B	3F
C1044	2B	2F
C1060	3B	3F
C1064	3B	4G
C1073	3C	2H
C1075	2D	2G
C1077	2D	2G
C1096	5E	5I
CR1006	2E	2H
CR1082	4D	4G
L1001	4D	5H
L1002	4D	5H
L1003	5D	5G
L1004	5D	5G
L1042	2B	3F
L1062	3B	4F
LR1096	5E	4I
P1062	2B	4F
P1094	4G	1I
Q1022	4B	5I
Q1024	4B	5I
Q1028	4B	4H
Q1034	4B	4H
Q1046	2C	4F
Q1049	2C	4H
Q1052	2C	4H
Q1058	2C	2H
Q1066	3C	4F
Q1072	3C	4H
Q1078	3C	2G
Q1084	2E	1I
R1001	2A	2E
R1002	2A	2F
R1003	3B	4F
R1004	2A	1F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1005	2A	2F
R1007	2D	2G
R1010	2E	2H
R1011	2E	2G
R1012	3E	2G
R1013	2A	2E
R1014	2A	2E
R1015	2A	2E
R1016	3A	2F
R1017	3A	2F
R1018	2B	2E
R1019	2B	3E
R1020	3A	3F
R1021	4A	5I
R1022	4B	5I
R1023	4B	5H
R1024	4B	5I
R1025	4B	5I
R1026	4B	5H
R1028	4B	4G
R1029	4C	4G
R1030	4B	5G
R1031	4B	5G
R1032	4B	5H
R1033	4B	5H
R1034	4B	4I
R1034	4F	4I
R1035	4B	5H
R1036	4F	4I
R1037	4F	4I
R1040	1B	3F
R1041	1B	3F
R1042	2C	4E
R1043	2B	3F
R1044	2B	2F
R1045	2C	4E
R1046	2C	4G
R1047	2B	2G
R1049	2C	5I
R1052	2C	2H
R1054	3D	2G
R1058	2C	2H
R1059	2C	2H
R1060	3B	4F
R1061	3B	3F
R1062	2C	5E
R1063	3B	4F
R1064	3B	4G
R1065	2C	4E
R1066	3C	5G

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1067	3B	4G
R1069	2B	3F
R1071	2D	2G
R1072	3C	2H
R1073	3C	2G
R1074	2D	2G
R1075	2D	2G
R1076	2D	2G
R1077	2D	2G
R1078	3C	2H
R1079	1E	4G
R1080	1E	4G
R1081	1E	5H
R1082	1E	5G
R1083	1E	4G
R1084	2F	1I
R1085	2F	2H
R1086	2E	1I
R1087	2E	1I
R1088	2E	1I
R1089	2E	2H
R1094	3F	1I
R1095	3F	1I
R1096	5E	5I
RT1080	1E	4G
TP1028	4C	4H
TP1034	3C	4H
TP1058	2C	2H
TP1078	3C	2H
U1006	2A	2E
U1014A	2F	2H
U1014B	3E	2H
U1018	1B	3F
U1082	1D	3G
U1094	1F	3I
VR1005	2A	2F
VR1082	4E	4G
W1002	2A	2F
W1034	4F	4I
W1037	4F	4I
W1084	2E	3H
W1087	2F	3H
W1089	3F	4H
W1095	3F	2I

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1098	4G	CHASSIS
LR1097	4G	CHASSIS
LR1098	4G	CHASSIS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P782	4A	CHASSIS
P790	4A	CHASSIS
P882	4D	CHASSIS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1099	4G	CHASSIS

	A	B	C
1	SEE ASSEMBLY A19 CIRCUIT BOARD ILLUSTRATION ADJACENT TO DIAGRAM 10		

Horizontal Amplifier
component locator (A19)

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

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VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltages shown on the diagram were obtained with all R7103 front-panel variable controls, except INTENSITY and READOUT INTENSITY, set to midrange (INTENSITY and READOUT INTENSITY were set fully counterclockwise). Other R7103 front-panel controls were set as follows:

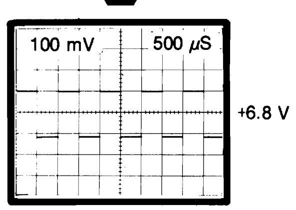
VERTICAL MODE	LEFT
TRIGGER SOURCE	VERT MODE
CALIBRATOR	4 V

A 7A-series amplifier plug-in unit was installed in the R7103 HORIZ plug-in compartment, and set as follows:

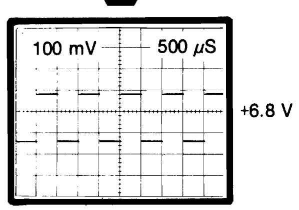
Position	Centered
Volts/Div	0.5
Input signal	None

Waveform Conditions: The waveforms shown below were obtained with a test oscilloscope with 1 MΩ input impedance and bandwidth of at least 60 MHz (TEKTRONIX 7904 Oscilloscope, 7B10 Time Base, and 7A13 Differential Comparator with a P6053 10X Probe). A 7A-series amplifier was installed in the R7103 HORIZ compartment and the output of the R7103 CALIBRATOR was connected to the input of the 7A-amplifier. The R7103 INTENSITY was set for a display of moderate brightness, and the CALIBRATOR signal was used to externally trigger the test oscilloscope. The 7A-amplifier was set to 0.5 V/Div to produce a display of six to eight divisions, centered on the R7103 crt.

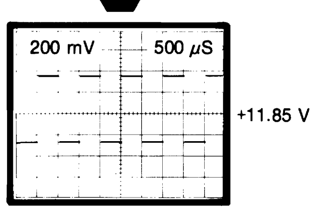
34



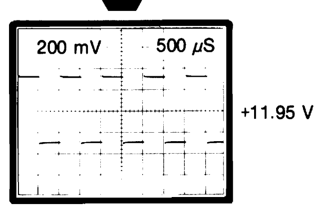
35



36



37



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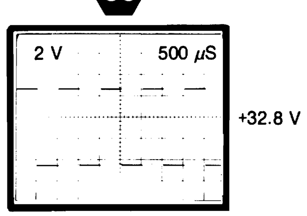
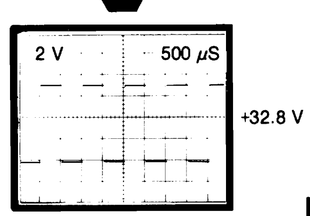
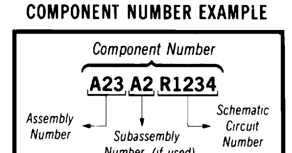


39

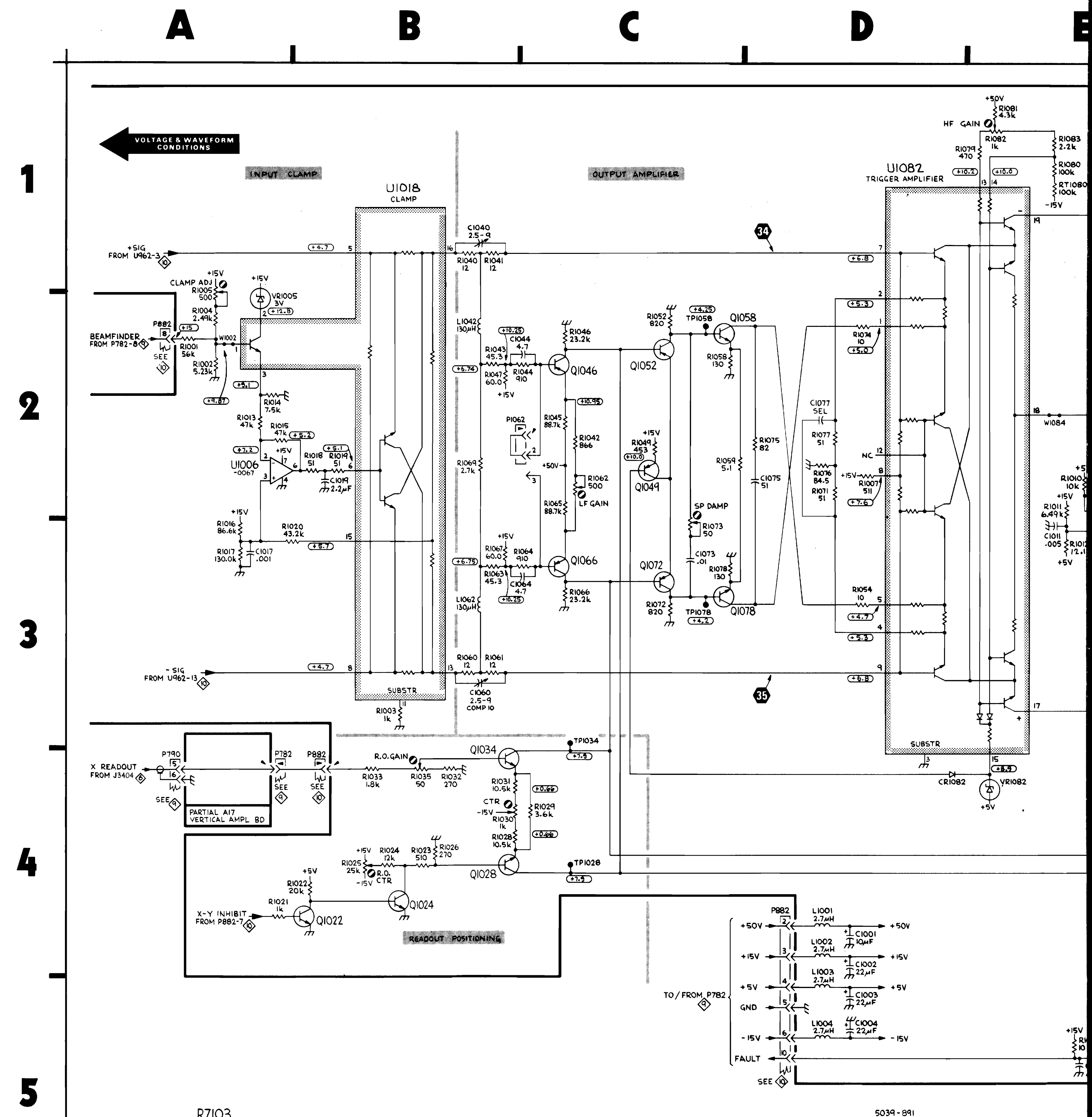


Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



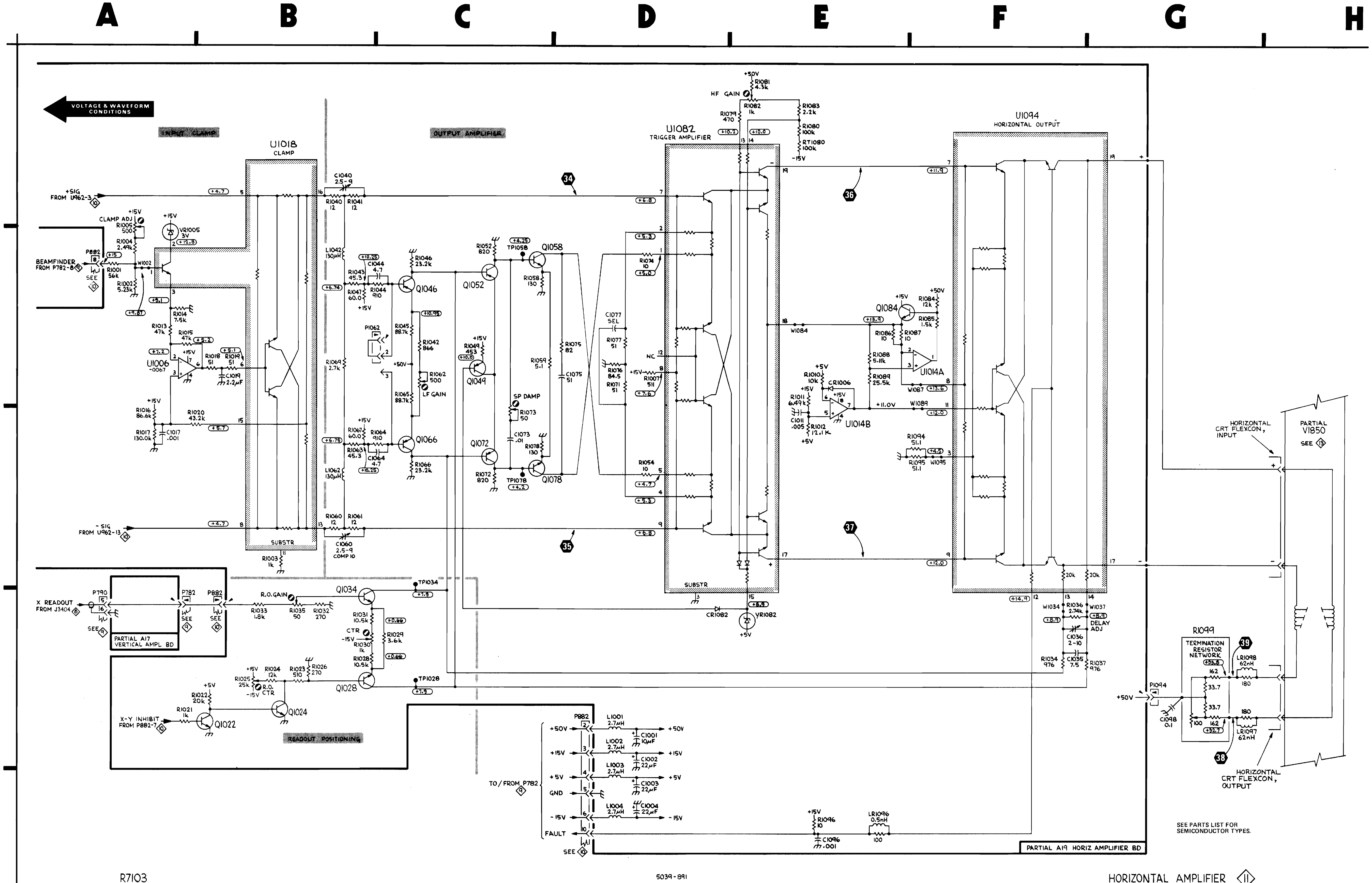
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



ultimeter
readout-

SITY and
e). Other

ance and
or with a
he R7103
moderate
set to 0.5



R7103

5039-891

HORIZONTAL AMPLIFIER 11

Horizontal Amplifier

Reverse Side A1,A21

itive Devices
nance Section

BER EXAMPLE

Number

R1234

Schematic Circuit Number

nbly
used)

have no Assembly Number
le Electrical Parts List.

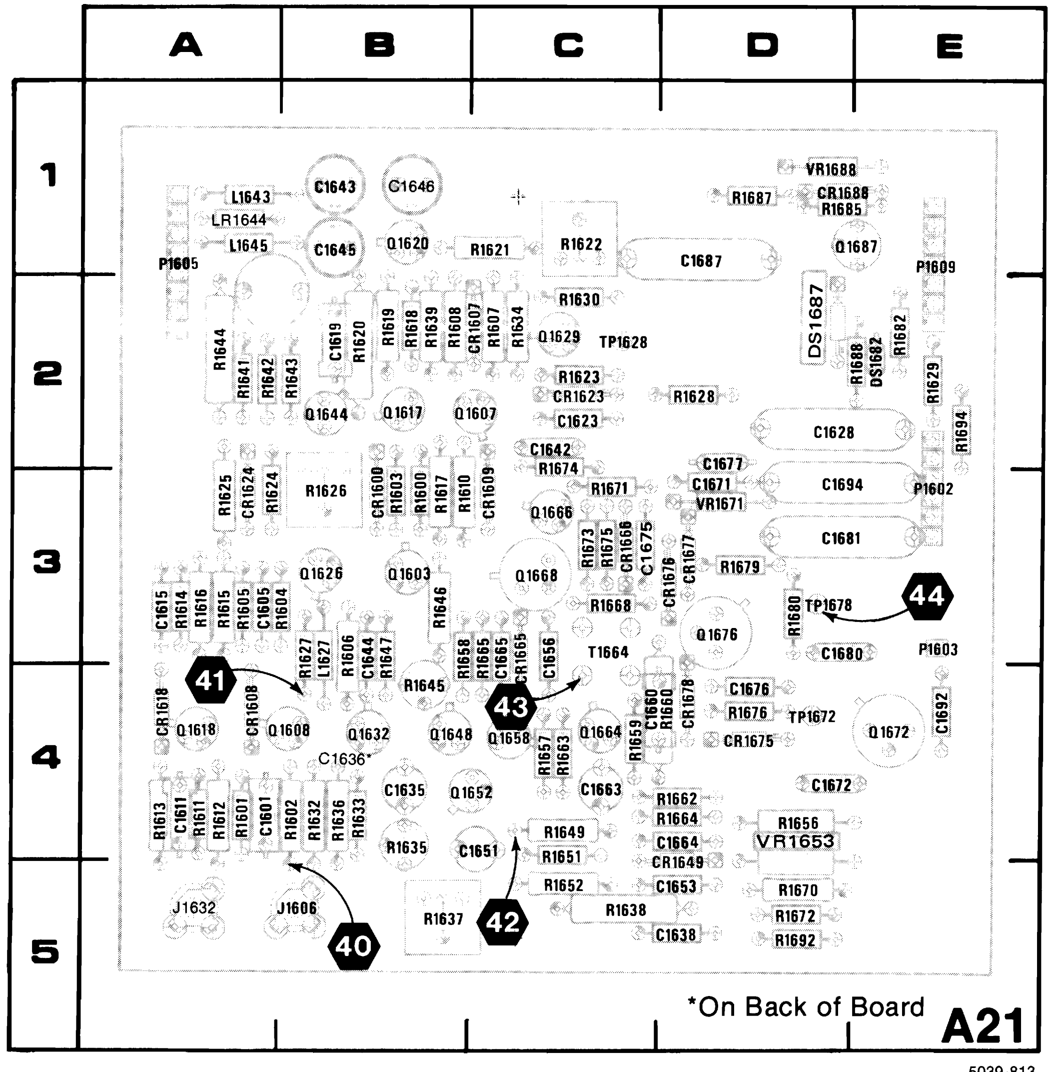


Figure 8-13. A21—Z-Axis Board assembly.

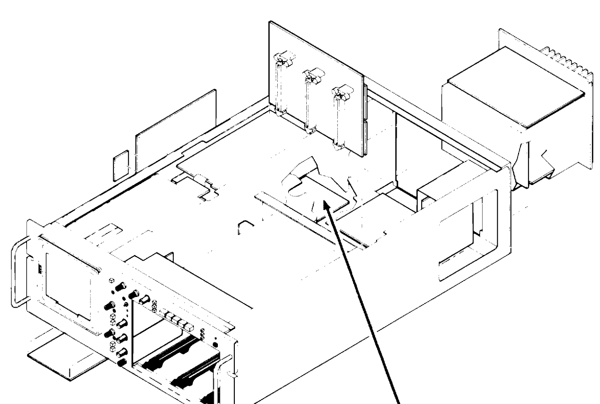
	A	B	C
1	SEE ASSEMBLY A1 CIRCUIT BOARD ILLUSTRATION ADJACENT TO DIAGRAM ⟨2⟩		

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List



INTENSITY LIMITER AND Z-AXIS DIAGRAM ⟨12⟩

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1950	3A	1E
C1952	3A	2D
C1953	3A	1E
C1955	3B	2E
C1956	3B	2E
C1968	2B	5E
C1969	2B	5D
C1971	3C	3F
C1982	4C	2G
C1984	3C	3F
C1985	3C	4F
C1985	3C	4F
C1990	4D	1E
C1993	3D	5F
C1994	1A	5E
C1994	2C	5E
C1995	1A	2F
C1996	1A	2F
C1997	1A	2F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR1963	3B	4E
CR1971	4B	3F
CR1972	2B	4E
CR1974	4C	3E
CR1991	2D	4F
CR1992	3C	3F
CR1992	3C	3F
CR1993	2E	4F
CR1994	3E	4F
CR1998	4C	2F
L1995	1A	2F
L1996	1A	1F
L1997	1A	2F
P1904	1A	1F
P1909	2C	1G
P1909	4D	1G
Q1956	3B	4D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
Q1970	2C	4E
Q1974	4C	2E
Q1978	4C	2F
Q1980	4C	2E
Q1982	4C	2E
Q1994	3D	5G
Q1995	3D	5F
Q1998	4C	2F
Q1999	5D	1F
R1950	3A	1E
R1951	3A	1E
R1952	3A	4E
R1953	3A	1E
R1954	3B	3E
R1955	3B	2E
R1956	3B	3D
R1957	3B	4E
R1958	3B	2E
R1959	4A	4E

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1960	4A	3E
R1961	4B	3E
R1962	4B	3E
R1963	3B	4E
R1964	3B	4E
R1965	3B	4E
R1966	3B	4E
R1967	2B	5E
R1968	2B	5E
R1969	2C	5E
R1970	2C	5E
R1971	4C	3E
R1972	2B	5E
R1973	2B	4E
R1974	4C	3E
R1975	2B	3E
R1976	2B	5E
R1977	2B	4E
R1979	3C	4F
R1980	4C	1E

CIRCUIT NUMBER	SCHEM LOCATION	B LO
R1981	4C	
R1982	4C	
R1983	3C	
R1985	3C	
R1985	3C	
R1986	3C	
R1986	3C	
R1987	3D	
R1988	4D	
R1989	4D	
R1990	4D	
R1991	3D	
R1992	3D	
R1993	3D	
R1994	3D	
R1995	3D	
R1996	4C	
R1997	4C	
R1998	5D	
R1999	4D	

Partial A1 also shown on diagrams 2 and 7.

ASSEMBLY A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1601	1E	4A
C1605	2E	3A
C1611	1E	4A
C1615	1E	3A
C1619	2G	2B
C1623	1G	2C
C1628	1H	2D
C1635	3F	4B
C1636	3F	4B
C1638	2F	5D
C1642	4E	2C
C1643	4E	1B
C1644	3E	3B
C1645	5E	1B
C1646	4E	1B
C1651	4F	4C
C1653	4F	5D
C1656	4F	3C
C1660	5G	4C
C1663	3F	4C
C1664	3G	4D
C1665	4G	3C
C1671	3H	3D
C1672	3G	4D
C1675	4G	3C

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1676	3G	4D
C1677	4G	2D
CR1600	2F	3B
CR1607	2F	2C
CR1608	2E	4A
CR1609	2F	3C
CR1618	1E	4A
CR1623	1G	2C
CR1624	1E	3A
CR1649	4F	4D
CR1665	4G	3C
CR1666	4G	3C
CR1675	4G	4D
CR1676	3G	3D
CR1677	4G	3D
CR1678	4G	4D
J1606	1E	5B
J1632	1E	5A
L1627	1F	3B
L1643	4E	1A
L1645	5E	1A

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
LR1644	4E	1A
P1605	3E	1A
Q1603	2F	3B
Q1607	2F	2C
Q1608	1E	4B
Q1617	2G	2B
Q1618	1E	4A
Q1620	2G	1B
Q1626	1F	3B
Q1629	1G	2C
Q1632	3F	4B
Q1644	3E	2B
Q1648	3F	4B
Q1652	3F	4B
Q1658	4F	4C
Q1664	3G	4C
Q1666	4G	3C
Q1668	4G	3C
Q1672	3G	4E
Q1676	3G	3D
R1600	2F	3B
R1601	1E	4A

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1602	1E	4B
R1603	2F	3B
R1604	2E	3A
R1605	2E	3A
R1606	2F	3B
R1607	2F	2C
R1608	2F	2B
R1610	2G	3B
R1611	1E	4A
R1612	1E	4A
R1613	1E	4A
R1614	1E	3A
R1615	1E	3A
R1616	1E	3A
R1617	2G	3B
R1618	2G	2B
R1619	2G	2B
R1620	2G	2B
R1621	1G	1C
R1622	1G	1C
R1623	1G	2C
R1624	1E	3A
R1625	1E	3A
R1626	1E	3B
R1627	1F	3B

CIRCUIT NUMBER	SCHEM LOCATION	B LO
R1628	1H	
R1630	2G	
R1632	2F	
R1633	3F	
R1634	2G	
R1635	3F	
R1636	3F	
R1637	3F	
R1638	2F	
R1639	2G	
R1641	3E	
R1642	3E	
R1643	3E	
R1644	3F	
R1645	3F	
R1646	3F	
R1647	3F	
R1649	4F	
R1651	4F	
R1652	4F	
R1656	4F	
R1657	4F	
R1658	4F	
R1659	5G	
R1660	5G	

Partial A21 also shown on diagram 13.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS1970	3C	CHASSIS
DS1994	3E	CHASSIS
J1989	5D	CHASSIS
S1988	4D	CHASSIS

Assembly A21 & component locator

INTENSITY LIMITER AND Z-AXIS DIAGRAM 12

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1950	3A	1E
C1952	3A	2D
C1953	3A	1E
C1955	3B	2E
C1956	3B	2E
C1968	2B	5E
C1969	2B	5D
C1971	3C	3F
C1982	4C	2G
C1984	3C	3F
C1985	3C	4F
C1985	3C	4F
C1990	4D	1E
C1993	3D	5F
C1994	1A	5E
C1994	2C	5E
C1995	1A	2F
C1996	1A	2F
C1997	1A	2F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR1963	3B	4E
CR1971	4B	3F
CR1972	2B	4E
CR1974	4C	3E
CR1991	2D	4F
CR1992	3C	3F
CR1992	3C	3F
CR1993	2E	4F
CR1994	3E	4F
CR1998	4C	2F
L1995	1A	2F
L1996	1A	1F
L1997	1A	2F
P1904	1A	1F
P1909	2C	1G
P1909	4D	1G
Q1956	3B	4D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
Q1970	2C	4E
Q1974	4C	2E
Q1978	4C	2F
Q1980	4C	2E
Q1982	4C	2E
Q1994	3D	5G
Q1995	3D	5F
Q1998	4C	2F
Q1999	5D	1F
R1950	3A	1E
R1951	3A	1E
R1952	3A	4E
R1953	3A	1E
R1954	3B	3E
R1955	3B	2E
R1956	3B	3D
R1957	3B	4E
R1958	3B	2E
R1959	4A	4E

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1960	4A	3E
R1961	4B	3E
R1962	4B	3E
R1963	3B	4E
R1964	3B	4E
R1965	3B	4E
R1966	3B	4E
R1967	2B	5E
R1968	2B	5E
R1969	2C	5E
R1970	2C	5E
R1971	4C	3E
R1972	2B	5E
R1973	2B	4E
R1974	4C	3E
R1975	2B	3E
R1976	2B	5E
R1977	2B	4E
R1979	3C	4F
R1980	4C	1E

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1981	4C	2E
R1982	4C	2F
R1983	3C	3F
R1985	3C	4F
R1985	3C	4F
R1986	3C	4F
R1986	3C	4F
R1987	3D	5F
R1988	4D	1E
R1989	4D	1E
R1990	4D	1F
R1991	3D	5F
R1992	3D	5E
R1993	3D	4F
R1994	3D	4F
R1995	3D	4F
R1996	4C	2F
R1997	4C	2F
R1998	5D	1F
R1999	4D	1F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
TP1952	3A	2D
TP1956	3B	1F
TP1958	3B	4D
TP1962	4B	2E
TP1968	2C	5E
TP1970	3C	4E
TP1986	3D	4F
TP1991	3D	4F
TP1992	3D	4F
U1952	3A	2E
U1958A	3B	3E
U1958B	4B	3E
U1968	2C	5E
U1970	3C	3E
U1986	3C	3F
U1992	3D	5F

Partial A1 also shown on diagrams 2 and 7.

ASSEMBLY A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1601	1E	4A
C1605	2E	3A
C1611	1E	4A
C1615	1E	3A
C1619	2G	2B
C1623	1G	2C
C1628	1H	2D
C1635	3F	4B
C1636	3F	4B
C1638	2F	5D
C1642	4E	2C
C1643	4E	1B
C1644	3E	3B
C1645	5E	1B
C1646	4E	1B
C1651	4F	4C
C1653	4F	5D
C1656	4F	3C
C1660	5G	4C
C1663	3F	4C
C1664	3G	4D
C1665	4G	3C
C1671	3H	3D
C1672	3G	4D
C1675	4G	3C

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1676	3G	4D
C1677	4G	2D
CR1600	2F	3B
CR1607	2F	2C
CR1608	2E	4A
CR1609	2F	3C
CR1618	1E	4A
CR1623	1G	2C
CR1624	1E	3A
CR1649	4F	4D
CR1665	4G	3C
CR1666	4G	3C
CR1675	4G	4D
CR1676	3G	3D
CR1677	4G	3D
CR1678	4G	4D
J1606	1E	5B
J1632	1E	5A
L1627	1F	3B
L1643	4E	1A
L1645	5E	1A

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
LR1644	4E	1A
P1605	3E	1A
Q1603	2F	3B
Q1607	2F	2C
Q1608	1E	4B
Q1617	2G	2B
Q1618	1E	4A
Q1620	2G	1B
Q1626	1F	3B
Q1629	1G	2C
Q1632	3F	4B
Q1644	3E	2B
Q1648	3F	4B
Q1652	3F	4B
Q1658	4F	4C
Q1664	3G	4C
Q1666	4G	3C
Q1668	4G	3C
Q1672	3G	4E
Q1676	3G	3D
R1600	2F	3B
R1601	1E	4A

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1602	1E	4B
R1603	2F	3B
R1604	2E	3A
R1605	2E	3A
R1606	2F	3B
R1607	2F	2C
R1608	2F	2B
R1610	2G	3B
R1611	1E	4A
R1612	1E	4A
R1613	1E	4A
R1614	1E	3A
R1615	1E	3A
R1616	1E	3A
R1617	2G	3B
R1618	2G	2B
R1619	2G	2B
R1620	2G	2B
R1621	1G	1C
R1622	1G	1C
R1623	1G	2C
R1624	1E	3A
R1625	1E	3A
R1626	1E	3B
R1627	1F	3B

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1628	1H	2D
R1630	2G	2C
R1632	2F	4B
R1633	3F	4B
R1634	2G	2C
R1635	3F	4B
R1636	3F	4B
R1637	3F	5B
R1638	2F	5C
R1639	2G	2B
R1641	3E	2A
R1642	3E	2A
R1643	3E	2B
R1644	3F	2A
R1645	3F	4B
R1646	3F	3B
R1647	3F	3B
R1649	4F	4C
R1651	4F	4C
R1652	4F	5C
R1656	4F	4D
R1657	4F	4C
R1658	4F	3B
R1659	5G	4C
R1660	5G	4D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1662	3G	4D
R1663	4F	4C
R1664	3G	4D
R1665	4G	3C
R1668	4G	3C
R1670	3H	5D
R1671	4G	3C
R1672	3G	5D
R1673	4G	3C
R1674	4G	2C
R1675	4G	3C
R1676	3G	4D
R1679	4G	3D
T1664	4G	3C
TP1628	1H	2C
TP1672	3G	4D
TP1678	4G	3D
VR1653	4F	4D
VR1671	3H	3D

Partial A21 also shown on diagram 13.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS1970	3C	CHASSIS
DS1994	3E	CHASSIS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J1989	5D	CHASSIS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
S1988	4D	CHASSIS

VOLTAGE AND WAVEFORM CONDITIONS

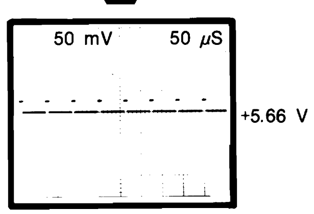
Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltages shown on the diagram were obtained with all R7103 front-panel variable controls, except INTENSITY and READOUT INTENSITY, set to midrange (INTENSITY and READOUT INTENSITY were set fully counterclockwise). Other R7103 front-panel controls were set as follows:

VERTICAL MODE ....LEFT
TRIGGER SOURCE ....VERT MODE

Waveform Conditions: The waveforms shown below were obtained with a test oscilloscope with 1 MΩ input impedance and bandwidth of at least 60 MHz (a TEKTRONIX 7904 Oscilloscope, 7B10 Time Base, and 7A13 Differential Comparator with a P6053 10X Probe, in this case). A 7B-series time base was installed in the R7103 HORIZ plug-in compartment; the time base was set to free run at 5 μs/div. The INTENSITY control was turned clockwise until the LIMITED VIEWING TIME indicator was lit.

40



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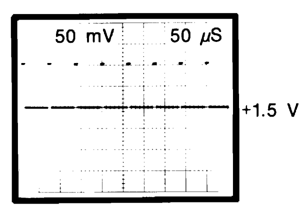

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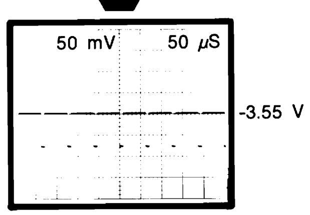

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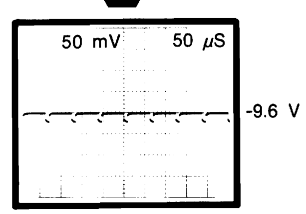

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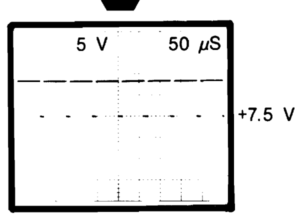
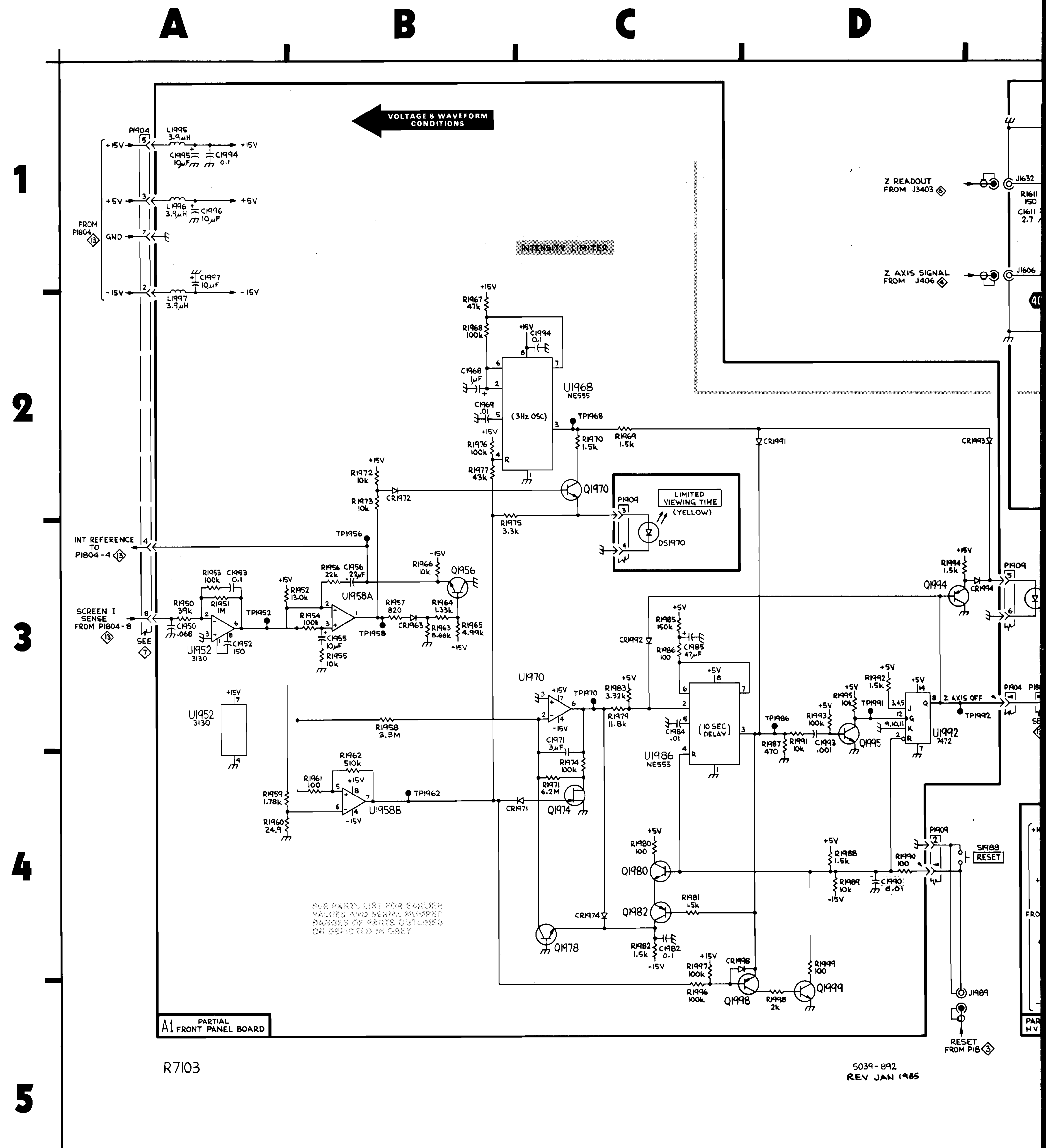


Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



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BER EXAMPLE

Number
R1234
Schematic Circuit Number
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have no Assembly Number
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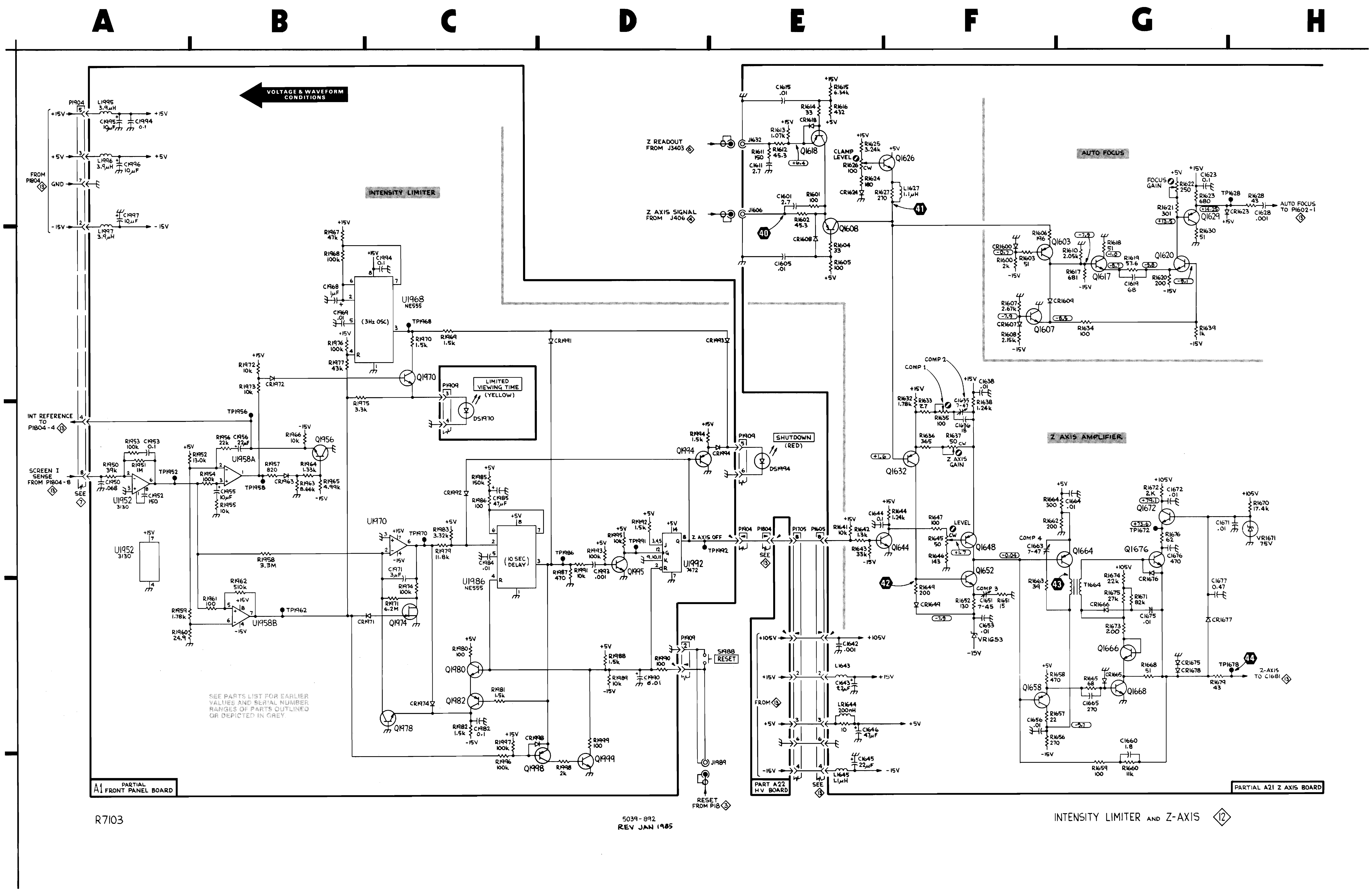

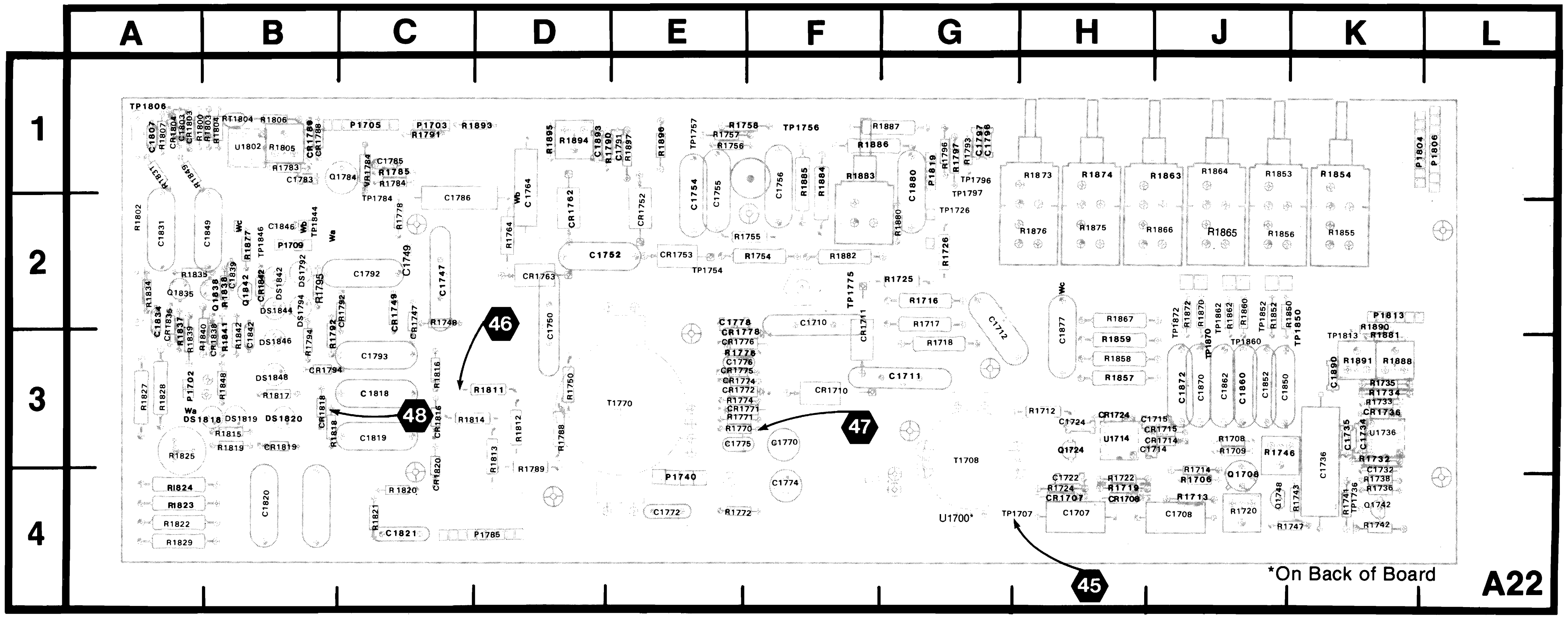

Figure 8-14. A22—High-Voltage Board assembly.

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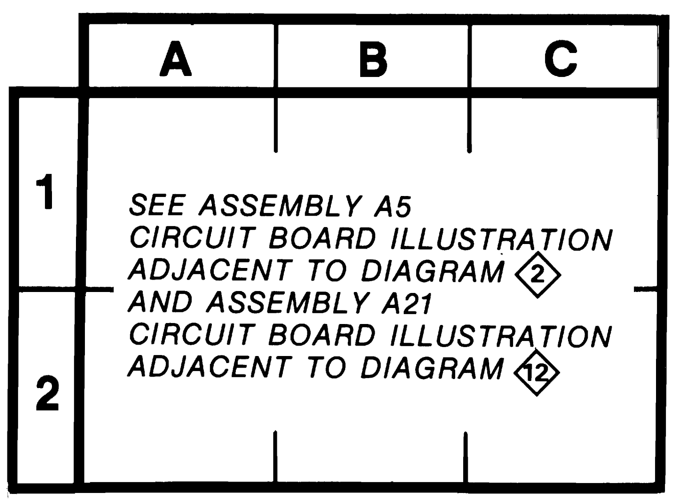
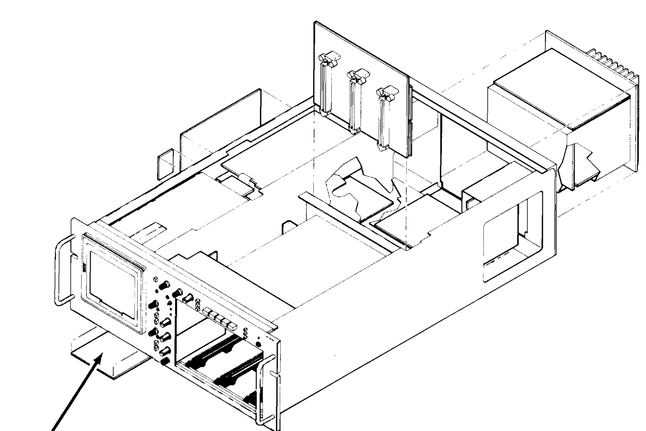
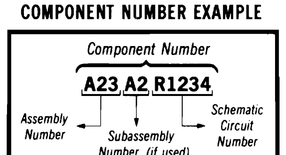




A22
HIGH-VOLTAGE
BOARD

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

ASSEMBLY A5

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRC NUM
R309	4C	4B	R310	1H	3A	R31

Partial A5 also shown on diagram 2.

ASSEMBLY A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRC NUM
C1680	3E	3D	CR1688	3F	1D	P16
C1681	3E	3D				P16
C1687	3F	1D	DS1682	3E	2E	
C1692	2E	4E	DS1687	3E	2D	Q16
C1694	5E	3D				

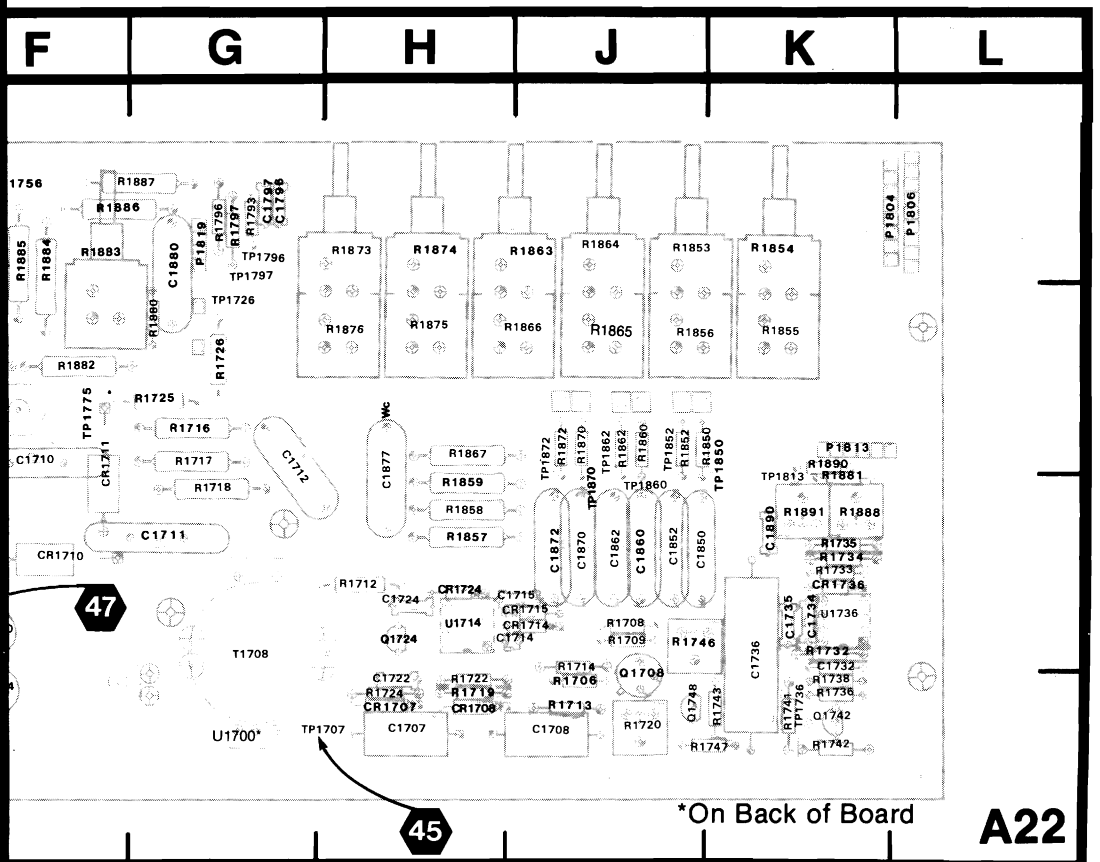
Partial A21 also shown on diagram 12.

ASSEMBLY A22

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRC NUM
C1707	2A	4H	C1860	2G	3J	DS1
C1708	2A	4J	C1862	2G	3J	DS1
C1710	2B	2F	C1870	2G	3J	DS1
C1711	1B	3G	C1872	3G	3J	DS1
C1712	2B	2G	C1877	3H	3H	DS1
C1714	2B	3J	C1880	2C	1G	
C1715	3B	3J	C1890	3G	3K	P17
C1722	2B	4H	C1893	4G	1D	P17
C1724	3B	3H				P17
C1732	3C	3K	CR1707	2A	4H	P17
C1735	3B	3K	CR1708	2A	4H	P18
C1736	2C	3K	CR1710	2B	3F	
C1747	3C	2C	CR1711	2B	2F	Q17
C1749	3D	2C	CR1714	2B	3J	Q17
C1750	4A	2D	CR1715	2B	3J	Q17
C1752	1A	2D	CR1724	3C	3H	Q17
C1754	1B	1E	CR1736	2C	3K	Q17
C1755	1B	1E	CR1747	3D	2C	Q18
C1756	1B	1F	CR1749	3D	2C	Q18
C1764	3B	1D	CR1752	1A	2E	Q18
C1770	4A	3F	CR1753	1B	2E	
C1772	5A	4E	CR1762	4A	2D	R17
C1774	4B	4F	CR1763	3B	2D	R17
C1775	5A	3E	CR1771	4B	3E	R17
C1776	4B	3E	CR1772	4B	3E	R17
C1778	4B	2E	CR1774	4A	3E	R17
C1783	4B	1B	CR1775	4A	3E	R17
C1785	4B	1C	CR1775	4B	3E	R17
C1786	4B	2C	CR1776	4B	3E	R17
C1791	2D	1E	CR1778	4B	3E	R17
C1792	3D	2C	CR1788	4C	1B	R17
C1793	3D	3C	CR1789	5C	1B .	R17
C1796	1E	1G	CR1792	3D	2C	R17
C1797	1E	1G	CR1794	3D	3B	R17
C1803	3B	1A	CR1803	4C	1A	R17
C1807	4D	1A	CR1804	4C	1A	R17
C1818	4D	3C	CR1816	4D	3C	R17
C1819	4D	3C	CR1818	4D	3B	R17
C1820	4D	4B	CR1819	4D	3B	R17
C1821	4D	4C	CR1820	4D	4C	R17
C1831	5C	2A	CR1835	5D	2A	R17
C1834	5D	2A	CR1838	5D	3B	R17
C1839	5D	2B	CR1842	5D	2B	R17
C1842	5D	3B				R17
C1846	5D	2B	DS1792	3E	2B	R17
C1849	5E	2B	DS1794	3E	2B	R17
C1850	2G	3J	DS1818	4D	3B	R17
C1852	2G	3J	DS1819	4D	3B	R17

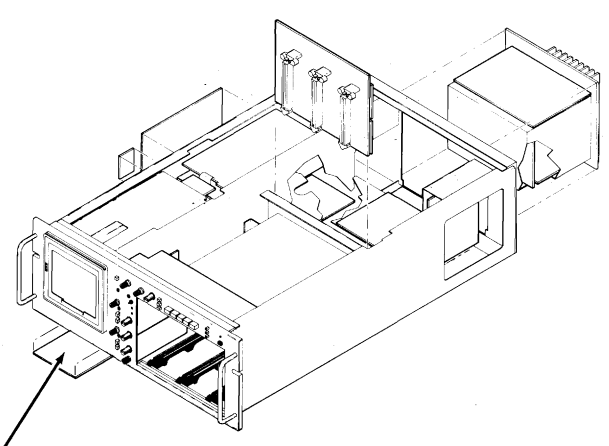
CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCU NUMB
P85	2D	CHASSIS	P1603	2F	CHASSIS	P170
P89	2C	CHASSIS	P1605	2E	CHASSIS	P170
P1602	3F	CHASSIS	P1609	E3	CHASSIS	P170



5039-814

...tage Board assembly.



CRT CIRCUIT DIAGRAM 13

ASSEMBLY A5

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R309	4C	4B	R310	1H	3A	R313	4H	4B	S309	4C	4A

Partial A5 also shown on diagram 2.

ASSEMBLY A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1680	3E	3D
C1681	3E	3D
C1687	3F	1D
C1692	2E	4E
C1694	5E	3D
CR1688	3F	1D
DS1682	3E	2E
DS1687	3E	2D
P1603	2F	3E
P1609	3E	1E
Q1687	3E	1D
R1629	4F	2E
R1680	3E	3D
R1682	3E	2E
R1685	3F	1D
R1687	3F	1D
R1688	3E	2E
R1692	2E	5D
R1694	5E	2E
VR1688	3E	1D

Partial A21 also shown on diagram 12.

ASSEMBLY A22

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1707	2A	4H
C1708	2A	4J
C1710	2B	2F
C1711	1B	3G
C1712	2B	2G
C1714	2B	3J
C1715	3B	3J
C1722	2B	4H
C1724	3B	3H
C1732	3C	3K
C1735	3B	3K
C1736	2C	3K
C1747	3C	2C
C1749	3D	2C
C1750	4A	2D
C1752	1A	2D
C1754	1B	1E
C1755	1B	1E
C1756	1B	1F
C1764	3B	1D
C1770	4A	3F
C1772	5A	4E
C1774	4B	4F
C1775	5A	3E
C1776	4B	3E
C1778	4B	2E
C1783	4B	1B
C1785	4B	1C
C1786	4B	2C
C1791	2D	1E
C1792	3D	2C
C1793	3D	3C
C1796	1E	1G
C1797	1E	1G
C1803	3B	1A
C1807	4D	1A
C1818	4D	3C
C1819	4D	3C
C1820	4D	4B
C1821	4D	4C
C1831	5C	2A
C1834	5D	2A
C1839	5D	2B
C1842	5D	3B
C1846	5D	2B
C1849	5E	2B
C1850	2G	3J
C1852	2G	3J

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1860	2G	3J
C1862	2G	3J
C1870	2G	3J
C1872	3G	3J
C1877	3H	3H
C1880	2C	1G
C1890	3G	3K
C1893	4G	1D
CR1707	2A	4H
CR1708	2A	4H
CR1710	2B	3F
CR1711	2B	2F
CR1714	2B	3J
CR1715	2B	3J
CR1724	3C	3H
CR1736	2C	3K
CR1747	3D	2C
CR1749	3D	2C
CR1752	1A	2E
CR1753	1B	2E
CR1762	4A	2D
CR1763	3B	2D
CR1771	4B	3E
CR1772	4B	3E
CR1774	4A	3E
CR1775	4A	3E
CR1775	4B	3E
CR1776	4B	3E
CR1778	4B	3E
CR1788	4C	1B
CR1789	5C	1B
CR1792	3D	2C
CR1794	3D	3B
CR1803	4C	1A
CR1804	4C	1A
CR1816	4D	3C
CR1818	4D	3B
CR1819	4D	3B
CR1820	4D	4C
CR1835	5D	2A
CR1838	5D	3B
CR1842	5D	2B
DS1792	3E	2B
DS1794	3E	2B
DS1818	4D	3B
DS1819	4D	3B

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS1820	4D	3B
DS1842	5D	2B
DS1844	5D	2B
DS1846	5D	3B
DS1848	5E	3B
P1702	5F	3A
P1703	4G	1C
P1709	4E	2B
P1740	4A	4E
P1819	1F	1G
Q1708	2A	4J
Q1724	2B	3H
Q1742	2C	4K
Q1748	3C	4J
Q1784	4B	1C
Q1835	5D	2A
Q1838	5D	2B
Q1842	5D	2B
R1706	2B	4J
R1708	2A	3J
R1709	2A	3J
R1712	2B	3H
R1713	2B	4J
R1714	2B	3J
R1716	2B	2G
R1717	2B	2G
R1718	2B	3G
R1719	2B	4H
R1720	2B	4J
R1722	2B	4H
R1724	2B	4H
R1725	2B	2G
R1726	2B	2G
R1732	2C	3K
R1733	2C	3K
R1734	2C	3K
R1735	2C	3K
R1736	2C	4K
R1738	2C	4K
R1741	2D	4K
R1742	2D	4K
R1743	3C	4K
R1746	3C	3J
R1747	3C	4K
R1748	3D	2C

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1750	4A	3D
R1754	1B	2E
R1755	1B	2F
R1756	1B	1E
R1757	1B	1E
R1758	1B	1E
R1764	4B	2D
R1770	4A	3E
R1771	4B	3E
R1772	5A	4E
R1774	4B	3E
R1776	4B	3E
R1778	4B	2C
R1783	4B	1B
R1784	4B	1C
R1785	4B	1C
R1788	4C	3D
R1789	4D	3D
R1790	2D	1D
R1791	2D	1C
R1792	3D	3B
R1793	2D	1G
R1794	3D	3B
R1795	3E	2B
R1796	1E	2B
R1797	1E	1G
R1800	5C	1A
R1802A	4C	2A
R1802B	5C	2A
R1802C	5C	2A
R1803	5C	1B
R1804	5C	1B
R1805	4D	1B
R1806	4D	1B
R1807	5D	1A
R1811	4D	3D
R1812	4D	3D
R1813	4D	3D
R1814	4D	3C
R1815	4E	3B
R1816	4D	3C
R1817	4D	3B
R1818	4D	3B
R1819	4D	3B
R1820	4D	4C
R1821	4D	4C
R1822	4E	4A
R1823	4E	4A

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1824	4E	4A
R1825	4E	3A
R1827	4E	3A
R1828	4E	3A
R1829	4E	4A
R1831	5C	1A
R1834	5D	2A
R1835	5D	2A
R1837	5D	3A
R1838	5D	2B
R1839	5D	3A
R1840	5D	3A
R1841	5D	3B
R1842	5D	3B
R1848	5E	3B
R1849	4E	1A
R1850	2G	2J
R1852	2G	2J
R1853	2G	1J
R1854	2G	1K
R1855	2G	2K
R1856	2G	2J
R1857	2G	3H
R1858	2G	3H
R1859	2G	3H
R1860	2G	2J
R1862	2G	2J
R1863	2H	1J
R1864	2G	1J
R1865	2H	2J
R1866	2H	2J
R1867	2G	2H
R1870	2G	2J
R1872	3G	2J
R1873	2H	1H
R1874	2H	1H
R1875	2H	2J
R1876	3H	2H
R1877	3H	2B
R1880	2C	2G
R1881	3G	3K
R1882	1B	2F
R1883	2B	1F
R1884	2B	1F
R1885	2B	1F
R1886	2B	1F
R1887	2B	1G
R1888	3G	3K

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1890	3G	2K
R1891	3G	3K
R1893	4G	1C
R1894	4G	1D
R1895	4G	1D
R1896	4G	1E
R1897	4G	1E
RT1804	5C	1B
T1708	2B	3G
T1770	4A	3E
TP1707	2A	4H
TP1726	2E	2G
TP1736	2C	4K
TP1754	1B	2E
TP1756	5A	1F
TP1757	1B	1E
TP1775	1B	2F
TP1784	4B	2C
TP1796	1E	1G
TP1797	1E	1G
TP1806	5C	1A
TP1813	3G	3K
TP1844	3B	2B
TP1846	4D	2B
TP1850	2G	3K
TP1852	2G	2J
TP1860	2G	3J
TP1862	2G	2J
TP1870	2G	3J
TP1872	3G	2J
U1700	1A	4G
U1714A	2B	3H
U1714B	2B	3H
U1714	3B	3H
U1736	2C	3K
U1736	3B	3K
U1802	3B	1B
U1802	4C	1B
VR1784	4B	1C

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P85	2D	CHASSIS
P89	2C	CHASSIS
P1602	3F	CHASSIS
P1603	2F	CHASSIS
P1605	2E	CHASSIS
P1609	E3	CHASSIS
P1702	5F	CHASSIS
P1703	4G	CHASSIS
P1705	2E	CHASSIS
P1709	E3	CHASSIS
P1740	4A	CHASSIS
P1785	2A	CHASSIS
P1804	1A	CHASSIS
P1806	2A	CHASSIS
P1810	2G	CHASSIS
P1813	3G	CHASSIS
P2006	4D	CHASSIS

VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope, and a TEKTRONIX P6013A, 12 kV, 1000X Probe, Tektronix Part 010-0117-01.

The voltages shown on the diagram were obtained with all R7103 front-panel variable controls, except INTENSITY, set at midrange (INTENSITY was set fully counterclockwise). Other front-panel controls were set as follows:

VERTICAL MODE ....LEFT
TRIGGER SOURCE ....VERT MODE

No plug-in units were installed in the R7103.

Waveform Conditions: The waveforms shown below were obtained with a test oscilloscope with 1 MΩ input impedance and bandwidth of at least 60 MHz (a TEKTRONIX 7904 Oscilloscope, 7B10 Time Base, and 7A13 Differential Comparator with a P6053 10X Probe, in this case).

No plug-in units were installed in the R7103.

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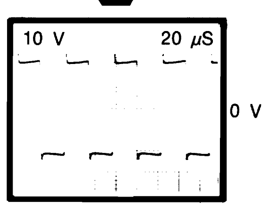

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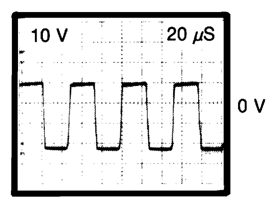

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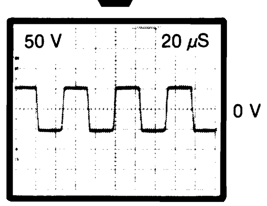

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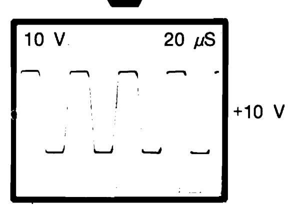
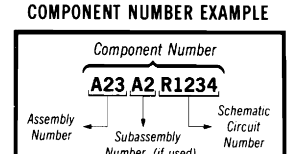
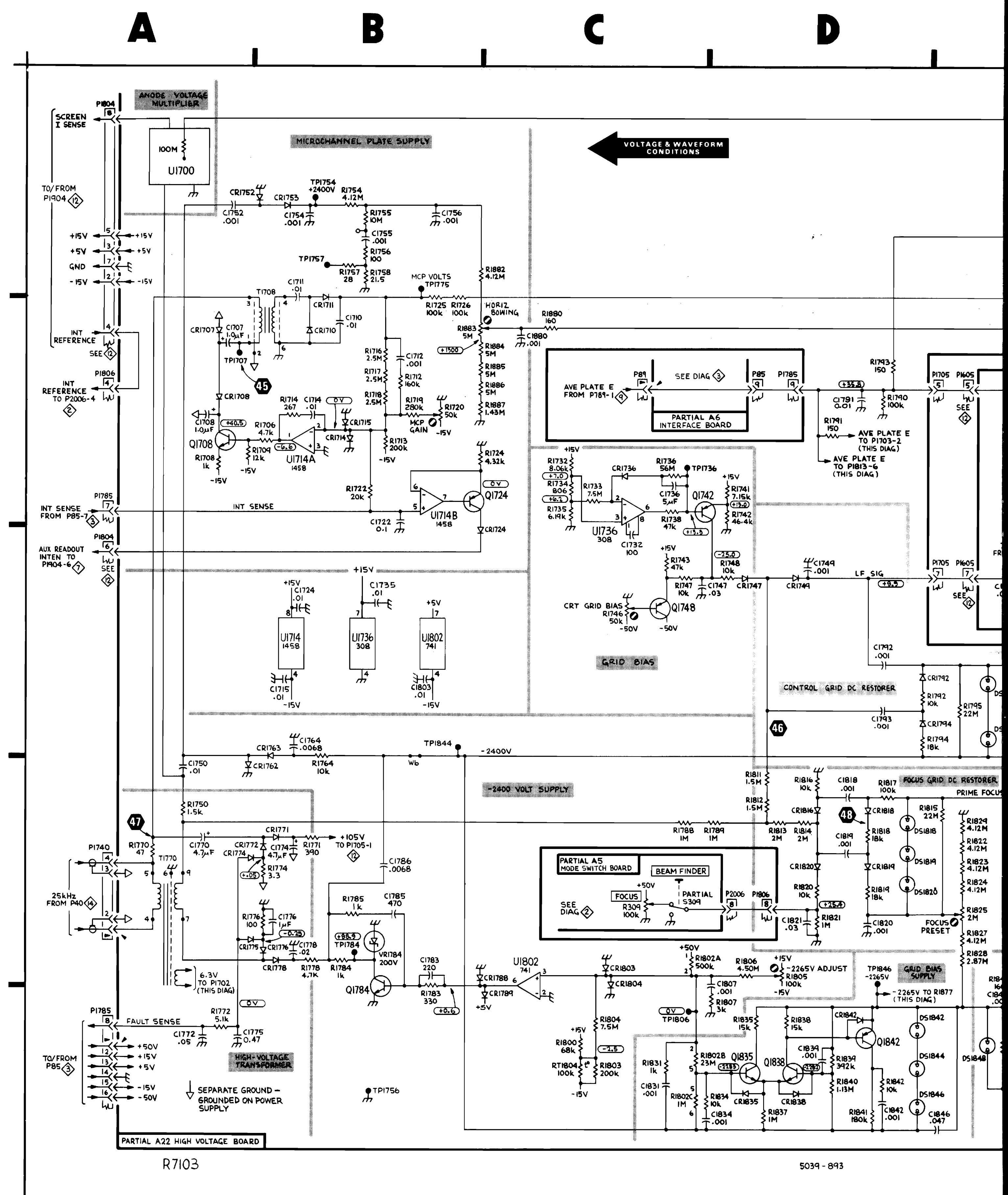


Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



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Schematic Circuit Number
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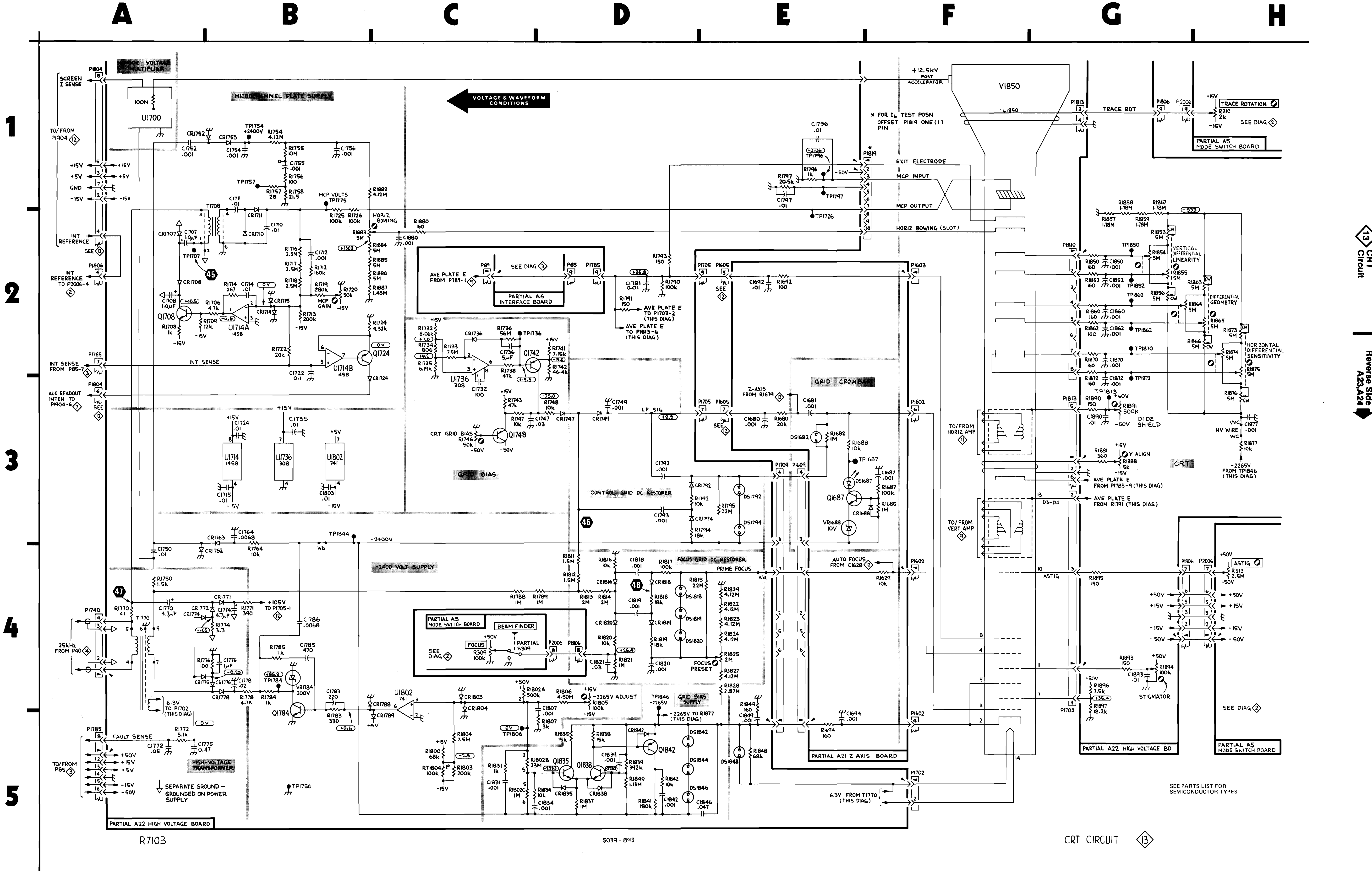

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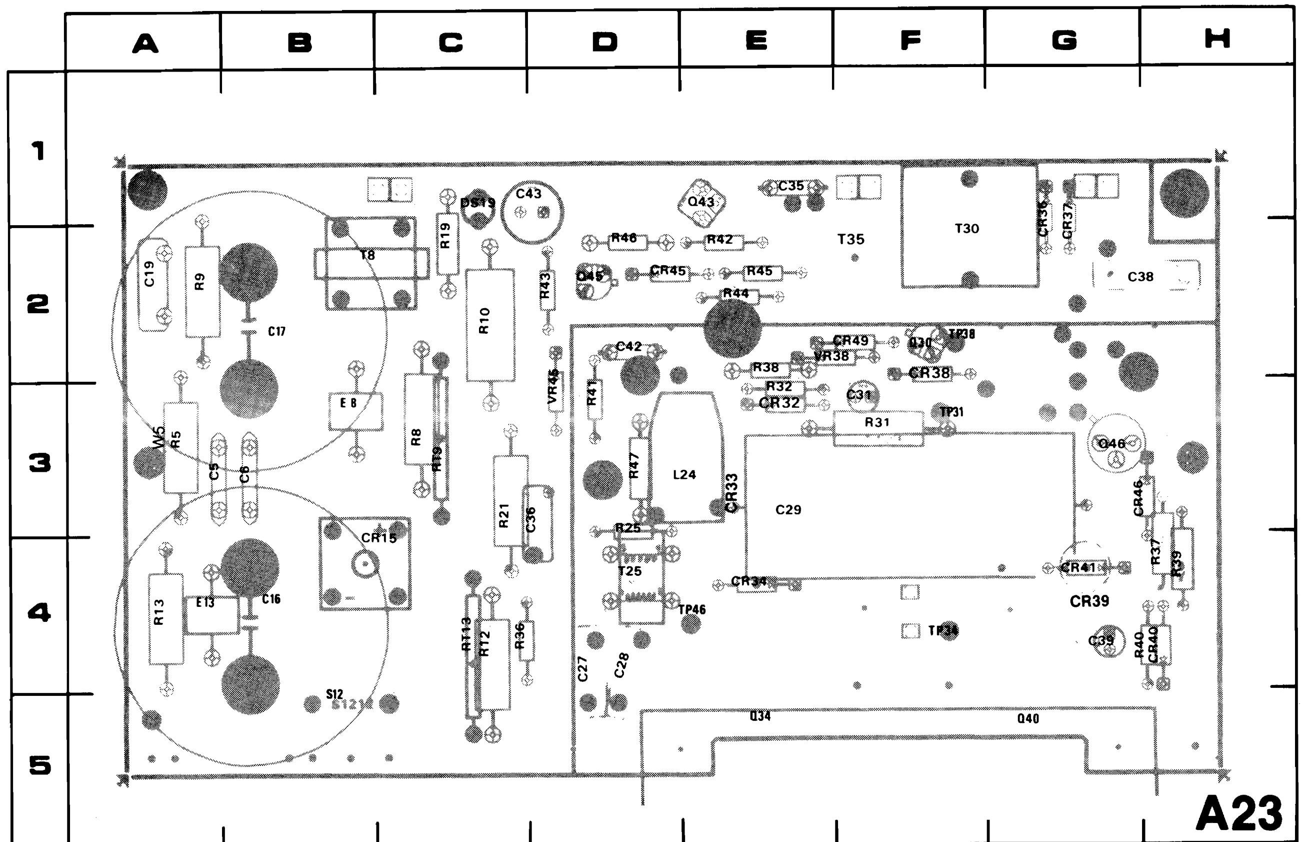
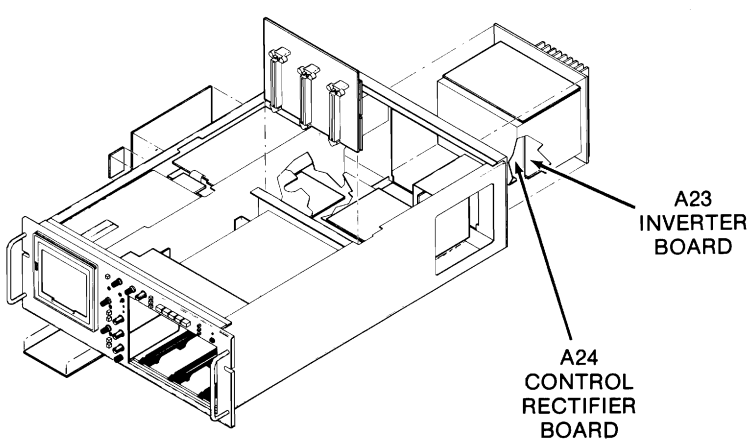


Figure 8-15. A23—Inverter Board assembly.

	A	B	C
1	SEE ASSEMBLY A25 CIRCUIT BOARD ILLUSTRATION ADJACENT TO DIAGRAM 15		



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

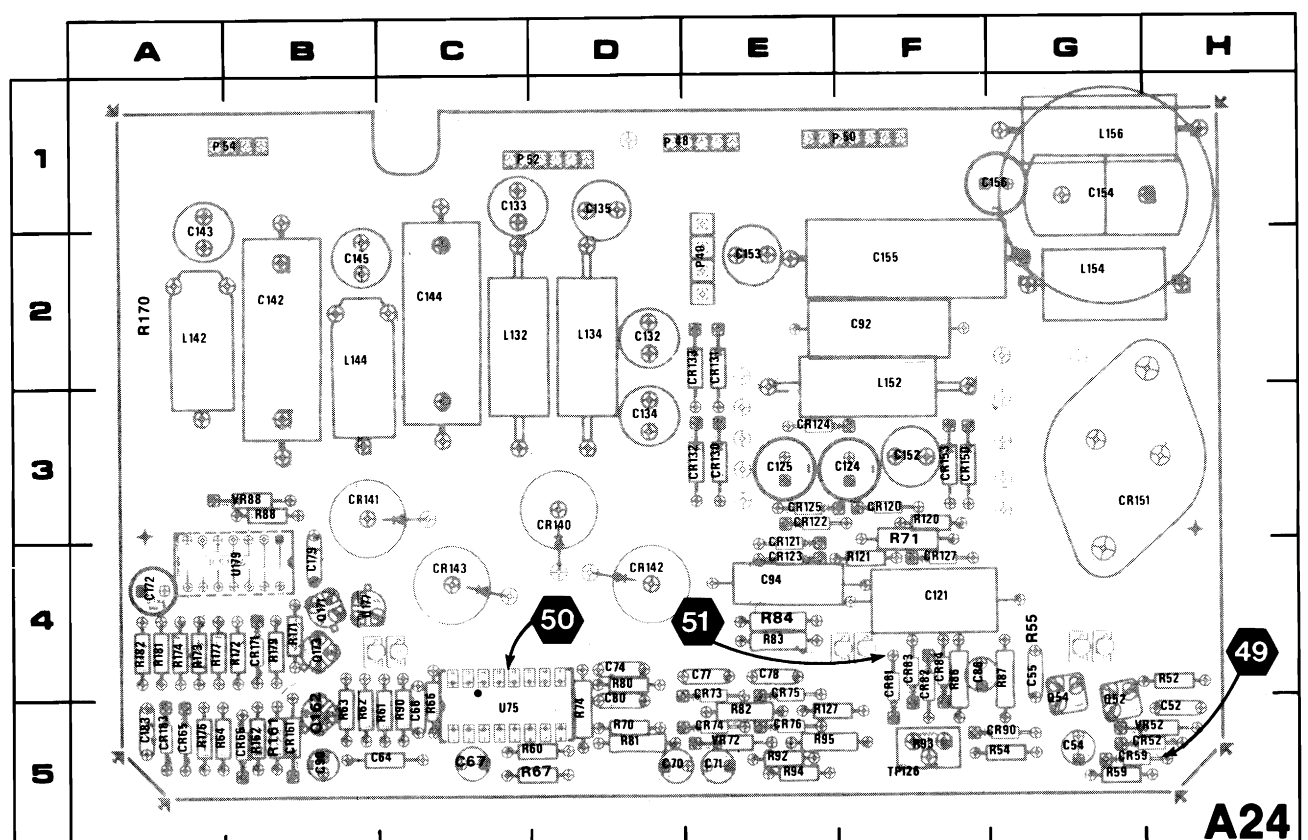


Figure 8-16. A24—Control Rectifier Board assembly.

CONVERT

ASSEMBLY A23

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER
C5	2A	3A	CR15	1A	4C	E8
C6*	2A	3B	CR32	1C	3D	E13
C16	1B	4B	CR33	1C	3E	
C17	1B	2B	CR34	1C	4E	L24
C19	1B	2A	CR36	2B	1G	
C27	1B	4D	CR37	2B	1G	Q30
C28	1B	4D	CR38	1D	3F	Q34
C29	1C	3E	CR39	1C	4G	Q40
C31	1C	3F	CR40	1C	4H	Q43
C35	2D	1E	CR41	1C	4G	Q45
C36	2D	3D	CR45	1D	2D	Q46
C38	2C	2H	CR46	2C	3G	
C39	2C	4G	CR49	1C	1F	R5*
C42	2C	2D				R8*
C43	2D	1D	DS19	1B	1C	R9

ASSEMBLY A24

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER
C52	3B	5H	C143	2F	1A	CR90
C54	3B	5G	C144	2E	2C	CR120
C55	3B	4G	C145	2F	2B	CR121
C64	3B	5C	C152	3E	3F	CR122
C66	4B	5C	C153	3F	2E	CR123
C67	4B	5C	C154	3E	1G	CR124
C70	3C	5D	C155	3F	2F	CR125
C71	3C	5E	C156	3F	1F	CR127
C74	4C	4D	C172	3E	4A	CR130
C77	3D	4E	C179	3F	4B	CR131
C78	3D	4E	C183	3F	5A	CR132
C80	4C	5D				CR133
C86	4D	4F	CR52	3B	5G	CR140
C90	4D	5B	CR59	3B	5G	CR141
C92	4D	2F	CR65	4B	5A	CR142
C94	4D	4E	CR66	4B	5B	CR143
C121	1E	4F	CR73	3D	5E	CR150
C124	1E	3F	CR74	3D	5E	CR151
C125	1E	3E	CR75	3D	5E	CR153
C132	2E	2D	CR76	3D	5E	CR161
C133	2F	1C	CR81	4C	4F	CR171
C134	2E	3D	CR82	4C	4F	CR183
C135	2F	1D	CR83	4C	4F	
C142	2E	2B	CR84	4C	4F	L132

ASSEMBLY A25

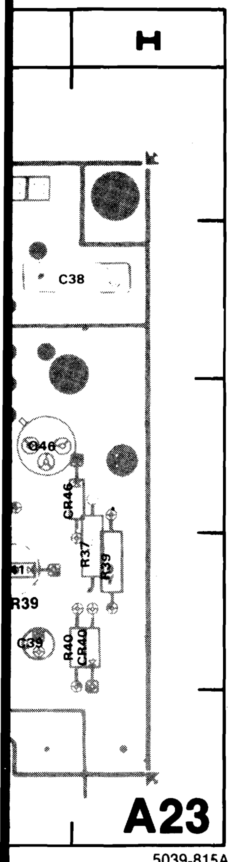
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER
C8	4E	5F	CR8	5E	5F	R1
						R2
CR7	5E	5F	P72	4E	5F	R3

Partial A25 also shown on diagram 15.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER
C37	1D	CHASSIS	F10	3A	CHASSIS	L37
C179	3F	CHASSIS				
			FL10	3A	CHASSIS	P10

*See Parts List for serial number ranges.



	A	B	C
1	SEE ASSEMBLY A25 CIRCUIT BOARD ILLUSTRATION ADJACENT TO DIAGRAM 15		

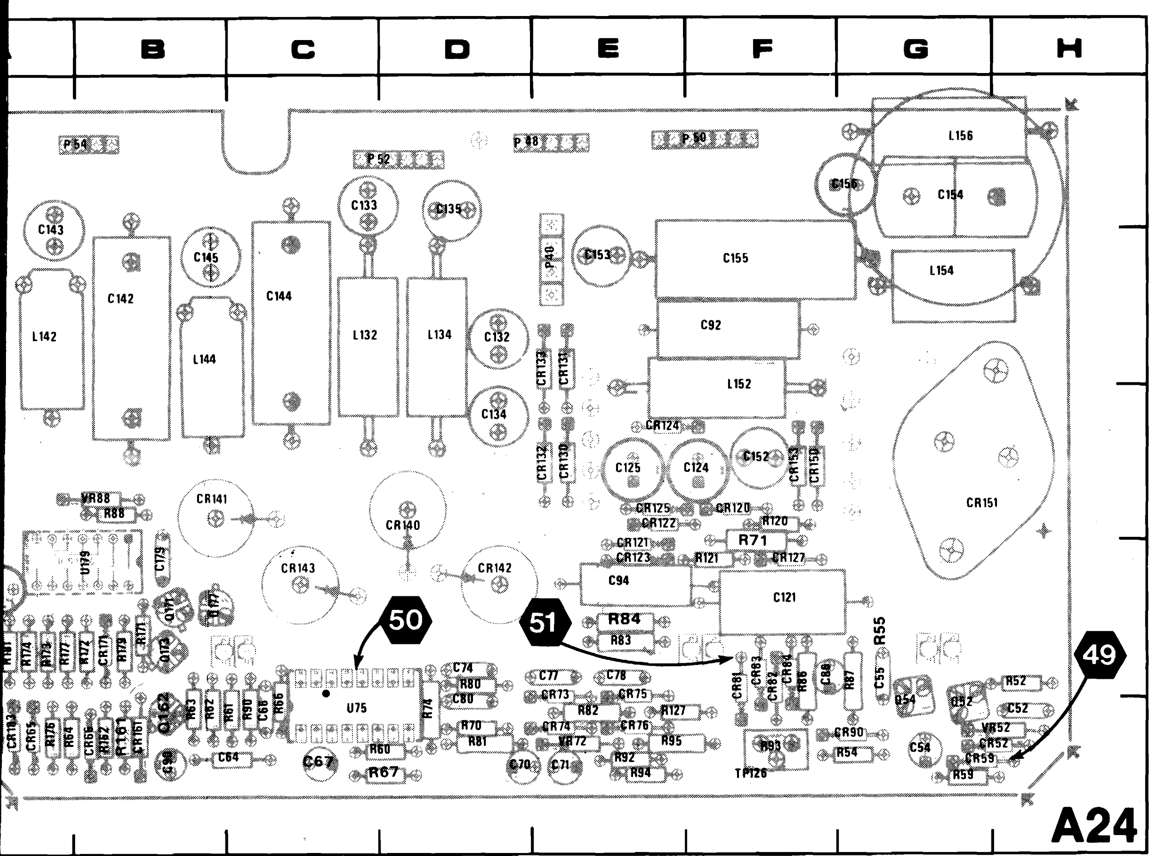


Figure 8-16. A24—Control Rectifier Board assembly.

CONVERTER/RECTIFIERS DIAGRAM 14

ASSEMBLY A23

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C5	2A	3A	CR15	1A	4C	E8	1B	3B	R10	2B	2C	R43	2D	2D	TP31	1C	3F
C6*	2A	3B	CR32	1C	3D	E13	1A	4A	R12*	1A	4C	R44	1D	2E	TP34	1D	4F
C16	1B	4B	CR33	1C	3E				R13	1A	4A	R45	1D	2E	TP38	1C	2F
C17	1B	2B	CR34	1C	4E	L24	1B	3E	R19	1B	2C	R46	1D	2D	TP46	2B	4E
C19	1B	2A	CR36	2B	1G				R21	1B	3C	R47	1C	3D			
C27	1B	4D	CR37	2B	1G	Q30	2C	2F	R25	1B	3D				VR38	2C	1F
C28	1B	4D	CR38	1D	3F	Q34	1C	5E	R31	1C	3F	RT9	2A	3C	VR45	2C	3D
C29	1C	3E	CR39	1C	4G	Q40	1C	5G	R32	1C	3E	RT13	1A	4C	W5*	2A	3A
C31	1C	3F	CR40	1C	4H	Q43	1D	1E	R36	2D	4C						
C35	2D	1E	CR41	1C	4G	Q45	1D	2E	R37	1C	4H	S12	1A	5B			
C36	2D	3D	CR45	1D	2D	Q46	2C	3G	R38	2C	2E						
C38	2C	2H	CR46	2C	3G				R39	1C	4H	T8	2A	2B			
C39	2C	4G	CR49	1C	1F	R5*	2A	3A	R40	1C	4G	T25	1B	4D			
C42	2C	2D				R8*	2A	3C	R41	2C	3D	T30	1C	1F			
C43	2D	1D	DS19	1B	1C	R9	2A	2A	R42	1D	2E	T35	2D	2E			

ASSEMBLY A24

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C52	3B	5H	C143	2F	1A	CR90	4C	5G	L134	2E	2D	R61	3B	5C	R127	1E	5E
C54	3B	5G	C144	2E	2C	CR120	1E	3F	L142	2E	2A	R62	3B	5B	R161	3D	5B
C55	3B	4G	C145	2F	2B	CR121	1E	4E	L144	2E	2B	R63	3B	5B	R162	3D	5B
C64	3B	5C	C152	3E	3F	CR122	1E	3E	L152	3E	2F	R64	4B	5A	R170	5D	2A
C66	4B	5C	C153	3F	2E	CR123	1E	4E	L154	3E	2G	R66	4B	5C	R171	4E	4B
C67	4B	5C	C154	3E	1G	CR124	1E	3E	L156	3E	1G	R67	4B	5C	R172	3E	4B
C70	3C	5D	C155	3F	2F	CR125	1E	3E				R70	3C	5D	R173	3E	4A
C71	3C	5E	C156	3F	1F	CR127	1E	4F	P40	1E	2E	R71	3C	4F	R174	3E	4A
C74	4C	4D	C172	3E	4A	CR130	2E	3E	P48	1F	1D	R74	4C	5D	R176	4E	5A
C77	3D	4E	C179	3F	4B	CR131	2E	2E	P50	3F	1F	R80	4C	4D	R177	3E	4A
C78	3D	4E	C183	3F	5A	CR132	2E	3E	P52	2F	1C	R81	4C	5D	R179	3E	4B
C80	4C	5D				CR133	2E	2E				R82	4C	5E	R181	3E	4A
C86	4D	4F	CR52	3B	5G	CR140	2E	3D	Q52	3B	5G	R83	4C	4E	R182	3E	4A
C90	4D	5B	CR59	3B	5G	CR141	2E	3B	Q54	3B	5G	R84	4C	4E			
C92	4D	2F	CR65	4B	5A	CR142	2E	4D	Q162	3D	5B	R86	4D	4F	TP126	1F	5F
C94	4D	4E	CR66	4B	5B	CR143	2E	4C	Q171	4E	4B	R87	4D	4G			
C121	1E	4F	CR73	3D	5E	CR150	3E	3F	Q173	3E	4B	R88	4D	3B	U75	3C	5C
C124	1E	3F	CR74	3D	5E	CR151	3E	3G	Q177	4E	4B	R90	4D	5C	U179A	4E	4B
C125	1E	3E	CR75	3D	5E	CR153	3E	3F				R92	4D	5E	U179B	3F	4B
C132	2E	2D	CR76	3D	5E	CR161	3D	5B	R52	3B	4H	R93	4D	5F	U179C	3E	4B
C133	2F	1C	CR81	4C	4F	CR171	3E	4B	R54	3B	5G	R94	4D	5E			
C134	2E	3D	CR82	4C	4F	CR183	3F	5A	R55	3C	4G	R95	4D	5E	VR52	3B	5G
C135	2F	1D	CR83	4C	4F				R59	3B	5G	R120	1E	3F	VR72	3C	5E
C142	2E	2B	CR84	4C	4F	L132	2E	2C	R60	3B	5C	R121	1E	4F	VR88	4D	3B

ASSEMBLY A25

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C8	4E	5F	CR8	5E	5F	R1	4E	6F	R4	4E	5E
						R2	4E	6E	R5	4E	6E
CR7	5E	5F	P72	4E	5F	R3	4E	5E	R8	4E	5F

Partial A25 also shown on diagram 15.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C37	1D	CHASSIS	F10	3A	CHASSIS	L37	1D	CHASSIS	P11	3A	CHASSIS	S72	4E	CHASSIS
C179	3F	CHASSIS												
			FL10	3A	CHASSIS	P10	3A	CHASSIS	S10	3A	CHASSIS	T110	2D	CHASSIS

***See Parts List for serial number ranges.**

VOLTAGE AND WAVEFORM CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltages shown on the diagram were obtained with all R7103 front-panel variable controls, except INTENSITY, set at midrange (INTENSITY was set fully counterclockwise). Other front-panel controls were set as follows:

VERTICAL MODE ....LEFT
TRIGGER SOURCE ....VERT MODE

No plug-in units were installed in the R7103.

Waveform Conditions: The waveforms shown below were obtained with a test oscilloscope with 1 MΩ input impedance and bandwidth of at least 60 MHz (a TEKTRONIX 7904 Oscilloscope, 7B10 Time Base, and 7A13 Differential Comparator with a P6053 10X Probe, in this case).

No plug-in units were installed in the R7103.

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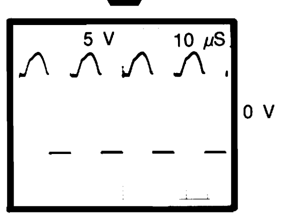

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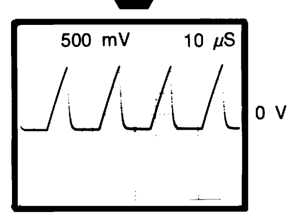

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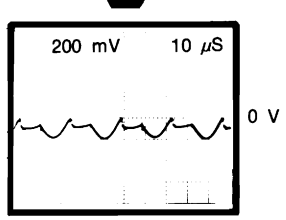
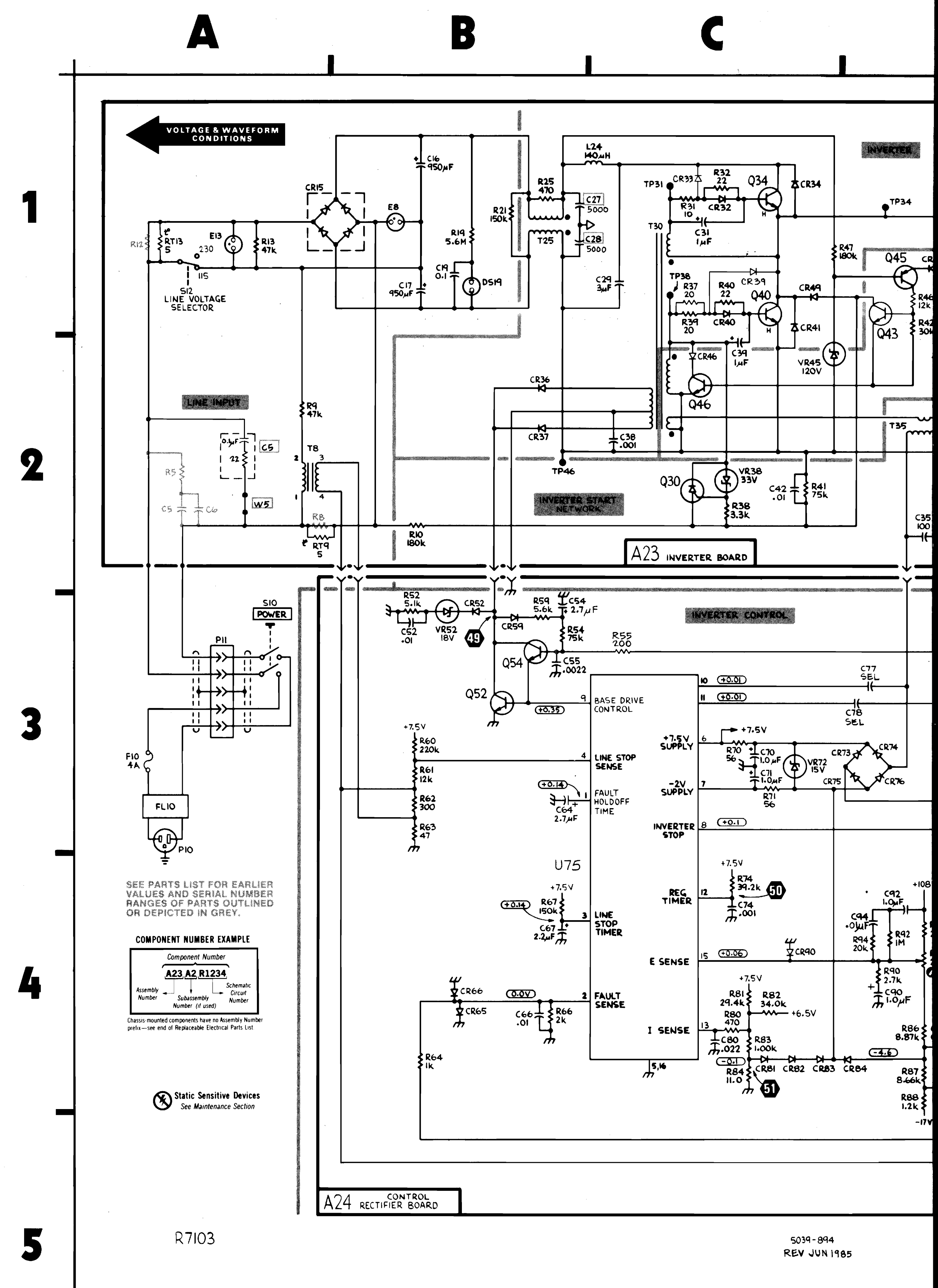


Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



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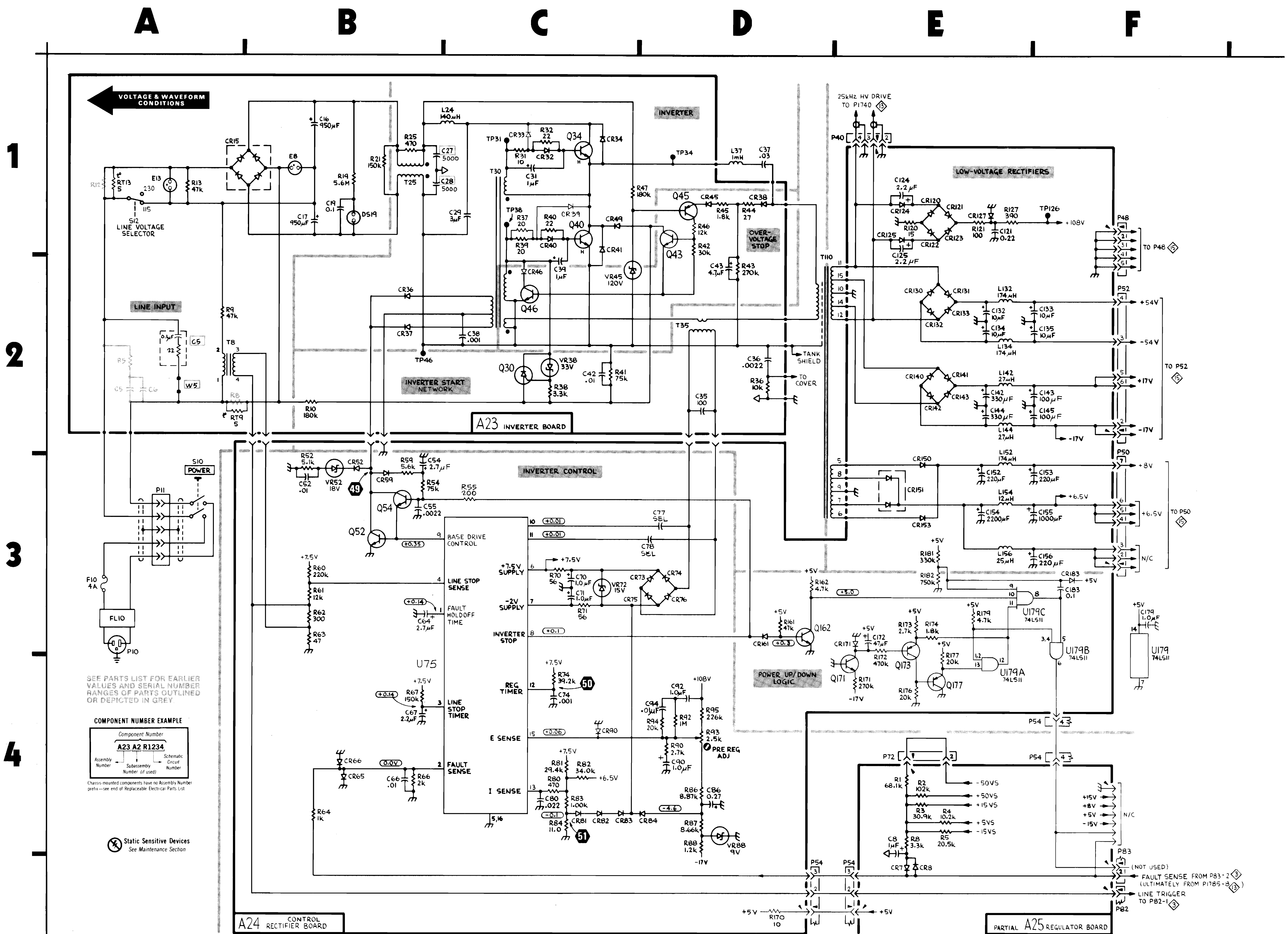

14 Converter/Rectifiers
Reverse Side A25

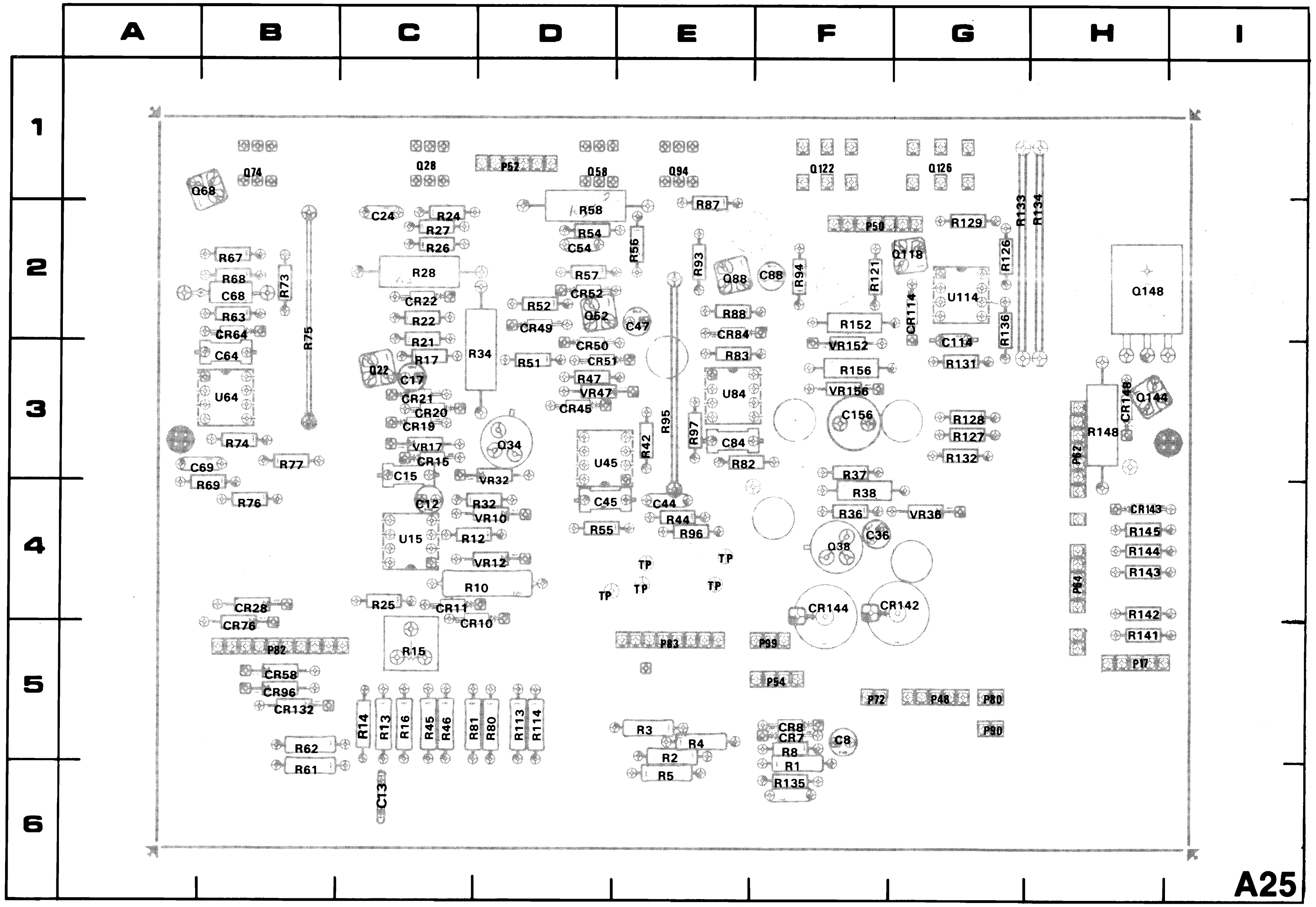

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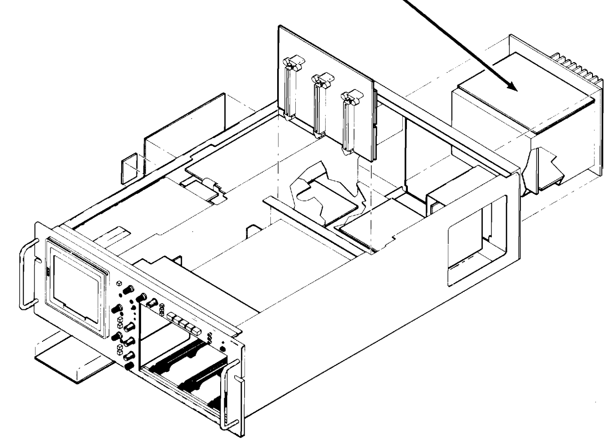
Figure 8-17. A25—Regulator Board assembly.

A25 REGULATOR BOARD



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Assembly A25 & component locator

LOW-VOLTAGE REGULA

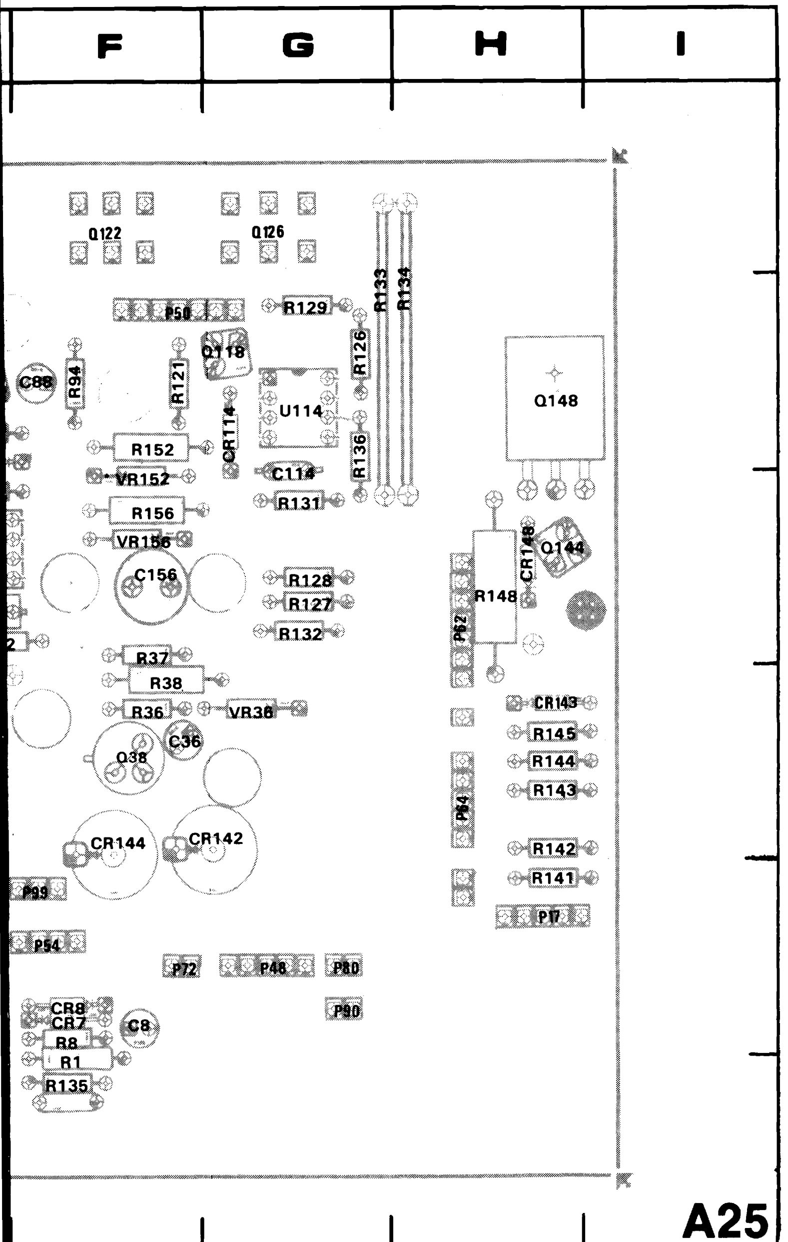
ASSEMBLY A25

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCH LOCA
C12	1A	4C	Q38	
C13	2B	6C	Q52	
C15	1B	3C	Q58	
C17	1B	3C	Q68	
C24	1B	2C	Q74	
C36	2B	4F	Q88	
C44	2B	4E	Q94	
C45	2B	4D	Q118	
C47	3B	2E	Q122	
C54	3B	2D	Q126	
C64	1D	3B	Q144	
C68	1D	2B	Q148	
C69	1E	3B		
C84	2D	3E	R10	
C88	2D	2F	R12	
C114	3D	2G	R13	
C156	2D	3F	R14	
			R15	
CR10	1A	5D	R16	
CR11	1A	4C	R17	
CR15	1B	3C	R21	
CR19	1B	3C	R22	
CR20	1B	3C	R24	
CR21	1B	3C	R25	
CR22	1B	2C	R26	
CR28	1C	4B	R27	
CR45	3B	3D	R28	
CR49	3B	2D	R32	
CR50	3B	3D	R34	
CR51	3B	3D	R36	
CR52	3B	2D	R37	
CR58	3C	5B	R38	
CR64	1D	2B	R42	
CR76	1E	5B	R44	
CR84	2D	2E	R45	
CR96	2E	5B	R46	
CR114	3D	2G	R47	
CR132	3E	5B	R51	
CR142	4D	4G	R52	
CR143	4D	4H	R54	
CR144	4D	4F	R55	
CR148	4E	5G	R56	
			R57	
P17	4D	5H	R58	
P48	3C	5G	R61	
P50	4D	2F	R62	
P62	4E	5G	R63	
P80	3A	5G	R67	
P90	3A	5G	R68	
P99	3D	5F	R69	
			R73	
Q22	1B	3C	R74	
Q28	1B	1C	R75	
Q34	2A	3D	R76	

Partial A25 also shown on diagram 14.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCH LOCA
B90	3A	CHASSIS	R90	



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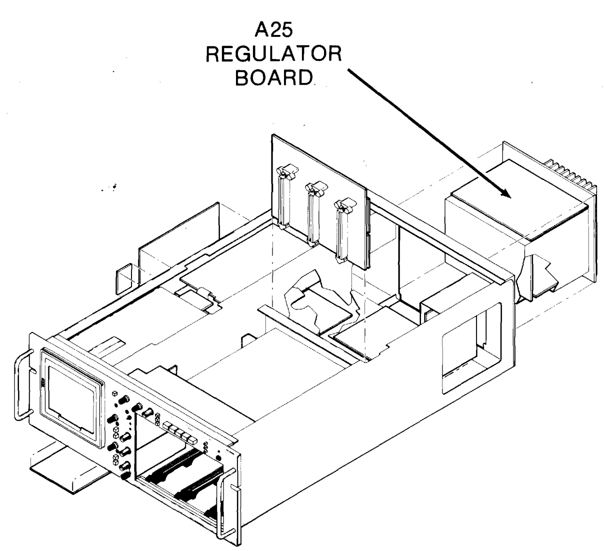
assembly.



LOW-VOLTAGE REGULATORS DIAGRAM 15

ASSEMBLY A25

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C12	1A	4C	Q38	2B	4F	R77	1E	3B
C13	2B	6C	Q52	3B	2D	R80	3D	5D
C15	1B	3C	Q58	3B	1D	R81	3D	5C
C17	1B	3C	Q68	1D	1B	R82	2D	3E
C24	1B	2C	Q74	1E	1B	R83	2D	3E
C36	2B	4F	Q88	2D	2E	R87	2D	2E
C44	2B	4E	Q94	2E	1E	R88	2D	2E
C45	2B	4D	Q118	3D	2G	R93	2E	2E
C47	3B	2E	Q122	3D	1F	R94	2E	2F
C54	3B	2D	Q126	3E	1G	R95	2E	3E
C64	1D	3B	Q144	4D	5G	R96	2E	4E
C68	1D	2B	Q148	4E	5G	R97	2E	3E
C69	1E	3B				R113	3D	5D
C84	2D	3E	R10	1A	4D	R114	3D	5D
C88	2D	2F	R12	1A	4C	R121	3D	2F
C114	3D	2G	R13	2B	6C	R126	3E	2G
C156	2D	3F	R14	2A	5C	R127	3E	3G
			R15	2A	5C	R128	3E	3G
CR10	1A	5D	R16	2B	5C	R129	3E	2G
CR11	1A	4C	R17	1B	3C	R131	3D	3G
CR15	1B	3C	R21	1B	3C	R132	3E	3G
CR19	1B	3C	R22	1B	2C	R133	3E	3G
CR20	1B	3C	R24	1B	2C	R134	3E	2H
CR21	1B	3C	R25	1B	4C	R135	3E	6F
CR22	1B	2C	R26	1B	2C	R136	3E	2G
CR28	1C	4B	R27	1B	2C	R141	4D	5H
CR45	3B	3D	R28	1B	2C	R142	4D	4H
CR49	3B	2D	R32	2A	4D	R143	4D	4H
CR50	3B	3D	R34	2A	3D	R144	4D	4H
CR51	3B	3D	R36	2B	4F	R145	4D	4H
CR52	3B	2D	R37	2B	3F	R148	4E	6G
CR58	3C	5B	R38	2B	4F	R152	1D	2F
CR64	1D	2B	R42	3A	3E	R156	2D	3F
CR76	1E	5B	R44	2B	4E			
CR84	2D	2E	R45	2A	5C	U15	1A	4C
CR96	2E	5B	R46	2B	5C	U45	3A	3D
CR114	3D	2G	R47	3B	3D	U64A	1D	3B
CR132	3E	5B	R51	3B	3D	U64B	1E	3B
CR142	4D	4G	R52	3B	2D	U84A	2E	3E
CR143	4D	4H	R54	3B	2D	U84B	2D	3E
CR144	4D	4F	R55	2B	4D	U114A	3D	2G
CR148	4E	5G	R56	3B	2E	U114B	3E	2G
			R57	3B	2D			
P17	4D	5H	R58	3B	2D	VR10	1A	4D
P48	3C	5G	R61	1D	6B	VR12	1A	4D
P50	4D	2F	R62	1D	5B	VR17	1B	3C
P62	4E	5G	R63	2D	2B	VR32	2A	3D
P80	3A	5G	R67	1D	2B	VR36	2B	4G
P90	3A	5G	R68	1D	2B	VR47	3B	3D
P99	3D	5F	R69	1E	4B	VR152	2D	3F
			R73	1E	2B	VR156	2D	3F
Q22	1B	3C	R74	1E	3B			
Q28	1B	1C	R75	1E	2B			
Q34	2A	3D	R76	1E	4B			

Partial A25 also shown on diagram 14.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
B90	3A	CHASSIS	R90	3A	CHASSIS	S99	3C	CHASSIS

VOLTAGE CONDITIONS

Voltage Conditions: Use a digital voltmeter with 10 MΩ input impedance, such as the TEKTRONIX DM 501A Digital Multimeter installed in a TM 500- or TM 5000-series power module, or a TEKTRONIX 7D13A Digital Multimeter installed in a readout-equipped 7000-series oscilloscope.

The voltages shown on the diagram were obtained with all R7103 front-panel variable controls, except INTENSITY, set at midrange (INTENSITY was set fully counterclockwise). Other front-panel controls were set as follows:

VERTICAL MODE ....LEFT
TRIGGER SOURCE ....VERT MODE

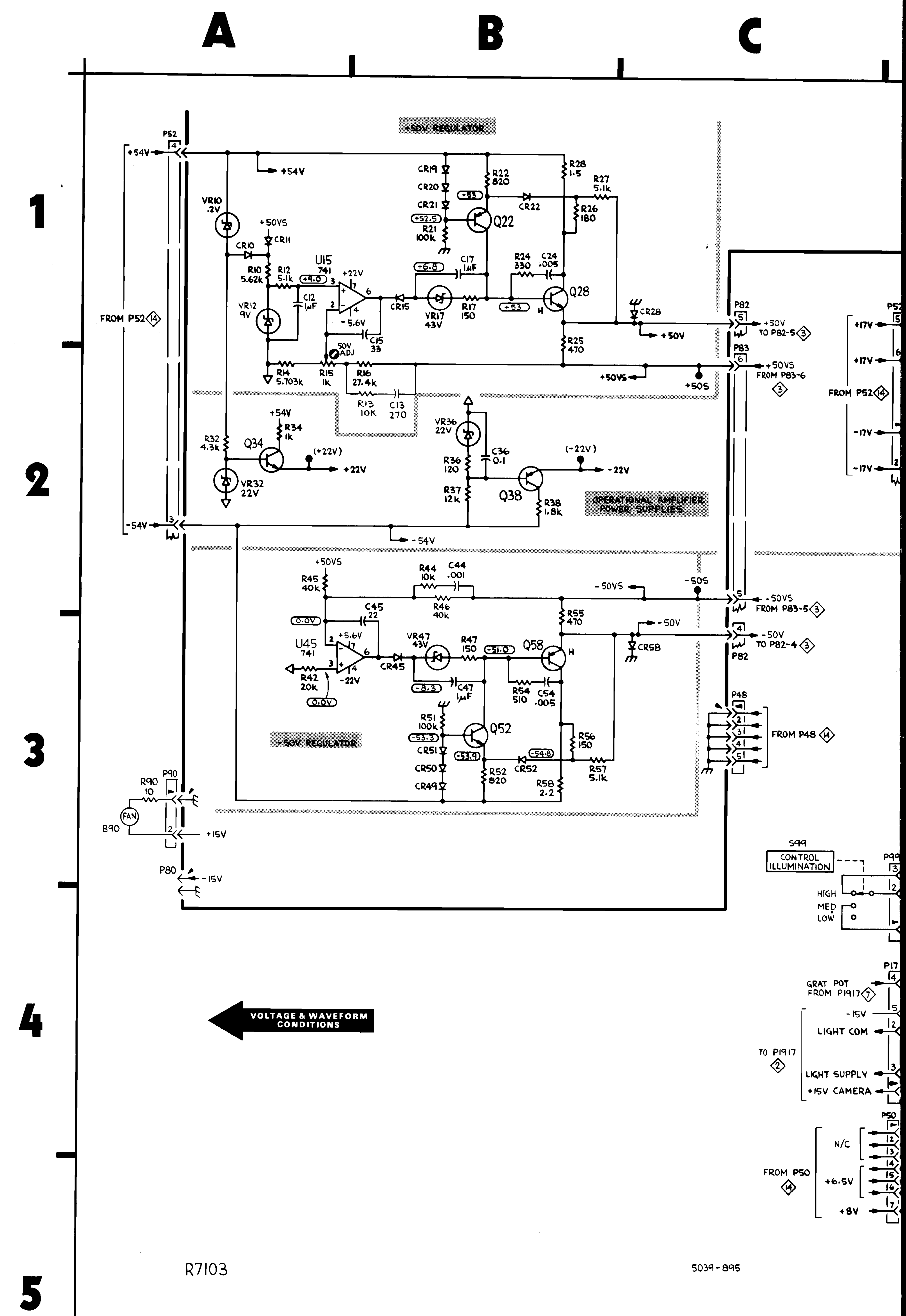
No plug-in units were installed in the R7103.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

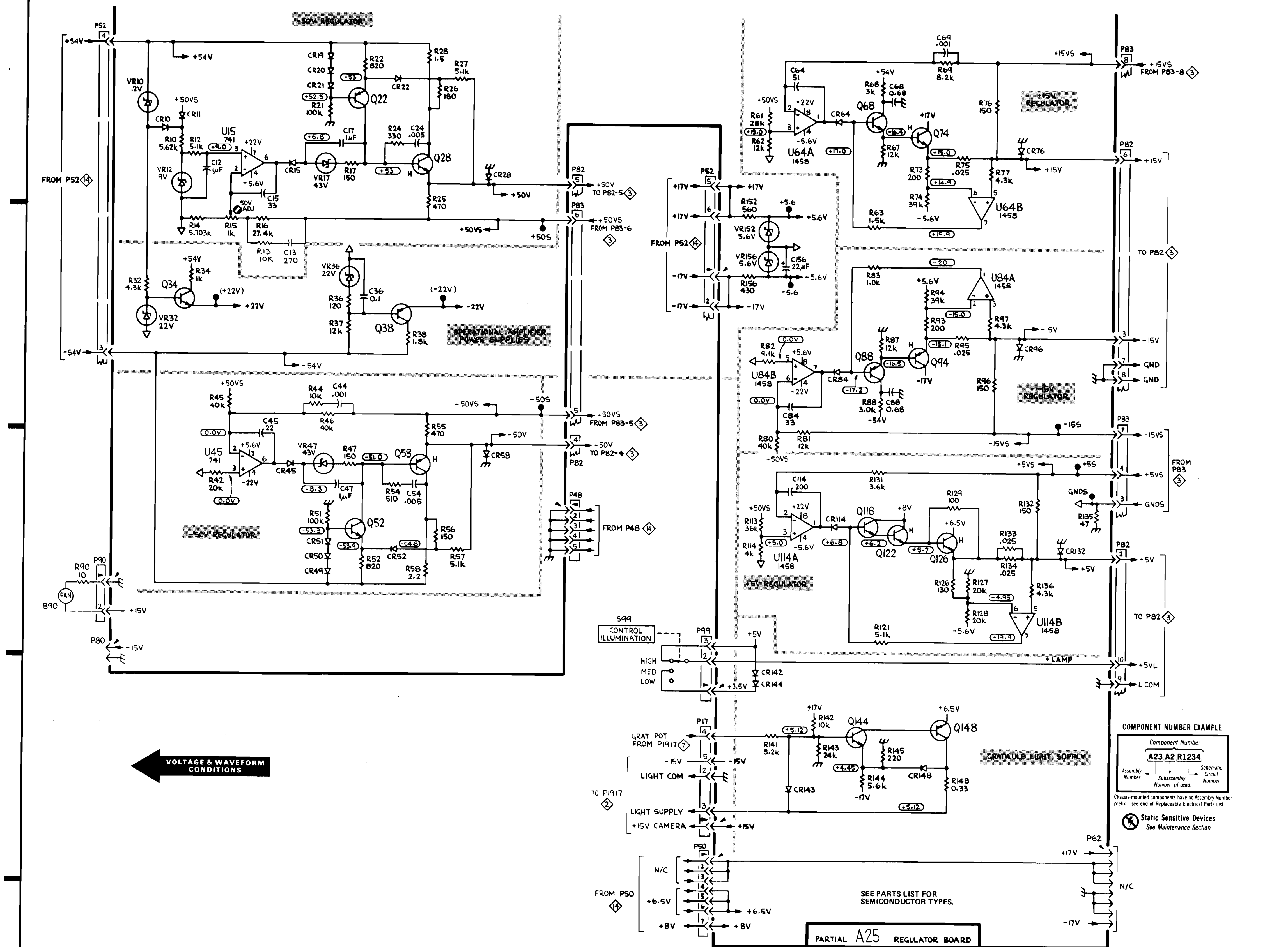
Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



A B C D E F

1
2
3
4
5



R7103

5039-895

Scans by ArtekMedia => 2009

LOW-VOLTAGE REGULATORS 15

R7103 TROUBLESHOOTING CHART

TROUBLESHOOTING CHART INSTRUCTIONS:

1. **Beginning at the top left block of the chart proceed downward until the R7103 does not perform as indicated.**
2. **Then follow the dashed line as the symptom indicates. Each shaded block indicates a circuit which may be the cause of the malfunction. Refer to Section 3, Theory of Operation, for a detailed discussion of the circuit, and Section 8, Diagrams and Circuit Board Illustrations, for the circuit schematic.**

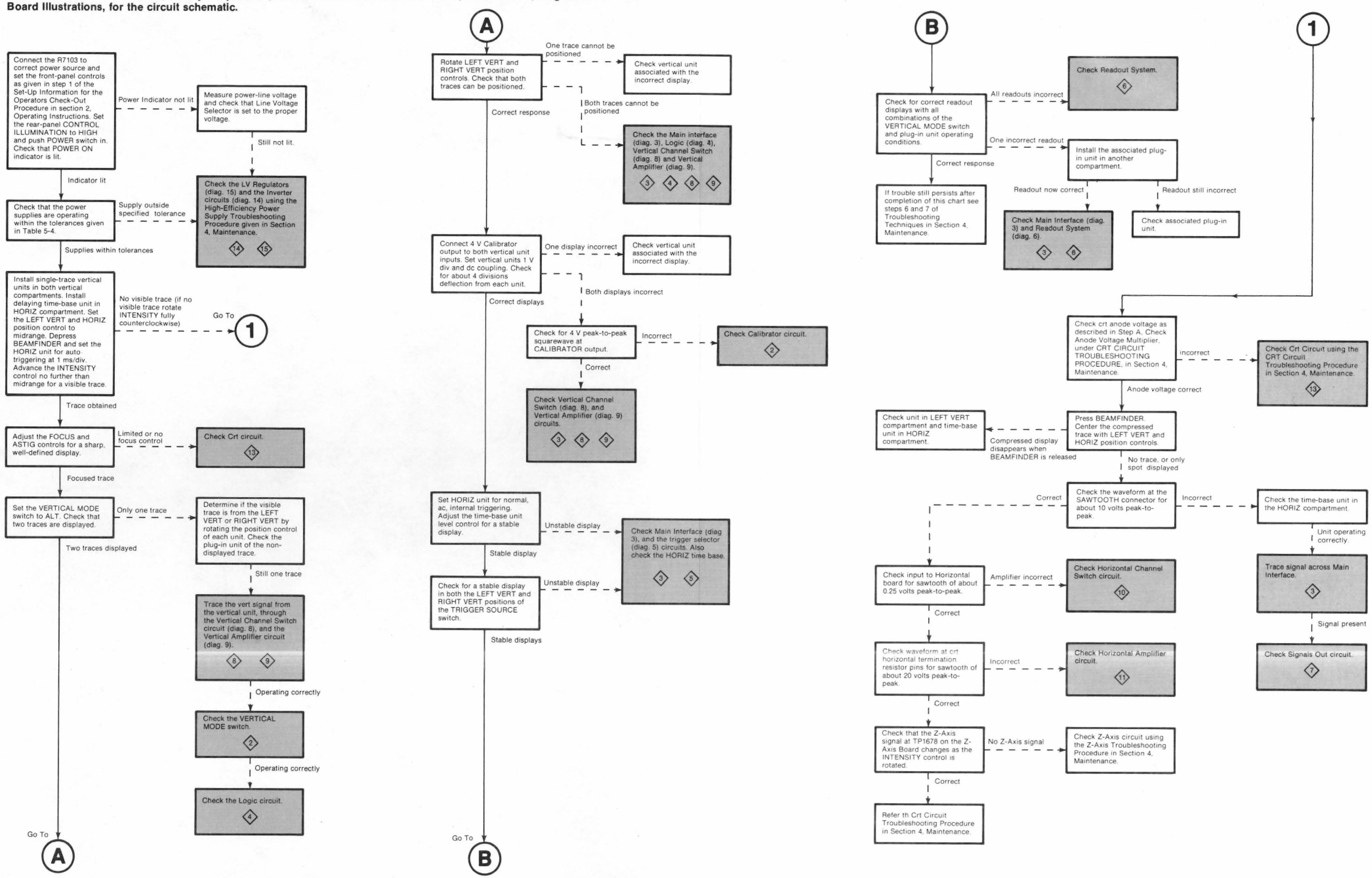


Figure 8-18. R7103 Troubleshooting Chart.

5039-818

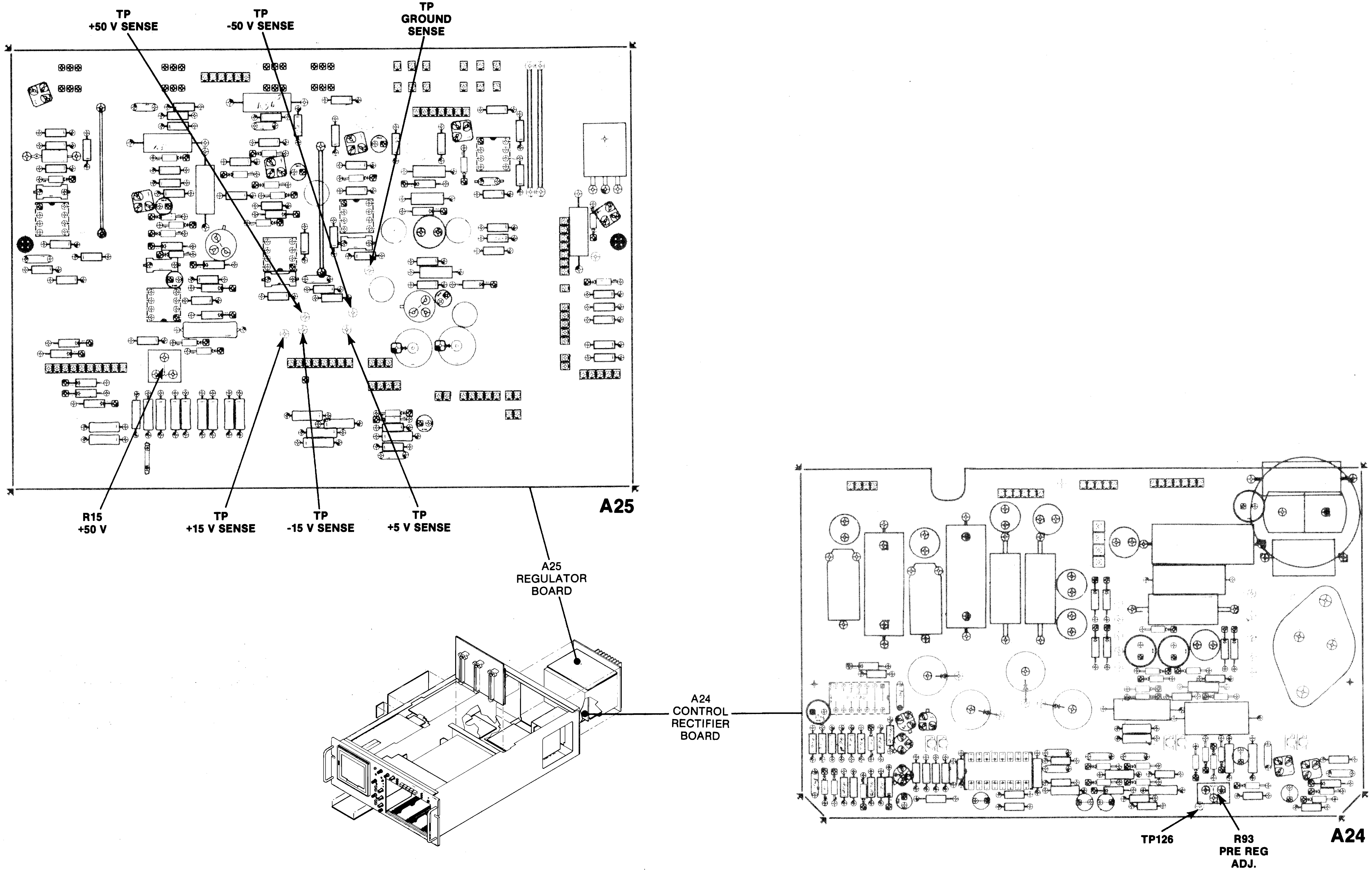


Figure 8-19. Test Point and Adjustment Locations A.

5039-819

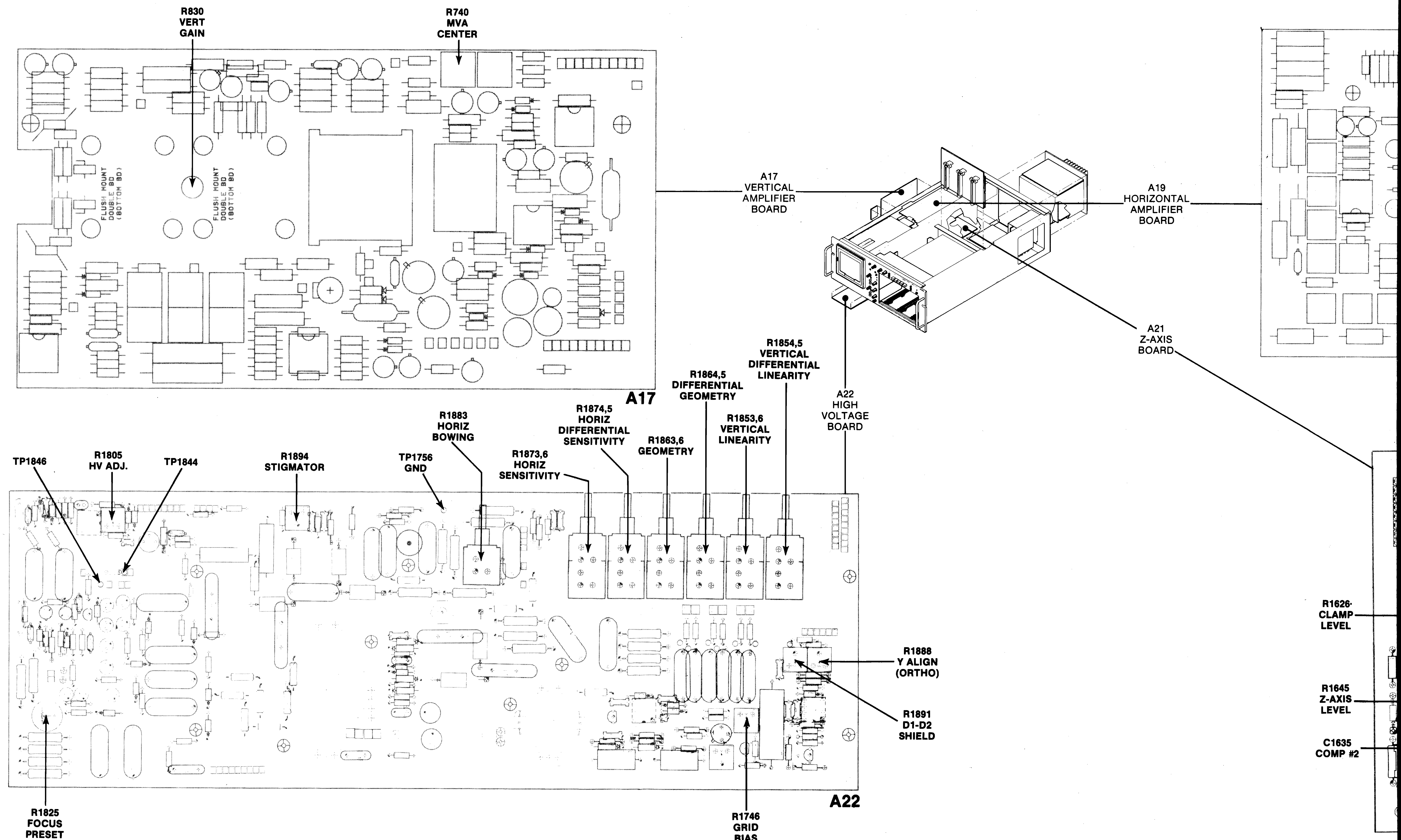


Figure 8-20. Test Point and Adjustment Locations B.

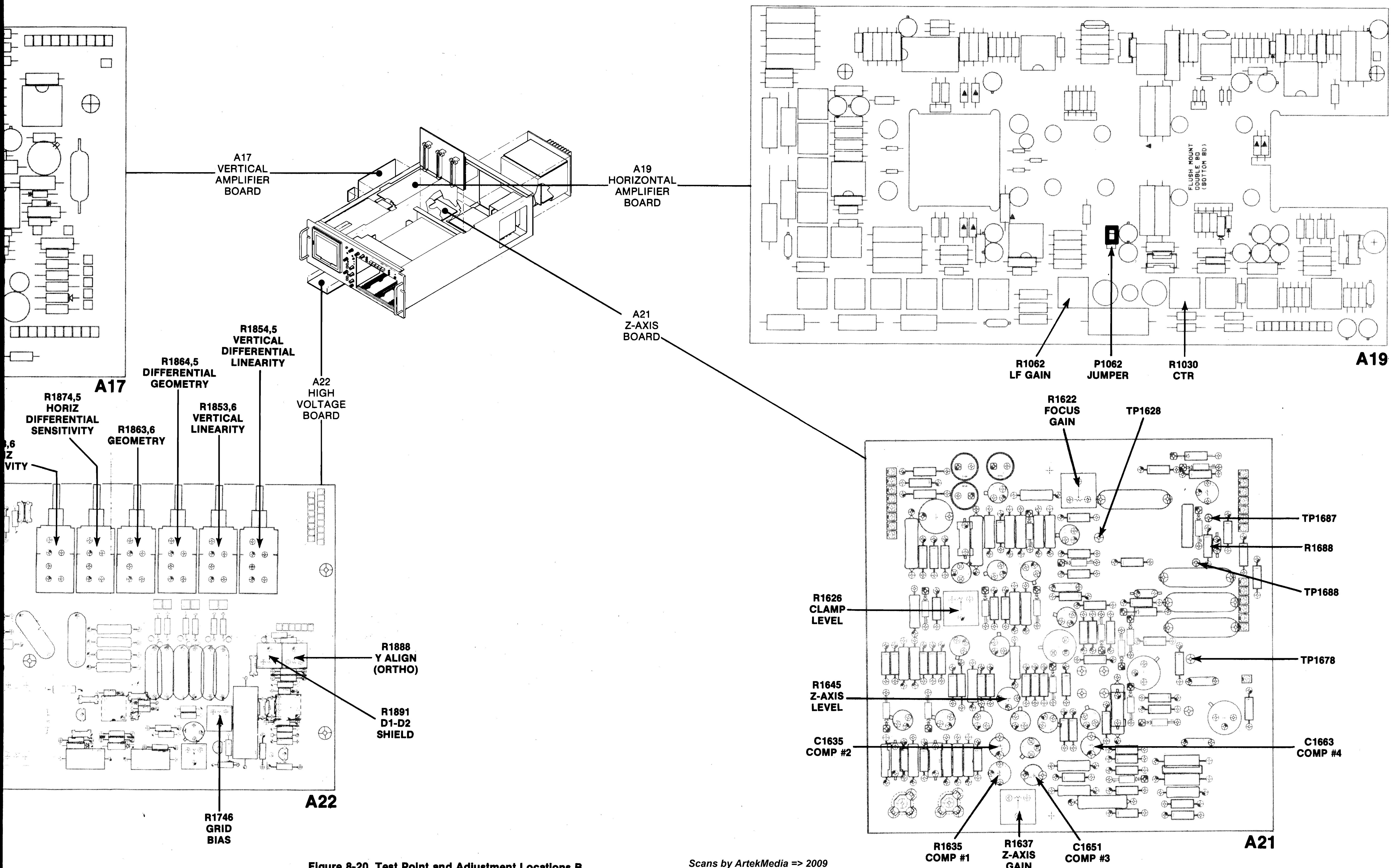


Figure 8-20. Test Point and Adjustment Locations B.

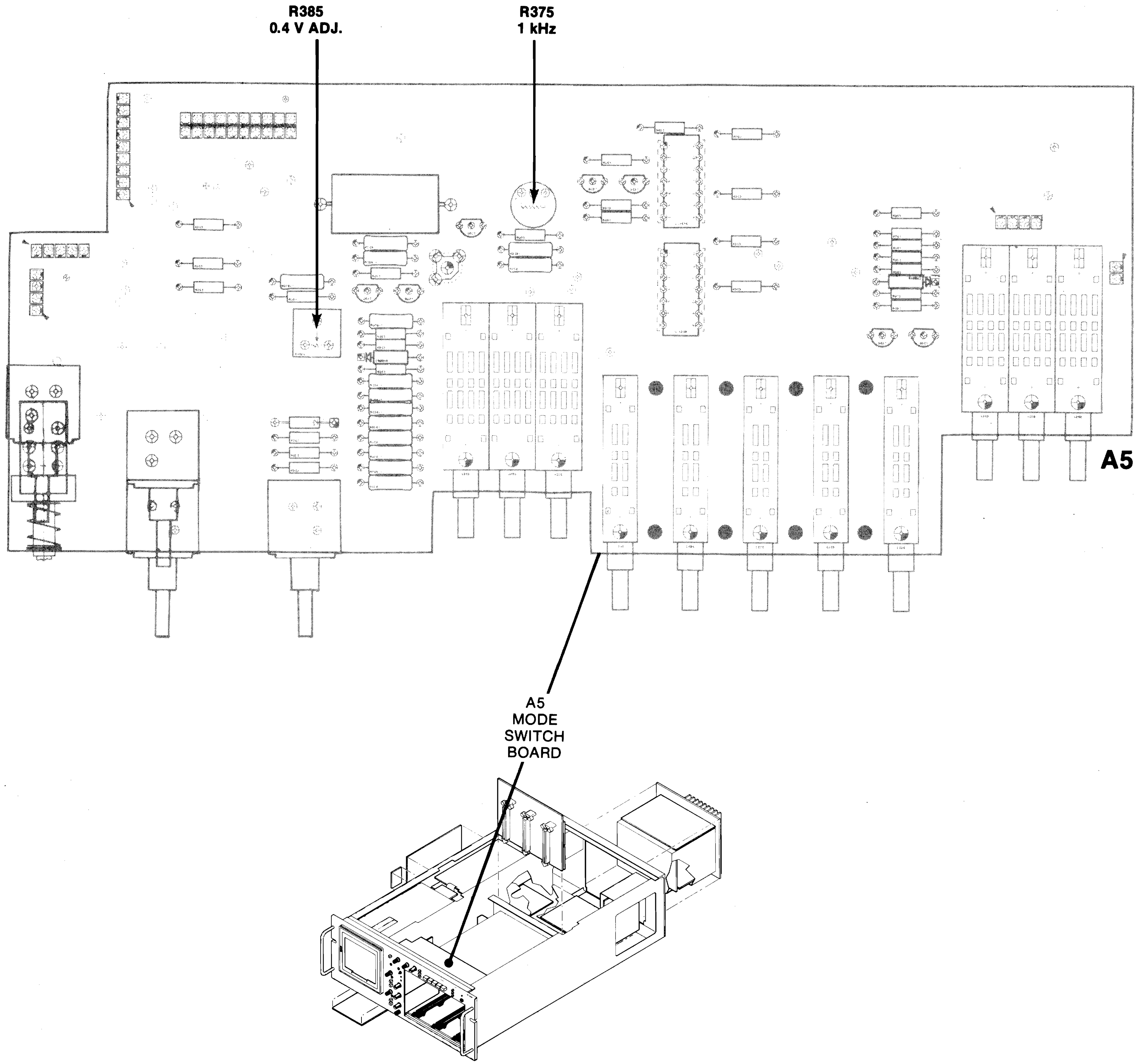
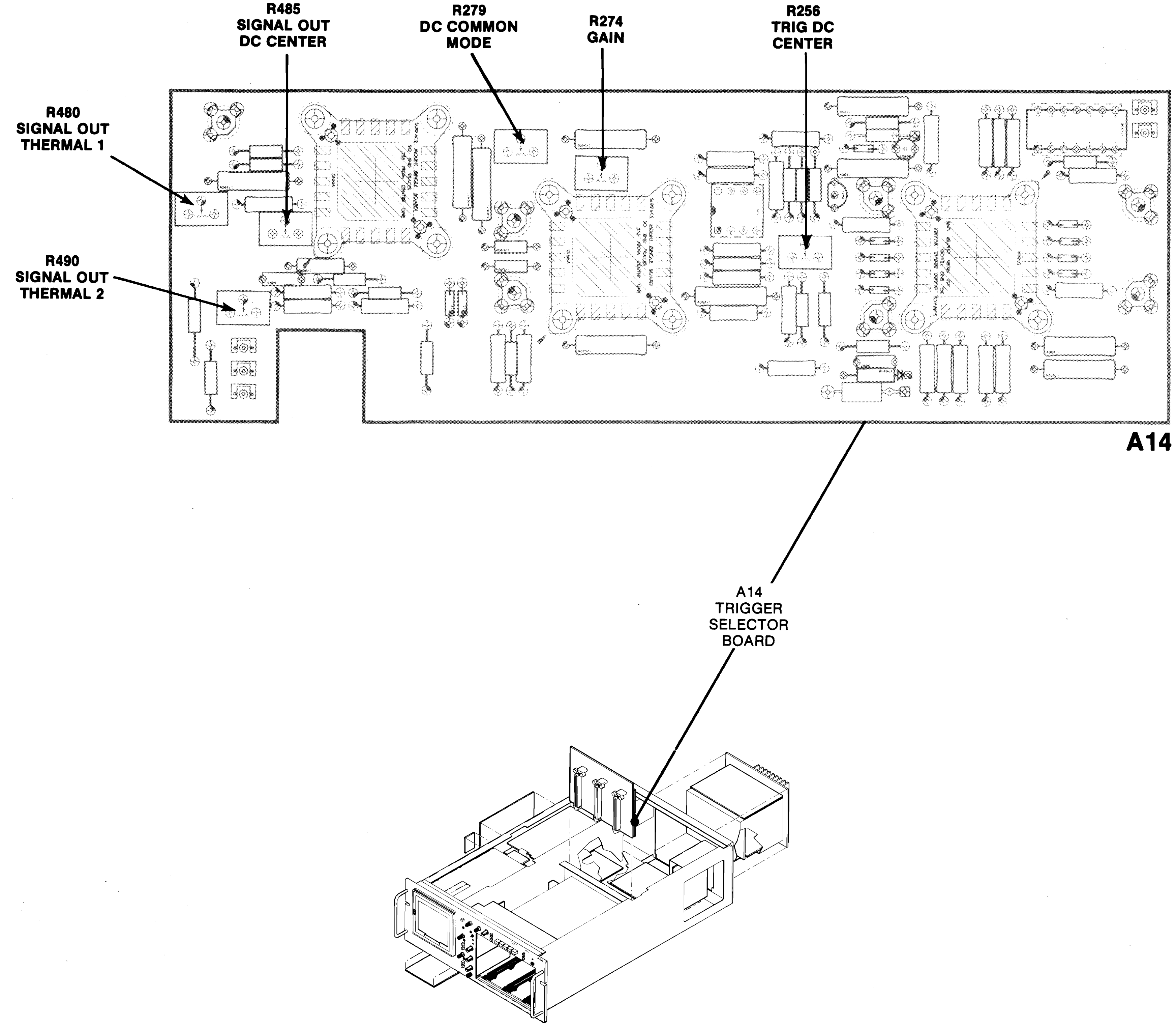


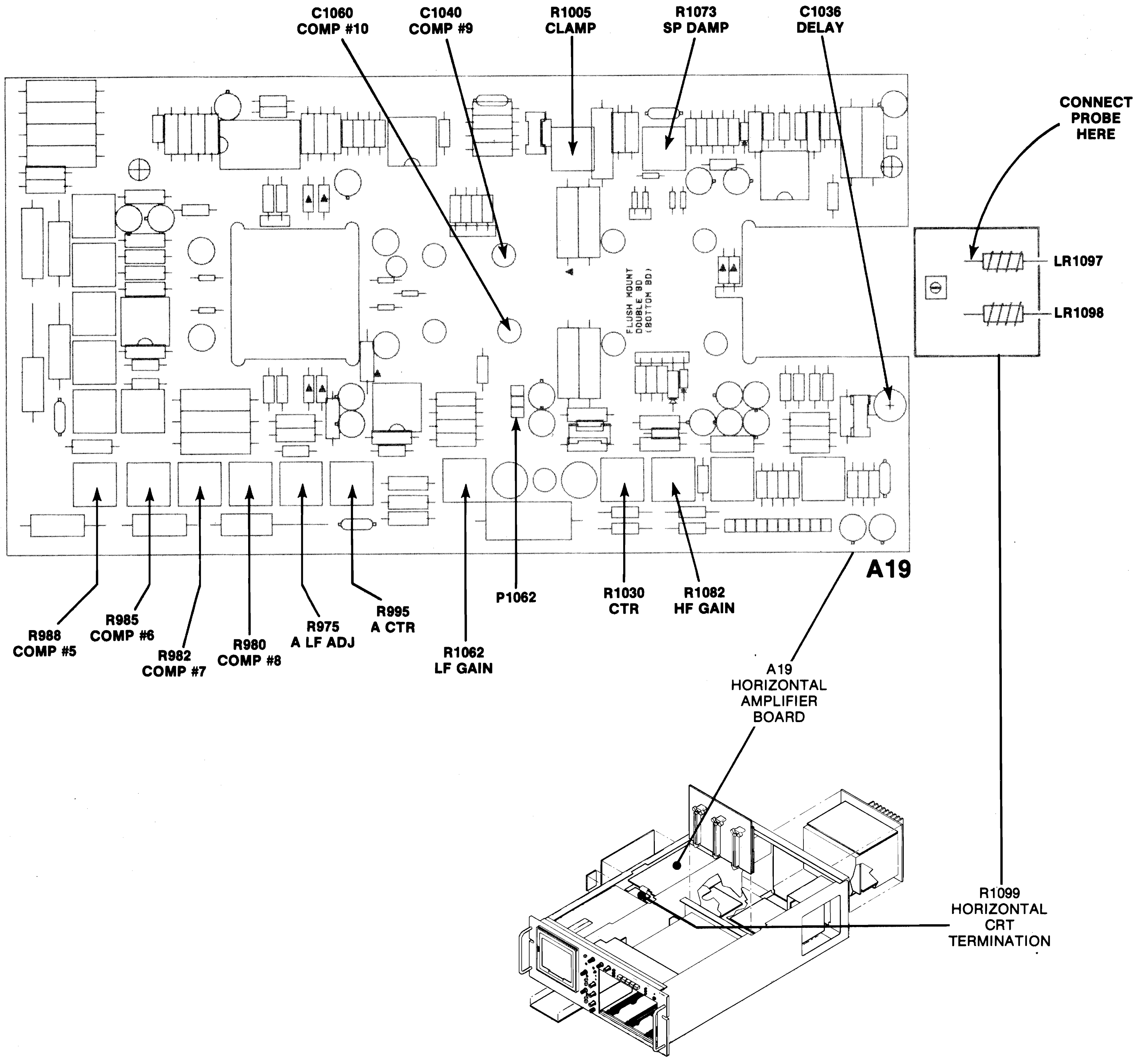
Figure 8-21. Adjustment Locations C.

5039-821



5039-822

Figure 8-22. Adjustment Locations D.



5039-823

Figure 8-23. Test Point and Adjustment Locations E.

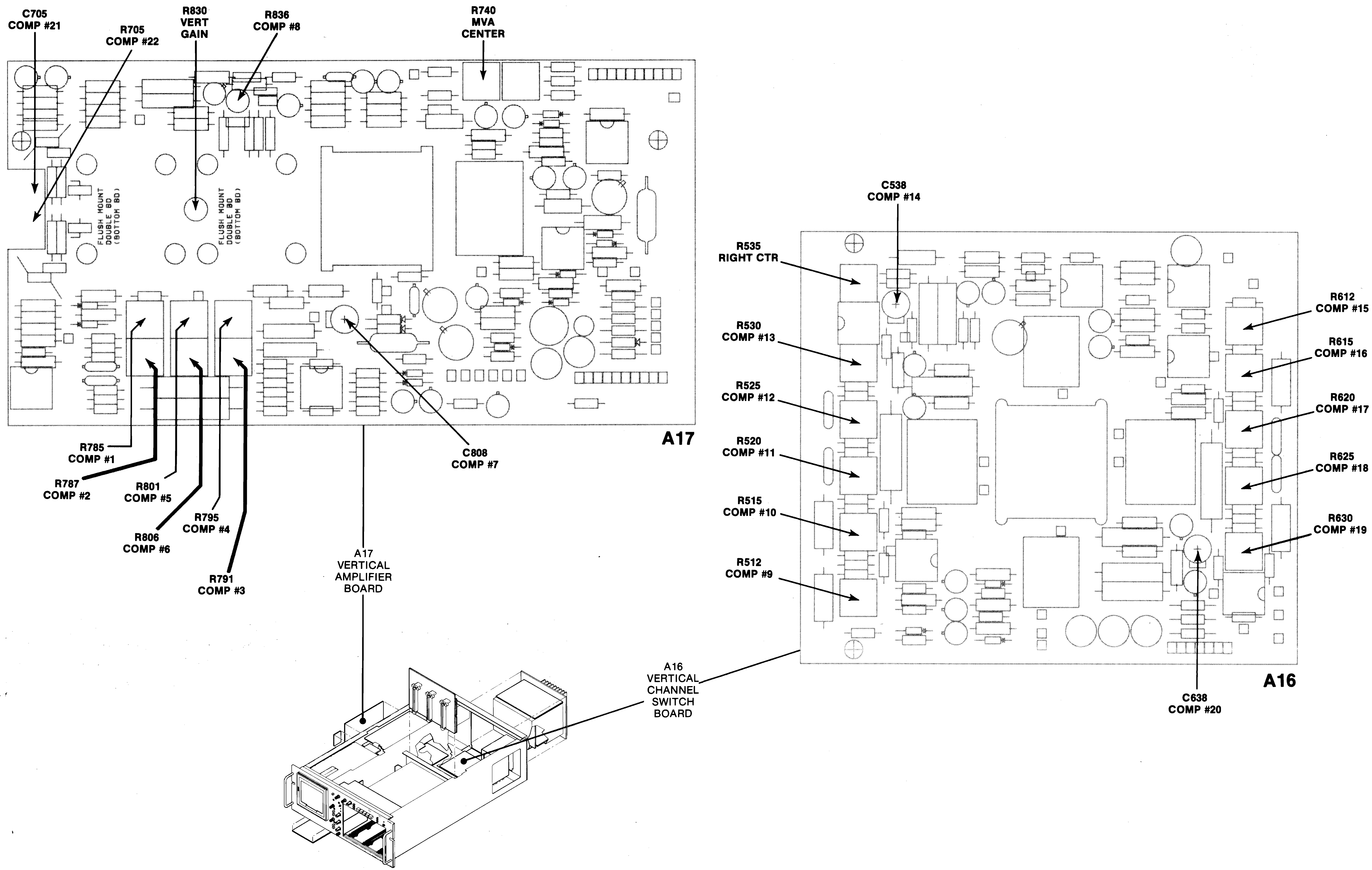


Figure 8-24. Test Point and Adjustment Locations F.

5039-824

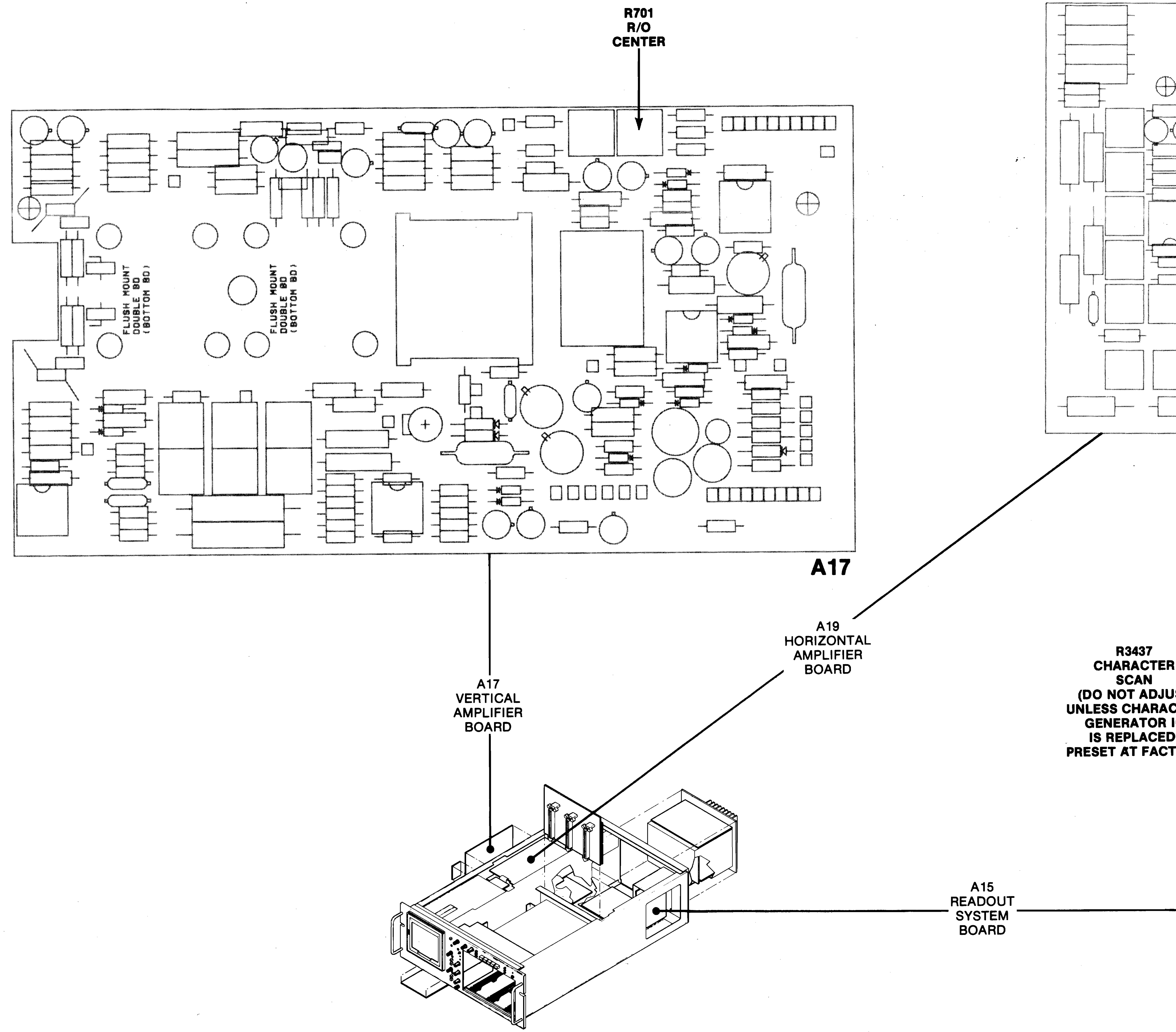


Figure 8-25. Test Point and Adjustment Locatio

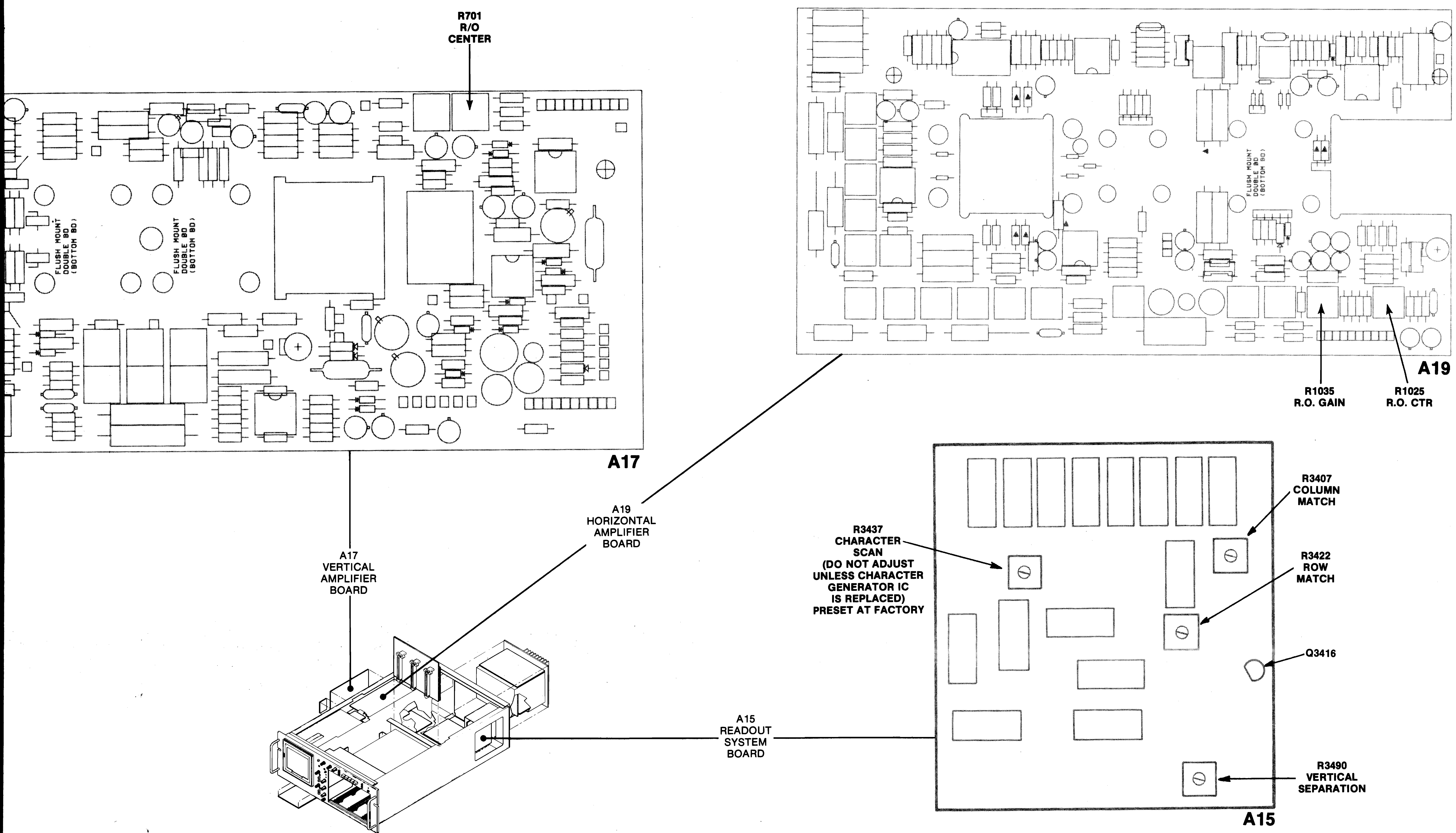
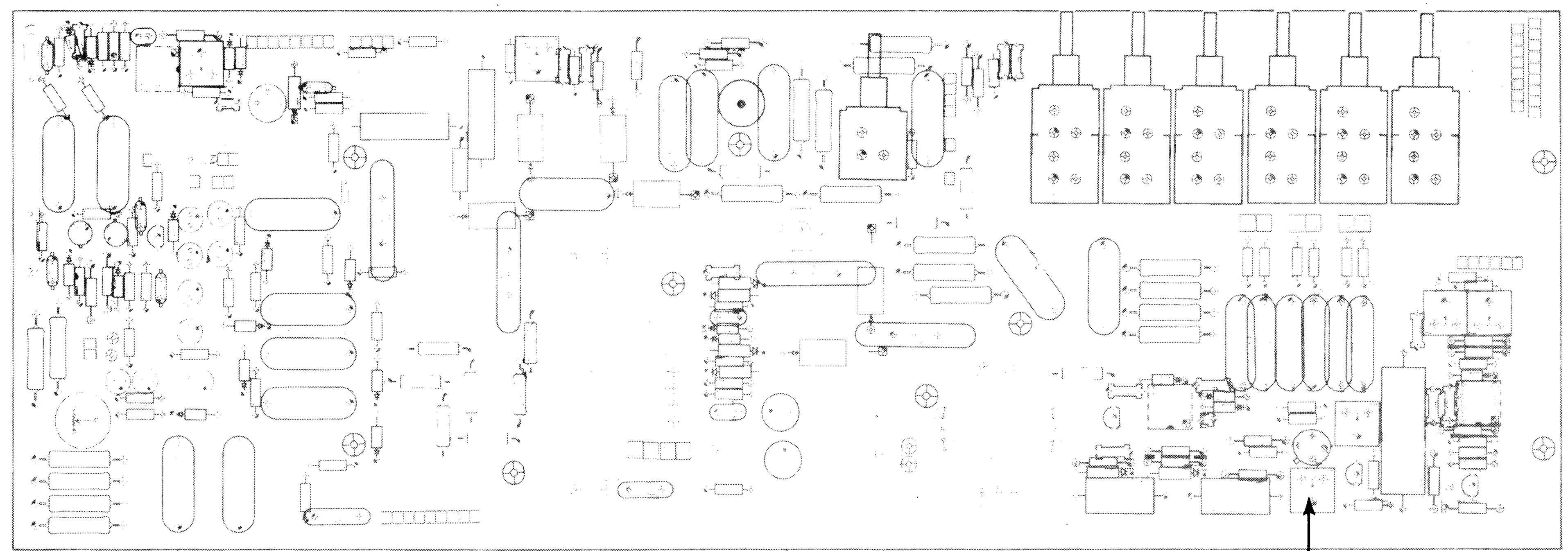


Figure 8-25. Test Point and Adjustment Locations G. REV JAN 1985

5039-825A



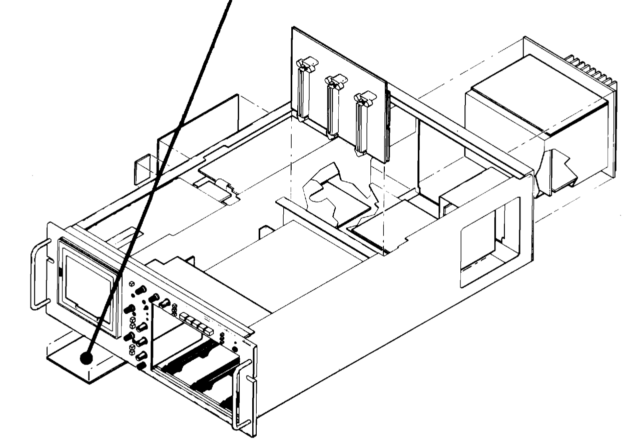


Figure 8-26. Adjustment Location H.

5039-826

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.

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.

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.

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000GY	DEK INC.	3480 SWENSEN AVE.	ST. CHARLES, IL 60174
00779	AMP, INC.	P.O. BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
02768	ILLINOIS TOOL WORKS, INC., FASTEX DIV.	195 ALGONQUIN ROAD	DES PLAINES, IL 60016
04811	PRECISION COIL SPRING COMPANY	P O BOX 5450, 10107 ROSE ST.	EL MONTE, CA 91734
06383	PANDUIT CORPORATION	17301 RIDGELAND	TINLEY PARK, IL 60477
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
06950	VSI CORP., SCREWCORP DIVISION	13001 E. TEMPLE AVE.	CITY OF INDUSTRY, CA 91746
07416	NELSON NAME PLATE CO.	3191 CASITAS	LOS ANGELES, CA 90039
07707	USM CORP., USM FASTENER DIV.	510 RIVER RD.	SHELTON, CT 06484
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
13103	THERMALLOY COMPANY, INC.	2021 W VALLEY VIEW LANE P O BOX 34829	DALLAS, TX 75234
16428	BELDEN CORP.	P. O. BOX 1331	RICHMOND, IN 47374
18565	CHOMERICS INC.	77 DRAGON COURT	WOBURN, MA 01801
18680	HIGHLAND MFG. CO., THE DIV. OF BUELL INDUSTRIES, INC.	1240 WOLCOTT STREET	WATERBURY, CT 06720
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
26365	GRIES REPRODUCER CO., DIV. OF COATS AND CLARK, INC.	125 BEECHWOOD AVE.	NEW ROCHELLE, NY 10802
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
30817	INSTRUMENT SPECIALTIES COMPANY, INC.		LITTLE FALLS,NJ 07424
49671	RCA CORPORATION	30 ROCKEFELLER PLAZA	NEW YORK, NY 10020
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
70903	BELDEN CORP.	2000 S BATAVIA AVENUE	GENEVA, IL 60134
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
77900	SHAKEPROOF DIV OF ILLINOIS TOOL WORKS	SAINT CHARLES RD	ELGIN, IL 60120
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80033	PRESTOLE EVERLOCK, INC.	P. O. BOX 278,1345 MIAMI ST.	TOLEDO, OH 43605
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83486	ELCO INDUSTRIES, INC.	1103 SAMUELSON ROAD	ROCKFORD, IL 61101
83907	ACCURATE RUBBER PRODUCTS CO.	123 N. RACINE	CHICAGO, IL 60607
85471	BOYD, A. B., CO.	2527 GRANT AVENUE	SAN LEANDRO, CA 94579
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	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98159	RUBBER TECK, INC.	19115 HAMILTON AVE., P O BOX 389	GARDENA, CA 90247
98978	INTERNATIONAL ELECTRONIC RESEARCH CORP.	135 W. MAGNOLIA BLVD.	BURBANK, CA 91502
S3109	C/O PANEL COMPONENTS CORP.	P.O. BOX 6626	SANTA ROSA, CA 95406
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST.	BERKELEY, CA 94170
T0401	SOUND MFG	12115 E MARGINAL WAY SOUTH	SEATTLE, WA 98168
T0435	LEWIS SCREW CO.	4114 SOUTH PERORIA AVE.	CHICAGO, IL 60609
T1544	COMPUTER CONNECTIONS	2427 PRATT AVE	HAYWARD, CA 94544
T1547	MOORE ELECTRONICS	15824 SW UPPER BOONES FERRY RD	LAKE OSWEGO, OR 97034
T1741	COLMAN FASTENERS CO LTD	HATTONS ROAD OFF WESTINGHOUSE ROAD, TRAFFORD PARK	MANCHESTER M 17 1DF ENGLAND

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	378-0603-00			1	FILTER,MESH:EMI	80009	378-0603-00
-2	367-0112-00			1	PULL,MASK:1.01 X 0.35 X 0.26,BLK ACET	80009	367-0112-00
					**************(ATTACHING PARTS)***********		
-3	213-0055-00			1	SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	93907	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-4	378-0625-00			1	FILTER,LT,CRT:BLUE,5.15 X 4.4 X 0.03	80009	378-0625-00
-5	331-0258-03			1	MASK,CRT SCALE:	80009	331-0258-03
-6	200-0939-01			1	RTNR,CRT SCALE:5.55 X 5.068 X 0.475,AL	80009	200-0939-01
					**************(ATTACHING PARTS)***********		
-7	212-0008-00			4	SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-8	337-1159-03			1	SHLD,IMPLOSION:4.75 X 3.93 X 0.7 THK,PLSTC	80009	337-1159-03
-9	331-0441-00			1	MASK,CRT SCALE:	80009	331-0441-00
-10	366-1189-00			4	KNOB:GY,0.127 ID X 0.5 OD X 0.53	80009	366-1189-00
-11	210-0583-00			4	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-12	210-0940-00			4	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
-13	366-1559-00			8	PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-14	426-1072-00			8	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-15	----- -----			-	SWITCH,PUSH:(SEE S1988 REPL)		
					**************(ATTACHING PARTS)***********		
-16	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-17	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-18	358-0301-02			4	BUSHING,SLEEVE:GRAY PLASTIC	80009	358-0301-02
-19	366-1161-57			1	PUSH BUTTON:SIL GRAY,LEFT	80009	366-1161-57
-20	366-1161-31			1	PUSH BUTTON:SIL GRAY,ALT	80009	366-1161-31
-21	366-1161-27			1	PUSH BUTTON:SIL GRAY,ADD	80009	366-1161-27
-22	366-1161-30			1	PUSH BUTTON:SIL GRAY,CHOP	80009	366-1161-30
-23	366-1161-58			1	PUSH BUTTON:SIL GRAY,RIGHT	80009	366-1161-58
-24	426-0568-00			5	FR,PUSHBUTTON:PANEL MOUNT	80009	426-0568-00
-25	366-1650-00			3	PUSH BUTTON:CLEAR,0.184 X 0.214 X 0.8 L	80009	360-1650-00
-26	366-1480-02			1	PUSH BUTTON:GRAY	80009	366-1480-02
-27	426-0681-00			1	FR,PUSH BUTTON:	80009	426-0681-00
-28	333-3110-00			1	PANEL,FRONT:	80009	333-3110-00
					**************(ATTACHING PARTS)***********		
-29	213-0055-00			2	SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	93907	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-30	367-0022-00			2	HANDLE,BOW:1.5 X 4.5 INCH	88245	15986
					**************(ATTACHING PARTS)***********		
-31	212-0577-00			4	SCREW,MACHINE:10-32 X 0.625 ",TRH,STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-32	131-3280-00			3	CLIP,GROUND:EMI/RFI,SST	80009	131-3280-00
-33	131-3279-00			1	CLIP,GROUND:EMI/RFI,SST	80009	131-3279-00
-34	352-0157-00			2	LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-35	200-0935-00			2	BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-36	200-0678-00			4	COVER,ELEC CONN:BNC,SHORTING	91836	KC89-58TR5
-37	346-0045-00			4	STRAP,CONN COV:BNC ONE END,POLYPROPYLENE	80009	346-0045-00
-38	----- -----			4	CONN,RCPT:(SEE J95,J1916,J1925,J1944 REPL)		
					**************(ATTACHING PARTS)***********		
-39	210-0012-00			4	WASHER,LOCK:INTL,0.384 ID,INTL,0.022 TH	78189	1220-02-00-0541C
-40	210-0413-00			4	NUT,PLAIN,HEX.:0.375-32 X 0.50 BRS	73743	3145-402
					************(END ATTACHING PARTS)*********		
-41	129-0103-00			1	POST,BDG,ELEC:ASSEMBLY	80009	129-0103-00
					**************(ATTACHING PARTS)***********		
-42	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
-43	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
					************(END ATTACHING PARTS)*********		
-44	386-5151-00			1	SUBPANEL,FRONT:	80009	386-5151-00
-45	386-5150-00			1	SUPPORT,GASKET:EMI,BOTTOM,ALUMINUM	80009	386-5150-00
					**************(ATTACHING PARTS)***********		
-46	211-0105-00			3	SCREW,MACHINE:4-40 X 0.188,100 DEG,FLH ST	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-47	351-0202-00			3	GUIDE,SLIDE:UPPER	80009	351-0202-00
					**************(ATTACHING PARTS)***********		
-48	211-0105-00			6	SCREW,MACHINE:4-40 X 0.188,100 DEG,FLH ST	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-49	351-0509-00			1	GUIDE,PUSH BTN:THREE LAMP	80009	351-0509-00
					**************(ATTACHING PARTS)***********		
-50	211-0030-00			2	SCREW,MACHINE:2-56 X 0.25,FLH,82DEG,STL	83385	ORD BY DESCR
-51	210-0405-00			2	NUT,PLAIN,HEX:2-56 X 0.188,BRS,CD PL	73743	12157-50
					************(END ATTACHING PARTS)*********		
-52	—— ——			1	CIRCUIT BOARD ASSY:TRIG LIGHT(SEE A3 REPL)		
-53	386-5149-00			1	SUPPORT,GASKET:EMI,TOP,ALUMINUM	80009	386-5149-00
					**************(ATTACHING PARTS)***********		
-54	211-0105-00			3	SCREW,MACHINE:4-40 X 0.188,100 DEG,FLH ST	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-55	348-0625-00			2	SHLD GSKT,ELEK:8.1 L	80009	348-0625-00
-56	—— ——			1	CIRCUIT BOARD ASSY:GRAT LIGHT(SEE A20 REPL		
-57	378-0614-01			1	.REFLECTOR,LIGHT:INT SCALE ILLUMINATION	80009	378-0614-01
					.*************(ATTACHING PARTS)***********		
-58	211-0062-00			2	.SCREW,MACHINE:2-56 X 0.312,PNH,STL	06950	ORD BY DESCR
					.**********(END ATTACHING PARTS)*********		
-59	344-0179-00			1	.CLIP,REFL RTNG:PLASTIC	80009	344-0179-00
-60	204-0380-00			1	BODY,TERMINAL:	80009	204-0380-00
					**************(ATTACHING PARTS)***********		
-61	131-0765-01			3	TERM,FEED THRU:0.584 L X 0.625 OD BRS GOLD	80009	131-0765-01
					************(END ATTACHING PARTS)*********		
-62	386-1884-10			1	SUPPORT,CRT:FRONT,FINISHED	80009	386-1884-10
					**************(ATTACHING PARTS)***********		
-63	212-0040-00			2	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83486	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	348-0031-00			1	CHASSIS,SCOPE:VERTICAL AMPLIFIER	80009	348-0031-00
-64	200-2982-00			2	COVER,MAINFRAME:ALUMINUM	80009	200-2982-00
					**************(ATTACHING PARTS)***********		
-65	211-0507-00	B010100	B030279	16	SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
	211-0504-00	B030280		16	SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-66	211-0538-00	B010100	B030279	4	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH	83385	ORD BY DESCR
	211-0502-00	B030280		4	SCREW,MACHINE:6-32 X 0.188,FLH,100 DEG,ST	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-67	348-0274-00			2	SHLD GSKT,ELEK:FINGER TYPE,24.0 L	30817	97-555CDC
	—— ——			-	(EACH END OF SIDE CABINET)		
-68	390-0928-00			1	CABINET,SIDE:LEFT,ALUMINUM	80009	390-0928-00
					**************(ATTACHING PARTS)***********		
-69	212-0040-00			4	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83486	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-70	200-2980-00			1	COVER,SIDE:LEFT,AL	80009	200-2980-00
					**************(ATTACHING PARTS)***********		
-71	211-0101-00			8	SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-72	426-2032-00			1	FRAME PNL,CAB:REAR	80009	426-2032-00
-73	—— ——			1	FAN:(SEE B90 REPL)		
					**************(ATTACHING PARTS)***********		
-74	211-0530-00			4	SCREW,MACHINE:6-32 X 1.750,PNH STL CD PL	83385	ORD BY DESCR
-75	210-0457-00			4	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-76	386-5166-00			1	PLATE,FAN MTG:	80009	386-5166-00
					**************(ATTACHING PARTS)***********		
-77	211-0578-00			4	SCREW,MACHINE:6-32 X 0.438 1NCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-78	378-2049-00			1	GRILL,FAN:3.07 DIA	80009	378-2049-00
-79	386-5152-00			1	SPRT,MAINFRAME:	80009	386-5152-00
					**************(ATTACHING PARTS)***********		
-80	212-0040-00			3	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83486	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-81	344-0250-00			1	CLIP,ELECTRICAL:COMPONENT MOUNTING	80033	E50005-007
					**************(ATTACHING PARTS)***********		
-82	211-0008-00			1	SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
-83	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					************(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-84	343-0853-00			1	CLAMP,LOOP:0.5 DIA,NYLON	000GY	021-0500
-85	255-0334-00			1	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYL	11897	122-37-2500
-86	———			1	RESISTOR,POWER:(SEE R90 REPL)		
					*************(ATTACHING PARTS)**********		
-87	211-0553-00			1	SCREW,MACHINE:6-32 X 1.5 INCH,PNH STL	83385	ORD BY DESCR
-88	210-0601-00			1	EYELET,METALLIC:CAD PLATED	18680	77362
-89	210-0478-00			1	INSERT,SCR THD:0.66" L,W/HEX FLG ONE END	80009	210-0478-00
-90	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ,TIN PL	86928	A-373-158-2
-91	211-0507-00			1	SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-92	175-9324-00			1	CA ASSY,SP,ELEC:2,26 AWG,12.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(R90 TO A25P90)		
-93	348-0274-00			2	SHLD GSKT,ELEK:FINGER TYPE,24.0 L	30817	97-555CDC
	———			-	(EACH END OF SIDE CABINET)		
-94	390-0929-00			1	CABINET,SIDE:RIGHT,ALUMINUM	80009	390-0929-00
					*************(ATTACHING PARTS)**********		
-95	212-0040-00			4	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83486	ORD BY DESCR
-96	211-0507-00			4	SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
-97	211-0503-00			1	SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-98	200-2981-00			1	COVER,SIDE:RIGHT	80009	200-2981-00
					*************(ATTACHING PARTS)**********		
-99	211-0101-00			4	SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-100	386-2141-00			1	SPRT,EXT SHAFT:PUSH SWITCH	80009	386-2141-00
-101	361-0007-00			1	SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
-102	351-0313-00			1	GUIDE,RACKMOUNT:19.218 INCH LONG,PAIR	06666	ORD BY DESCR
					*************(ATTACHING PARTS)**********		
-103	210-0458-00			12	NUT,PL,ASSEM WA:8-32 X 0.344,STL,CD PL	78189	511-081800-00
					***********(END ATTACHING PARTS)*********		

FIG. 1 FRONT, FRAME

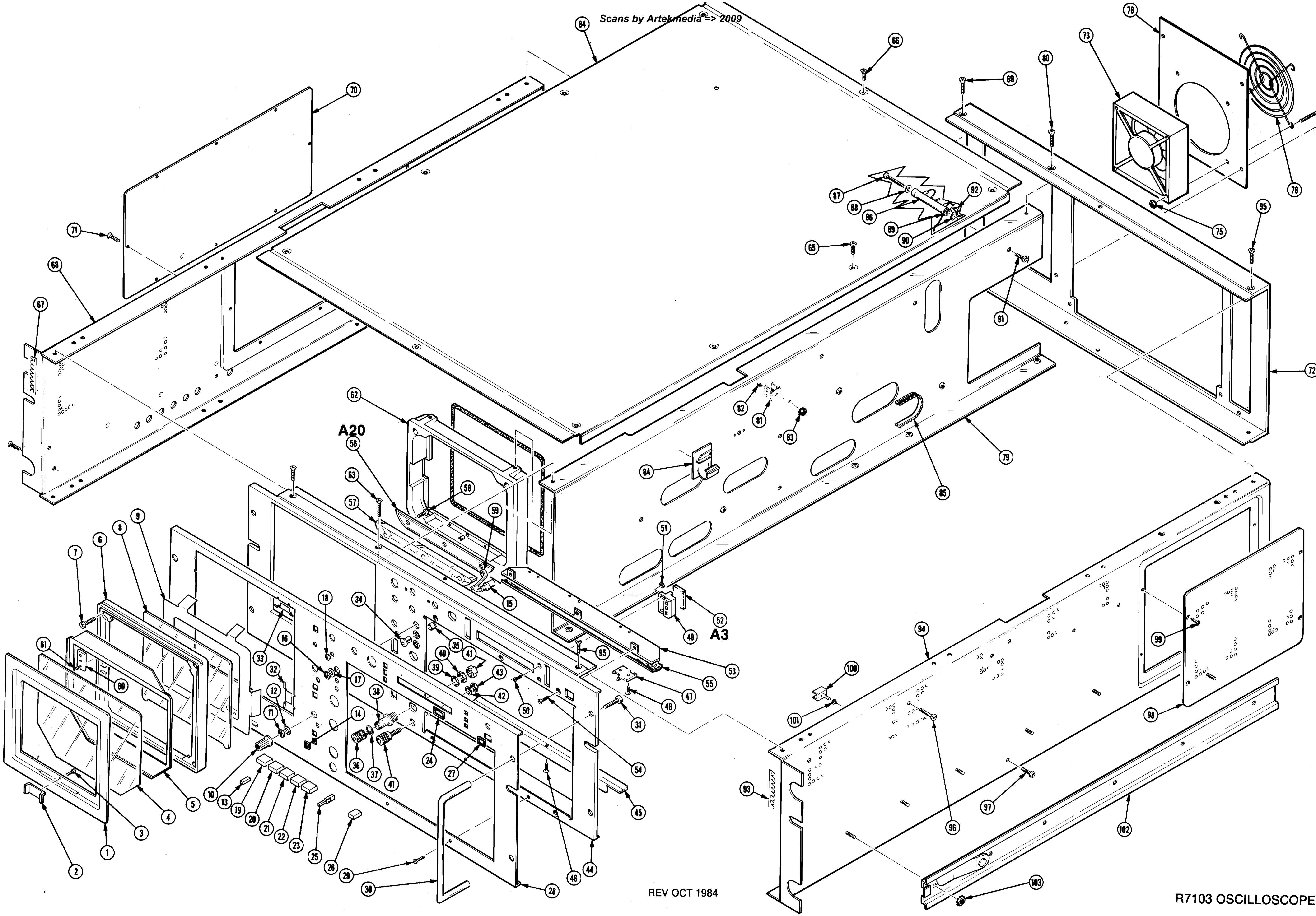


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FIG. 2 DISPLAY UNIT, LEFT SIDE

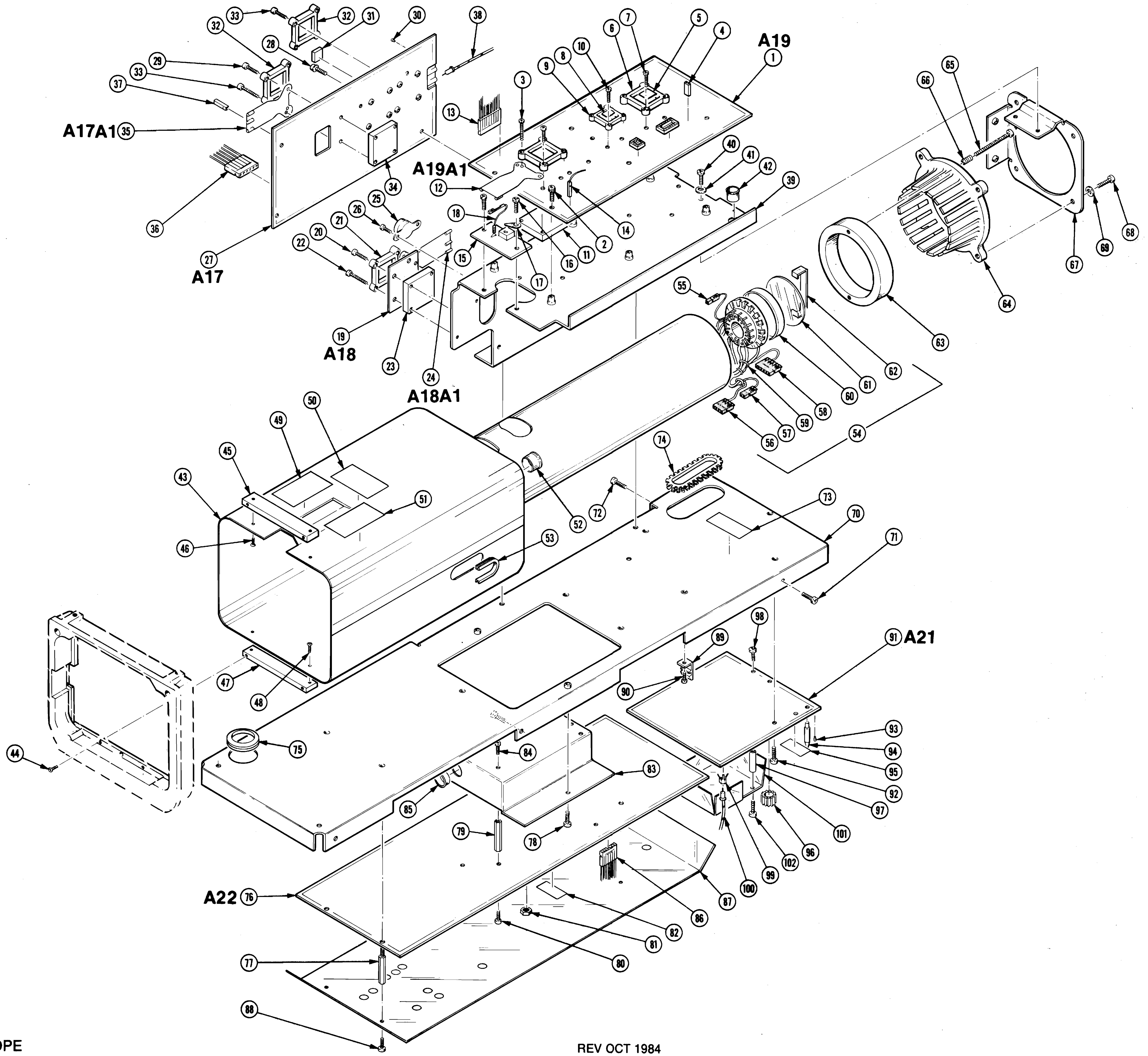

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	——			1	CIRCUIT BOARD ASSY:HORIZ AMPL(SEE A19 REPL		
					**************(ATTACHING PARTS)***********		
-2	211-0292-00			6	SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	51-040445-01
-3	211-0260-00			4	SCR,ASSEM WSHR:2-56 X 0.6875 L,PNH,STL CD	78189	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	——			-	HORIZONTAL AMPLIFIER ASSY INCLUDES:		
-4	131-0993-00			1	.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-5	131-1967-00			3	.CONT SET,ELEC:MICROCKT,1.75 CM,RUBBER	80009	131-1967-00
-6	426-1351-00			3	.FRAME,MICROCKT:1.75 CM	80009	426-1351-00
					.*************(ATTACHING PARTS)***********		
-7	211-0259-00			8	.SCR,ASSEM WSHR:2-56 X 0.437,PNH,STL CD PL	78189	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-8	131-1923-00			1	.CONTACT,ELEC:MICROCIRCUIT	80009	131-1923-00
-9	426-1337-00			1	.FRAME,MICROCKT:1.22 CM	80009	426-1337-00
					.*************(ATTACHING PARTS)***********		
-10	211-0259-00			4	.SCR,ASSEM WSHR:2-56 X 0.437,PNH,STL CD PL	78189	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-11	214-2543-00			2	.HT SK,MICROCKT:MICROCIRCUIT,AL	80009	214-2543-00
-12	——			1	.HORIZ FLEX CONN (SEE A19A1REPL)		
	——			-	(6-1 TO A19J71;6-0 TO A19J970)		
-13	175-9307-00			1	CA ASSY,SP,ELEC:10,26 AWG,3.0 L,RIBBON	T1544	ORDER BY DESCR
	——			-	(A19J882 TO A17J782)		
-14	196-1505-00			1	LEAD,ELECTRICAL:26 AWG,3.0 L,9-1	80009	196-1505-00
	——			-	(A19J1094 TO R1099)		
-15	——			1	HORIZONTAL TERMINATION (SEE R1099 REPL)		
					**************(ATTACHING PARTS)***********		
-16	211-0504-00			2	SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-17	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ,TIN PL	86928	A-373-158-2
					***********(END ATTACHING PARTS)*********		
-18	195-0581-00			2	LEAD,ELECTRICAL:26 AWG,1.5 L,9-1	80009	195-0581-00
	——			-	(COILS TO CRT PINS)		
-19	——			1	CRT TERMINATION:(SEE A18 REPL)		
					**************(ATTACHING PARTS)***********		
-20	211-0259-00			2	SCR,ASSEM WSHR:2-56 X 0.437,PNH,STL CD PL	78189	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	——			-	CRT TERMINATION ASSY INCLUDES:		
-21	426-1351-00			1	.FRAME,MICROCKT:1.75 CM	80009	426-1351-00
					.*************(ATTACHING PARTS)***********		
-22	211-0260-00			2	.SCR,ASSEM WSHR:2-56 X 0.6875 L,PNH,STL CD	78189	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-23	214-2543-00			1	.HT SK,MICROCKT:MICROCIRCUIT,AL	80009	214-2543-00
-24	——			1	.VERTICAL CRT FLEX CONN (SEE A18A1 REPL)		
-25	——			1	SWITCH,THERM:(SEE S70 REPL)		
					**************(ATTACHING PARTS)***********		
-26	210-0007-00			2	WASHER,LOCK:#8 EXT,0.02 THK,STL CD PL	78189	1108-00-00-0541C
					***********(END ATTACHING PARTS)*********		
-27	——			1	CIRCUIT BOARD ASSY:VERT AMPL(SEE A17 REPL)		
					**************(ATTACHING PARTS)***********		
-28	211-0292-00			4	SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	51-040445-01
-29	211-0260-00			2	SCR,ASSEM WSHR:2-56 X 0.6875 L,PNH,STL CD	78189	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	——			-	VERTICAL AMPLIFIER ASSY INCLUDES:		
-30	136-0252-00			2	.SOCKET,PIN TERM:U/W 0.019 DIA PINS	00779	2-330808-7
	136-0252-07			51	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-31	136-0727-00			4	.SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	131-1967-00			3	.CONT SET,ELEC:MICROCKT,1.75 CM,RUBBER	80009	131-1967-00
-32	426-1351-00			3	.FRAME,MICROCKT:1.75 CM	80009	426-1351-00
					.*************(ATTACHING PARTS)***********		
-33	211-0259-00			10	.SCR,ASSEM WSHR:2-56 X 0.437,PNH,STL CD PL	78189	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-34	214-2543-00			1	.HT SK,MICROCKT:MICROCIRCUIT,AL	80009	214-2543-00
-35	——			1	.VERTICAL FLEX CONN (SEE A17A1 REPL)		
-36	198-5423-00			1	WIRE SET,ELEC:	80009	198-5423-00
	——			-	(A17J790 TO A6J78,A15J04,A15J05)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-37	196-1504-00			1	LEAD,ELECTRICAL:26 AWG,3.0 L,9-1	80009	196-1504-00
	———			-	(A17J783 TO CRT TERMINATION)		
-38	———			-	(FROM DL592)		
-39	426-2031-00			1	FRAME SECT,CAB:LEFT,ALUMINUM	80009	426-2031-00
					*************(ATTACHING PARTS)***********		
-40	211-0504-00			4	SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-41	210-0803-00			4	WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-42	342-0313-00			1	INSULATOR,BSHG:0.437 ID X 0.567 INCH OD	28520	SB-562-7
-43	337-2419-01			1	SHIELD,CRT:	80009	337-2419-01
					*************(ATTACHING PARTS)***********		
-44	211-0038-00			4	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-45	220-0803-00			1	NUT,BAR:2.95 X 0.5 X 0.25;(4) 4-40	80009	220-0803-00
					*************(ATTACHING PARTS)***********		
-46	211-0038-00			2	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-47	214-2417-00			1	NUT,BAR:3.1 INCH LONG,AL	80009	214-2417-00
					*************(ATTACHING PARTS)***********		
-48	211-0038-00			2	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-49	334-1379-00			1	MARKER,IDENT:MARKED HI VACUUM	80009	334-1379-00
-50	334-3302-00			1	MARKER,IDENT:MARKED ANODE LEAD CAUTION	80009	334-3302-00
-51	334-2208-00			1	MARKER,IDENT:MARKED DANGER	80009	334-2208-00
-52	348-0064-00			1	GROMMET,PLASTIC:GRAY,ROUND,0.582 ID	80009	348-0064-00
-53	348-0085-00			2	GROMMET,PLASTIC:GRAY,U-SHAPED,0.48 ID	80009	348-0085-00
-54	136-0648-00			1	SKT,PL-IN,ELEC:CRT,10 CONTACT W/LEADS	80009	136-0648-00
-55	204-0675-00			1	.CONN BODY,PLUG:1 FEMALE CONTACT	00779	87175-2
	———			-	.(TO A21J1602)		
-56	352-0162-03			1	.HLDR,TERM CONN:4 WIRE,ORANGE	80009	352-0162-03
	———			-	.(TO A22J1703)		
-57	352-0169-02			1	.HLDR,TERM CONN:2 WIRE,RED	80009	352-0169-00
	———			-	.(TO A22J1702)		
-58	352-0164-02			1	.HLDR,TERM CONN:6 WIRE,RED	80009	352-0164-02
	———			-	.(TO A21J1602)		
-59	343-0549-00			9	.STRAP,TIEDOWN:0.091 W X 4.0 L,ZYTEL	06383	PLT1M
-60	200-0917-01			1	.COV,CRT SKT:2.052 OD X 0.291 H,PLASTIC	80009	200-0917-01
-61	367-0117-00			1	.PULL,SOCKET:CRT,PLASTIC	80009	367-0117-00
-62	343-0254-00			1	.CLP,ELCTRN TUBE:DELRIN	80009	343-0254-00
-63	354-0347-00			1	RING,CRT CLAMP:2.127 ID X 2.595 OD X 0.563	80009	354-0347-00
-64	343-0205-01			1	RTNR,ELCTRN TU:3.0 DIA X 1.5 L,DELRIN	80009	343-0205-01
					*************(ATTACHING PARTS)***********		
-65	211-0170-00			2	SCREW,MACHINE:4-40 X 2.75 INCH,PNH STL	83385	ORD BY DESCR
-66	214-1333-00			2	SPRING,HLCPS:0.213 OD X 0.375 INCH LONG	80009	214-1333-00
					***********(END ATTACHING PARTS)*********		
-67	386-3731-00			1	SUPPORT,CRT:REAR	80009	386-3731-00
					*************(ATTACHING PARTS)***********		
-68	211-0510-00			2	SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
-69	210-0949-00			4	WASHER,FLAT:0.141 ID X 0.50 INCH OD,BRS	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-70	441-1566-00			1	CHASSIS,SCOPE:HIGH VOLTAGE	80009	441-1566-00
					*************(ATTACHING PARTS)***********		
-71	211-0507-00			3	SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
-72	211-0559-00			3	SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH ST	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-73	334-3301-00			1	MARKER,IDENT:MARKED DANGER	07416	ORDER BY DESCR
-74	255-0334-00			1	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYL	11897	122-37-2500
-75	348-0051-00			1	GROMMET,RUBBER:BLACK,ROUND,0.75 ID	83907	1107
-76	———			1	CIRCUIT BOARD ASSY:HIGH VOLT(SEE A22 REPL)		
					*************(ATTACHING PARTS)***********		
-77	129-0457-00			5	SPACER,POST:1.07L,W/4-40 TAP 1 END	80009	129-0457-00
-78	211-0507-00			3	SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		

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-	———			-	HIGH VOLTAGE ASSY INCLUDES:		
-79	129-0230-00			3	.SPACER,POST:1.375L,W/4-40 THD EA END,BR	80009	129-0230-00
					.*************(ATTACHING PARTS)***********		
-80	211-0008-00			3	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-81	220-0835-00			3	.NUT,PLAIN HEX:10-24,0.375 DIA,NYLON	95987	N-1024-X
	———			-	.(ATTACHES U1700)		
-82	334-3301-00			1	.MARKER,IDENT:MARKED DANGER	07416	ORDER BY DESCR
-83	337-3169-00			1	.SHIELD,ELEC:HIGH VOLTAGE,ALUMINUM	80009	337-3169-00
					.*************(ATTACHING PARTS)***********		
-84	211-0008-00			3	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-85	348-0064-00			1	GROMMET,PLASTIC:GRAY,ROUND,0.582 ID	80009	348-0064-00
-86	179-2933-00			1	WIRING HARNESS:HIGH VOLTAGE	T1544	ORDER BY DESCR
	———			-	(A22J1705,J1709 TO A21J1605,J1609)		
-87	337-3174-00			1	SHIELD,ELEC:HIGH VOLTAGE	T0401	ORDER BY DESCR
					**************(ATTACHING PARTS)***********		
-88	211-0008-00			5	SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-89	344-0133-00			2	CLIP,SPR,TNSN:CIRCUIT CARD MOUNTING	80009	344-0133-00
					**************(ATTACHING PARTS)***********		
-90	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-91	———			1	CIRCUIT BOARD ASSY:Z AXIS(SEE A21 REPL)		
					**************(ATTACHING PARTS)***********		
-92	211-0292-00			3	SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	51-040445-01
					************(END ATTACHING PARTS)*********		
	———			-	Z AXIS ASSY INCLUDES:		
-93	136-0252-07			59	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-94	386-1559-00			2	.SPACER,CKT BD:0.47 H,ACETAL	80009	386-1559-00
-95	334-3301-00			1	.MARKER,IDENT:MARKED DANGER	07416	ORDER BY DESCR
-96	214-2593-00			1	.HEAT SINK,XSTR:(1) TO-5 ALUMINUM	13103	2257B
-97	385-0107-00			2	.SPACER,POST:0.75 L W/4-40 THD THRU,NYL	80009	385-0107-00
					.*************(ATTACHING PARTS)***********		
-98	211-0040-00			2	.SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	921-1120-0014
					.***********(END ATTACHING PARTS)*********		
-99	———			2	.CONN,RCPT:(SEE A21J1606,J6032 REPL)		
-100	175-2937-00			1	CABLE ASSY,RF:50 OHM COAX,22.0 L,9-2	80009	175-2937-00
	———			-	(A21J1632 TO A15J03)		
-101	200-2081-00			1	COVER,CKT BD:	80009	200-2081-00
					**************(ATTACHING PARTS)***********		
-102	211-0040-00			2	SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	921-1120-0014
					************(END ATTACHING PARTS)*********		

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	CIRCUIT BOARD ASSY:FRONT PANEL(SEE A1 REPL		
					*************(ATTACHING PARTS)**********		
-2	211-0008-00			1	SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)********		
	———			1	FRONT PANEL BOARD INCLUDES:		
-3	136-0727-00			3	.SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
-4	136-0252-07	B010100	B030299	61	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0252-07	B030300		7	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	361-0542-00			8	.SPACER,PUSH SW:0.078 L,POLYPROPYLENE	71590	J76113
-5	———			4	.CONN,RCPT:(SEE J1915,J1924,J1943,)		
	———			-	.(J1992 REPL)		
-6	175-9434-00			1	CABLE ASSY,RF:50 OHM COAX,2.5 L,9-4	80009	175-9434-00
	———				(A1J1924 TO J1925)		
	175-9433-00			1	CABLE ASSY,RF:50 OHM COAX,4.0 L,9-3	80009	175-9433-00
	———				(A1J1943 TO J1944)		
	175-9437-00			1	CABLE,ASSY,RF:50 OHM COAX,36.0 L,9-7	80009	175-9437-00
	———				(A1J1915 TO J1916)		
	198-5422-00			1	WIRE SET,ELEC:	80009	198-5422-00
	175-9545-00			1	.CABLE ASSY,RF:50 OHM COAX,18.0 L,9-4	80009	175-9545-00
	———				.(A1J1992 TO A6J18)		
	131-0621-00			6	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
	131-0792-00			6	.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-7	352-0204-00			2	.CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
	———				.(A1P1900,A6P18)		
-8	175-9312-00			1	CA ASSY,SP,ELEC:5,26 AWG,30.0 L,RIBBON	T1544	ORDER BY DESCR
	———				(A1J1917 TO A25J17)		
-9	175-9311-00			1	CA ASSY,SP,ELEC:4,26 AWG,10.0 L,RIBBON	T1544	ORDER BY DESCR
	———				(A1J910 TO A5J310)		
-10	175-9317-00			1	CA ASSY,SP,ELEC:8,26 AWG,13.0 L,RIBBON	T1544	ORDER BY DESCR
	———				(A1J904 TO A22J1804)		
-11	175-9315-00			1	CA ASSY,SP,ELEC:6,26 AWG,6.5 L,RIBBON	T1544	ORDER BY DESCR
	———				(A1J1909 TO LED'S)		
-12	129-0304-00			1	INSULATOR,STDF:0.25 OD X 1.23 INCH LONG	80009	129-0304-00
					*************(ATTACHING PARTS)**********		
-13	211-0008-00			1	SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)********		
-14	———			1	CIRCUIT BOARD ASSY:MODE SWITCH(SEE A5 REPL		
					*************(ATTACHING PARTS)**********		
-15	211-0292-00			4	SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	51-040445-01
					***********(END ATTACHING PARTS)********		
	———				MODE SWITCH BOARD INCLUDES:		
-16	———			2	.SWITCH PB ASSY:(SEE A5S365,A5S395 REPL)		
-17	343-0496-03			2	.CLIP,SWITCH:FRONT,10 MM X 3 UNIT	80009	343-0496-03
					.************(ATTACHING PARTS)**********		
-18	210-3033-00			6	.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
					.**********(END ATTACHING PARTS)********		
-19	343-0497-03			2	.CLIP,SWITCH:REAR,10 MM X 3 UNIT	80009	343-0497-03
					.************(ATTACHING PARTS)**********		
-20	210-3033-00			6	.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
					.**********(END ATTACHING PARTS)********		
-21	343-0499-14			1	.CLIP,SWITCH:7.5MM X 5 UNIT	80009	343-0499-14
					.************(ATTACHING PARTS)**********		
-22	210-3033-00			5	.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
					.**********(END ATTACHING PARTS)********		
-23	343-0499-13			1	.CLIP,SWITCH:7.5MM X 4 UNIT	80009	343-0499-13
					.************(ATTACHING PARTS)**********		
-24	210-3033-00			4	.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
					.**********(END ATTACHING PARTS)********		
-25	343-0495-09			1	.CLIP,SWITCH:FRONT,7.5 MM,9 UNIT	80009	343-0495-09
					.************(ATTACHING PARTS)**********		
-26	210-3033-00			9	.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
					.**********(END ATTACHING PARTS)********		
-27	361-0542-00			2	.SPACER,PUSH SW:0.078 L,POLYPROPYLENE	71590	J76113
	———			-	.(UNDER S390)		
-28	———			1	.CONN,RCPT:(SEE J392)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-29	175-9435-00			1	CABLE ASSY,RF:50 OHM COAX,4.0 L,9-5	80009	175-9435-00
	----- -----			-	(A5J392 TO J396)		
-30	175-9319-00			1	CA ASSY,SP,ELEC:9,26 AWG,15.0 L,RIBBON	T1544	ORDER BY DESCR
	----- -----			-	(A5J2006 TO A22J1806)		
-31	175-9308-00			1	CA ASSY,SP,ELEC:5,26 AWG,22.0 L,RIBBON	T1544	ORDER BY DESCR
	----- -----			-	(A5J304 TO A20,DS308)		
-32	175-9313-00			1	CA ASSY,SP,ELEC:4,26 AWG,4.0 L,RIBBON	T1544	ORDER BY DESCR
	----- -----			-	(A5J306 TO A3J346)		
-33	384-1136-00			2	EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-34	384-1354-00			4	EXTENSION SHAFT:1.585 INCH LONG,OFFSET,NYL	80009	384-1354-00
-35	386-1558-00			1	SPACER,CKT BD:0.335 H,ACETAL	80009	386-1558-00
-36	380-0727-00			1	HOUSING,PL-IN:ALUMINUM	80009	380-0727-00
					**************(ATTACHING PARTS)***********		
-37	211-0504-00			5	SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-38	361-0585-00			1	SPCR,GUIDE RAIL:PLUG-IN,AL	80009	361-0585-00
					**************(ATTACHING PARTS)***********		
-39	213-0229-00			3	SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH ST	93907	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-40	351-0181-05			3	GUIDE,SLIDE:PLUG-IN UNIT,LWR,BLK NYLON	80009	351-0181-05
					**************(ATTACHING PARTS)***********		
-41	213-0229-00			3	SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH ST	93907	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-42	384-1236-01			1	EXTENSION SHAFT:9.055 L,PLSTC	80009	384-1236-01
-43	200-1731-00			1	COVER,ELEC SW:1.9 X 1.0 X 0.45 CLR PLASTC	85471	ORD BY DESCR
					**************(ATTACHING PARTS)***********		
-44	211-0034-00			1	SCREW,MACHINE:2-56 X 0.50 INCH,PNH	06950	ORD BY DESCR
-45	210-0850-00			1	WASHER,FLAT:0.093 ID X 0.281 INCH OD	12327	ORD BY DESCR
	210-0405-00			1	NUT,PLAIN,HEX:2-56 X 0.188,BRS,CD PL	73743	12157-50
					***********(END ATTACHING PARTS)*********		
-46	----- -----			1	SWITCH,POWER:(SEE S10 REPL)		
					**************(ATTACHING PARTS)***********		
-47	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-48	407-3234-00			1	BRACKET,SWITCH:	80009	407-3234-00
					**************(ATTACHING PARTS)***********		
-49	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
	----- -----			-	(TO SECURE GROUND WIRES)		
-50	386-5148-00			1	SUPPORT,INTFC:ALUMINUM	80009	386-5148-00
-51	348-0051-00			1	GROMMET,RUBBER:BLACK,ROUND,0.75 ID	83907	1107
-52	255-0334-00			AR	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYL	11897	122-37-2500
-53	131-0800-03			2	CONTACT,ELEC:PLUG-IN GND,BE NI HT TR	80009	131-0800-03
					**************(ATTACHING PARTS)***********		
-54	211-0007-00			4	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-55	131-0799-00			4	CONTACT,ELEC:PLUG-IN GROUND	80009	131-0799-00
					**************(ATTACHING PARTS)***********		
-56	211-0007-00			4	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-57	337-2514-00			2	SHIELD,ELEC:INTERFACE CIRCUIT BOARD	80009	337-2514-00
					**************(ATTACHING PARTS)***********		
-58	211-0008-00			6	SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-59	----- -----			1	CIRCUIT BOARD ASSY:MAIN INTFC(SEE A6 REPL)		
					**************(ATTACHING PARTS)***********		
-60	213-0119-00			9	SCR,TPG,THD FOR:4-24 X 0.375 INCH,PNH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	MAIN INTERFACE BOARD INCLUDES:		
-61	----- -----			3	.CONN,RCPT:(SEE A6J1,J2,J3 REPL)		
					.*************(ATTACHING PARTS)***********		
-62	213-0232-00			6	.SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					.**********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-63	131-0993-00			1	.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-64	136-0252-07			3	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-65	136-0729-00			2	.SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108T
	136-0619-00			4	.SOCKET,PIN TERM:U/W 0.026-0.029 DIA PINS	00779	1-331677-0
-66	386-1558-00			6	.SPACER,CKT BD:0.335 H,ACETAL	80009	386-1558-00
-67	211-0155-00			4	.SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-68	———			3	.CONN,RCPT:(SEE A6J78,J201,J202 REPL)		
-69	175-9326-00			1	CABLE ASSY,RF:50 OHM COAX,16.0 L,9-0	80009	175-9326-00
	———			-	(A6J202 TO A15J202)		
	175-9487-00			1	CABLE ASSY,RF:50 OHM COAX,16.0 L,9-1	80009	175-9487-00
	———			-	(A6J201 TO A15J01)		
-70	175-9323-00			1	CA ASSY,SP,ELEC:(2)10,26 AWG,(1)4,26 AWG	T1544	ORD BY DESCR
	———			-	(A6J75,J46,J47 TO A15J3475,J3446,??)		
-71	175-9314-00			1	CA ASSY,SP,ELEC:2,26 AWG,18.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(A6J87 TO J81,J83)		
-72	175-9318-00			1	CA ASSY,SP,ELEC:8,26 AWG,11.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(A6J83 TO A25J83)		
-73	175-9316-00			1	CA ASSY,SP,ELEC:7,26 AWG,9.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(A6J80 TO A16J680)		
-74	175-9325-00			1	CA ASSY,SP,ELEC:10,22 AWG,11.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(A6J82 TO A25J82)		
-75	175-9440-00			1	CA ASSY,SP,ELEC:20,28 AWG,12.75 L,RIBBON	T1547	ORD BY DESCR
	———			-	(A6J3,J9 TO A5J303,J309)		
-76	175-9320-00			1	CA ASSY,SP,ELEC:9,26 AWG,5.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(A6J85 TO A22J1785)		
-77	175-9322-00			1	CA ASSY,SP,ELEC:10,26 AWG,12.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(A6J89 TO A17J789)		
-78	214-2675-00			4	SPRING,CKT BD:	04811	ORD BY DESCR
	———			-	(A10 TO A6J3-11,A7 TO A6J3-20,)		
	———			-	(A11 TO A6J1-11/13,A12 TO A6J2-11/13)		
-79	———			1	CIRCUIT BOARD ASSY:HORIZ FOL(SEE A10 REPL)		
	———			-	.(6-1 TO A19J971,6-0 TO A19J970)		
	210-0775-00			2	.EYELET,METALLIC:0.126 OD X 0.23 INCH L,	80009	210-0775-00
	210-0800-00			2	.EYELET,METALLIC:0.152 OD X 0.26 L,BRS	80009	210-0800-00
-80	———			1	CIRCUIT BOARD ASSY:TRIG FOL(SEE A7 REPL)		
	———			-	.(6-0 TO A14J270,6-1 TO A14J271)		
	210-0775-00			2	.EYELET,METALLIC:0.126 OD X 0.23 INCH L,	80009	210-0775-00
	210-0800-00			2	.EYELET,METALLIC:0.152 OD X 0.26 L,BRS	80009	210-0800-00
-81	———			2	CKT BD ASSY:RT VERT FOL(SEE A11,A12 REPL)		
	———			-	.(A12:6-0 TO A14J200,6-1 TO A14J201,)		
	———			-	.(6-2 TO A16J502,6-3 TO A16J503)		
-82	———			-	.(A11:6-0 TO A14J400,6-1 TO A14J401,)		
	———			-	.(6-2 TO A16J602,6-3 TO A16J603)		
	210-0775-00			4	.EYELET,METALLIC:0.126 OD X 0.23 INCH L,	80009	210-0775-00
	210-0800-00			4	.EYELET,METALLIC:0.152 OD X 0.26 L,BRS	80009	210-0800-00
-83	———			1	CIRCUIT BOARD ASSY:LOGIC(SEE A13 REPL)		
-84	131-1003-00			2	.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
	———			-	.(SEE A13J395,J406 REPL)		
	136-0252-07			2	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-85	136-0729-00			2	.SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108T
	136-0263-07			20	.SOCKET,PIN TERM:U/W 0.025 SQ PIN	22526	ORD BY DESCR
-86	175-9436-00			1	CABLE ASSY,RF:50 OHM COAX,14.0 L,9-5	80009	175-9436-00
	———			-	(A13J395 TO J95)		
	175-6214-00			1	CABLE ASSY,RF:50 OHM COAX,15.0 L,9-6	80009	175-6214-00
	———			-	(J406 TO A21J1606)		
-87	———			1	CIRCUIT BOARD ASSY:TRIG SEL(SEE A14 REPL)		
-88	———			7	.CONN,RCPT:(SEE A14JXXX REPL)		
-89	426-1352-00			3	.FRAME,MICROCKT:1.75 CM,STEPPED	80009	426-1352-00
					.*************(ATTACHING PARTS)***********		
-90	211-0259-00			12	.SCR,ASSEM WSHR:2-56 X 0.437,PNH,STL CD PL	78189	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-91	131-1968-00			2	.CONT SET,ELEC:MICROCKT,1.75 CM,RUBBER	80009	131-1968-00
	———			-	.(UNDER U274,U492)		
	131-1968-01			1	.CONT SET,ELEC:MICROCKT,1.75 CM,RUBBER	80009	131-1968-01
	———			-	.(UNDER U232)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-92	136-0263-07			5	.SOCKET,PIN TERM:U/W 0.025 SQ PIN	22526	ORD BY DESCR
-93	175-9438-00			1	CABLE ASSY,RF:50 OHM COAX,28.0 L,6-1	80009	175-9438-00
	———			-	(A14J496 TO J497)		
-94	———			1	DELAY LINE:(SEE DL592 REPL)		
					**************(ATTACHING PARTS)***********		
-95	211-0559-00			4	SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH ST	83385	ORD BY DESCR
-96	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	———			-	(6N TO A16J592;6-0 TO A16J694)		
-97	407-3272-00			1	BRKT,DLY LINE:ALUMINUM	80009	407-3272-00
					**************(ATTACHING PARTS)***********		
-98	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-99	———			1	CIRCUIT BOARD ASSY:VERT CH SW(SEE A16 REPL		
					**************(ATTACHING PARTS)***********		
-100	211-0292-00			4	SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	51-040445-01
					************(END ATTACHING PARTS)*********		
	———			-	VERTICAL CHANNEL SWITCH BOARD INCLUDES:		
-101	136-0252-00			6	.SOCKET,PIN TERM:U/W 0.019 DIA PINS	00779	2-330808-7
	214-0668-00			1	.HEAT SINK,ELEC:FOR TO-5	13103	2211B
-102	214-2543-00			1	.HT SK,MICROCKT:MICROCIRCUIT,AL	80009	214-2543-00
-103	131-1967-01			1	.CONT SET,ELEC:MICROCKT,1.75 CM,RUBBER	80009	131-1967-01
-104	426-1351-00			1	.FRAME,MICROCKT:1.75 CM	80009	426-1351-00
					.************(ATTACHING PARTS)***********		
-105	211-0259-00			2	.SCR,ASSEM WSHR:2-56 X 0.437,PNH,STL CD PL	78189	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-106	211-0260-00			2	SCR,ASSEM WSHR:2-56 X 0.6875 L,PNH,STL CD	78189	ORD BY DESCR
-107	441-1569-00			1	CHASSIS,SCOPE:READOUT	80009	441-1569-00
					**************(ATTACHING PARTS)***********		
-108	211-0559-00			4	SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH ST	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-109	———			1	CIRCUIT BOARD ASSY READOUT(SEE A15 REPL)		
					**************(ATTACHING PARTS)***********		
-110	211-0292-00			4	SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	51-040445-01
					************(END ATTACHING PARTS)*********		
	———			-	READOUT BOARD INCLUDES:		
-111	136-0729-00			12	.SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108T
-112	136-0728-00			3	.SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	136-0252-07			44	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-113	———			5	.CONN,RCPT:(SEE A15J3401-J3405 REPL)		
-114	175-9310-00			1	CA ASSY,SP,ELEC:4,26 AWG,6.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(TO J33)		
	175-9321-00			1	CA ASSY,SP,ELEC:4,26 AWG,4.0 L,RIBBON	T1544	ORD BY DESCR
	———			-	(TO J30)		
-115	333-3146-00			1	PANEL,REAR:	80009	333-3146-00
					**************(ATTACHING PARTS)***********		
-116	211-0578-00			2	SCREW,MACHINE:6-32 X 0.438 1NCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-117	200-0678-00			4	COVER,ELEC CONN:BNC,SHORTING	91836	KC89-58TR5
-118	346-0045-00			4	STRAP,CONN COV:BNC ONE END,POLYPROPYLENE	80009	346-0045-00
-119	———			2	CONN,RCPT:(SEE J95,J1916 REPL)		
					**************(ATTACHING PARTS)***********		
-120	220-0413-00			2	NUT,SLEEVE:4-40 X 0.312 HEX X 0.562	80009	220-0413-00
-121	210-0012-00			2	WASHER,LOCK:INTL,0.384 ID,INTL,0.022 TH	78189	1220-02-00-0541C
					************(END ATTACHING PARTS)*********		
-122	220-0012-00			2	NUT,CPLG,CABLE:0.375-32 X 0.44 HEX,BRASS	91836	C-19-139-1M06
	———			-	(PART OF RF CABLE ASSY)		
-123	———			2	CONN,RCPT:(SEE J81,J83 REPL)		
					**************(ATTACHING PARTS)***********		
-124	220-0413-00			2	NUT,SLEEVE:4-40 X 0.312 HEX X 0.562	80009	220-0413-00
-125	210-0012-00			2	WASHER,LOCK:INTL,0.384 ID,INTL,0.022 TH	78189	1220-02-00-0541C
					************(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-126	----- -----			2	CONN,RCPT:(SEE J30,J33 REPL)		
					**************(ATTACHING PARTS)***********		
-127	220-0551-00			2	NUT,PLAIN,HEX.:9 MM X 0.437 INCH	73743	ORD BY DESCR
-128	210-0012-00			2	WASHER,LOCK:INTL,0.384 ID,INTL,0.022 TH	78189	1220-02-00-0541C
					************(END ATTACHING PARTS)*********		

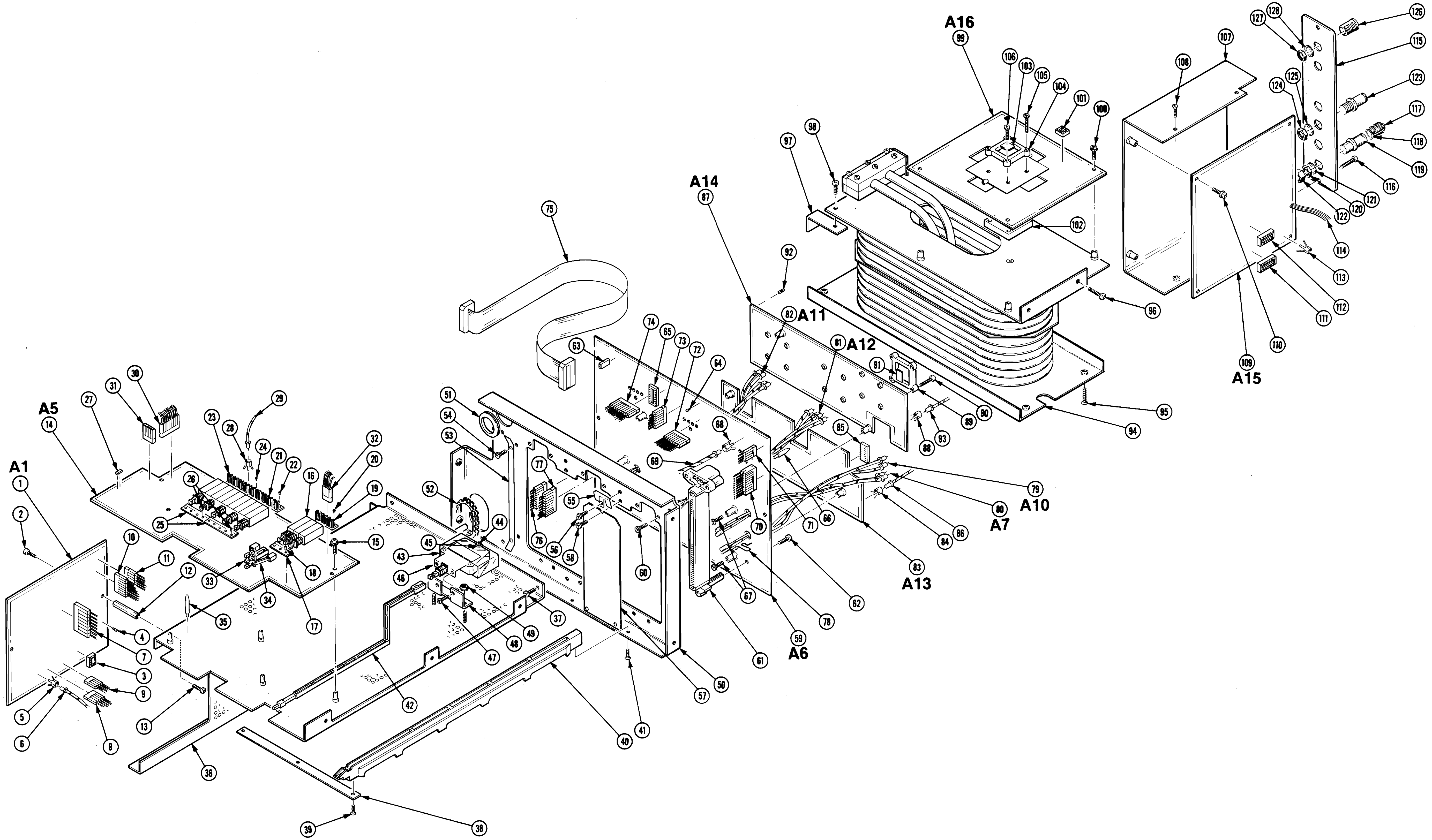

FIG. 3 PLUG-IN HOUSING, RIGHT SIDE

FIG. 4 POWER SUPPLY

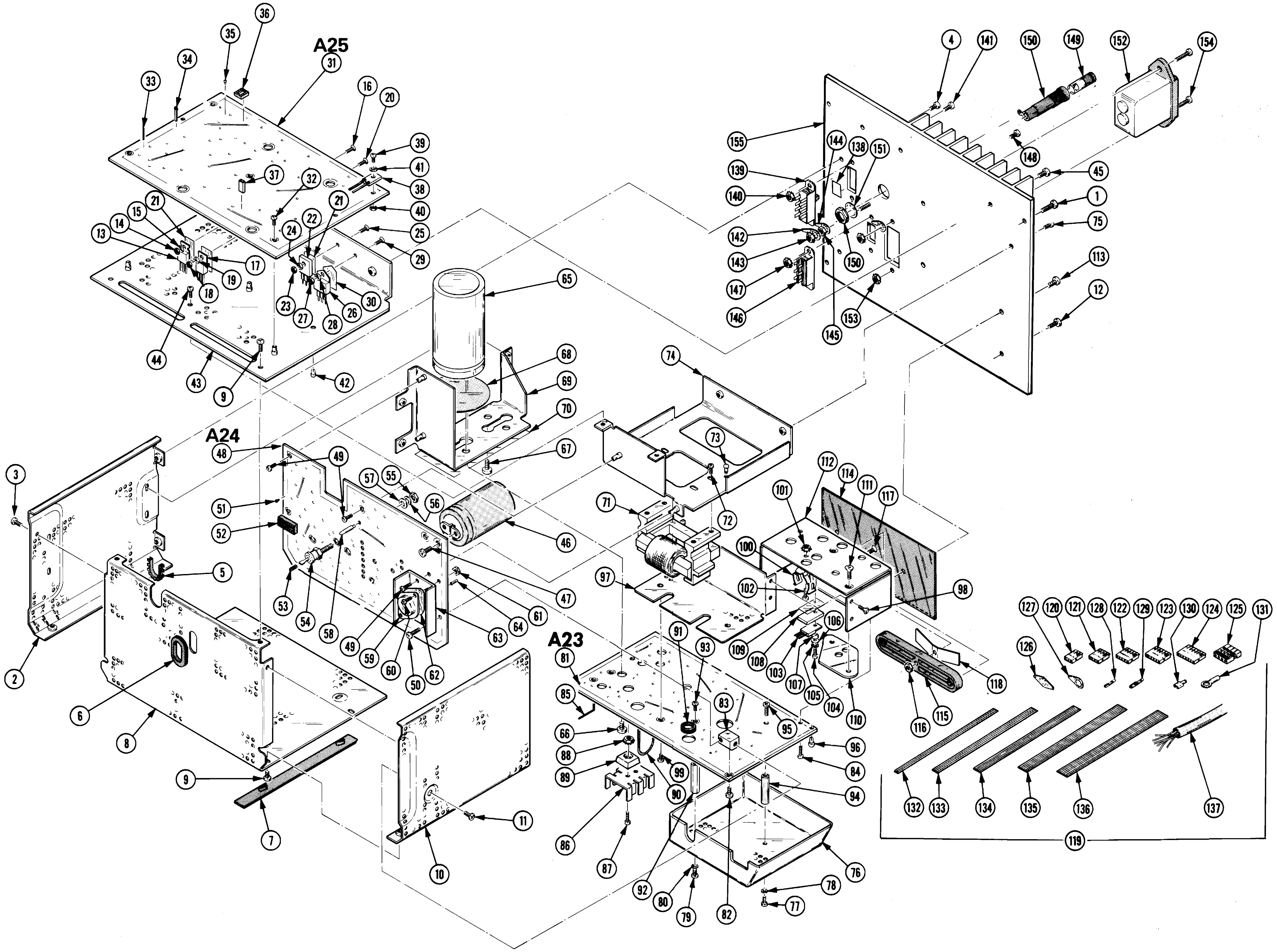

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-	620-0283-01	B010100	B029999	1	PWR SUPPLY ASSY:	80009	620-0283-01
	620-0283-02	B030000		1	PWR SUPPLY ASSY:	80009	620-0283-02
					*************(ATTACHING PARTS)***********		
-1	211-0578-00			4	SCREW,MACHINE:6-32 X 0.438 1NCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	——			-	POWER SUPPLY INCLUDES:		
-2	200-1262-02			1	.COVER,PWR SPLY:LEFT SIDE	80009	200-1262-02
					.************(ATTACHING PARTS)***********		
-3	211-0503-00			4	.SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	ORD BY DESCR
-4	211-0504-00			2	.SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-5	255-0334-00			AR	.PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYL	11897	122-37-2500
-6	348-0233-00			1	.GROMMET,PLASTIC:GRAY,OVAL SHAPE,0.927 ID	80009	348-0233-00
-7	351-0279-00			2	.GUIDE,SHOE:5.18 X 0.375,NYLON	80009	351-0279-00
-8	200-1906-00			1	.COVER,PWR SPLY:BOTTOM AND FRONT	80009	200-1906-00
					.************(ATTACHING PARTS)***********		
-9	211-0503-00			5	.SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-10	200-1263-01			1	.COVER,PWR SPLY:RIGHT SIDE	80009	200-1263-01
					.************(ATTACHING PARTS)***********		
-11	211-0503-00			1	.SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	ORD BY DESCR
-12	211-0507-00			2	.SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-13	——			2	.TRANSISTOR:(SEE Q28,Q74 REPL)		
					.************(ATTACHING PARTS)***********		
-14	210-0406-00			2	.NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-15	210-1178-00			2	.WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A
-16	211-0101-00			2	.SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-17	——			2	.TRANSISTOR:(SEE Q58,Q94 REPL)		
					.************(ATTACHING PARTS)***********		
-18	210-0406-00			2	.NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-19	210-1178-00			2	.WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A
-20	211-0101-00			2	.SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-21	342-0202-00			5	.INSULATOR,PLATE:TRANSISTOR,MICA	01295	10-21-023-106
-22	——			1	.TRANSISTOR:(SEE Q12 REPL)		
					.************(ATTACHING PARTS)***********		
-23	210-0406-00			1	.NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-24	210-1178-00			1	.WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A
-25	211-0038-00			1	.SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-26	——			1	.TRANSISTOR:(SEE Q126 REPL)		
					.************(ATTACHING PARTS)***********		
-27	210-0406-00			1	.NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-28	210-1178-00			1	.WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A
-29	211-0101-00			1	.SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-30	342-0311-00			1	.INSULATOR,PLATE:TRANSISTOR,MICA	01295	64-21-023-212
-31	——			1	.CKT BOARD ASSY:LV REGULATOR(SEE A25 REPL)		
					.************(ATTACHING PARTS)***********		
-32	211-0008-00			5	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
	——			-	.CKT BOARD ASSY INCLUDES:		
-33	131-0608-00			51	..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-34	214-0579-00			6	..TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-35	136-0252-07			24	..SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-36	136-0727-00			5	..SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
-37	131-0993-00			1	..BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-38	——			1	..TRANSISTOR:(SEE Q148 REPL)		
					..***********(ATTACHING PARTS)***********		
-39	211-0097-00			1	..SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-40	210-0551-00			1	..NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	000BK	ORD BY DESCR
-41	210-1178-00			1	..WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A
					..**********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-42	348-0023-00			1	.PLUG,HOLE:	02768	207090201000101
-43	441-1490-00			1	.CHASSIS,SCOPE:CIRCUIT BOARD	80009	441-1490-00
					.*************(ATTACHING PARTS)***********		
-44	211-0008-00			2	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
-45	211-0507-00			3	.SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-46	———			1	.CAPACITOR:(SEE C154 REPL)		
					.*************(ATTACHING PARTS)***********		
-47	212-0518-00			2	.SCREW,MACHINE:10-32 X 0.312,PNH,STL,CD PL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-48	———			1	.CKT BOARD ASSY:CONTROL RECT(SEE A24 REPL)		
					.*************(ATTACHING PARTS)***********		
-49	211-0008-00			3	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
-50	211-0504-00			1	.SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
	———			-	.CKT BOARD ASSY INCLUDES:		
-51	136-0252-07			6	..SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-52	136-0729-00			1	..SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108T
-53	136-0263-07			6	..SOCKET,PIN TERM:U/W 0.025 SQ PIN	22526	ORD BY DESCR
-54	———			4	..SEMINCOND DEVICE:(SEE CR140,CR141,CR142)		
	———			-	..AND CR143 REPL)		
					..***********(ATTACHING PARTS)***********		
-55	210-0410-00			4	..NUT,PLAIN,HEX.:10-32 X 0.312 INCH,BRS	73743	2X20003-402
-56	210-0056-00			4	..WASHER,LOCK:SPLIT,0.195 ID X 0.32" OD,P	86928	ORD BY DESCR
-57	210-1003-00			4	..WASHER,FLAT:# 10 X 0.036 THICK,BRS	12327	ORD BY DESCR
					..*********(END ATTACHING PARTS)*********		
-58	386-1559-00			2	..SPACER,CKT BD:0.47 H,ACETAL	80009	386-1559-00
-59	———			1	..SEMICOND DEVICE:(SEE CR151 REPL)		
					..***********(ATTACHING PARTS)***********		
-60	211-0012-00			2	..SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	ORD BY DESCR
-61	210-0586-00			2	..NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					..*********(END ATTACHING PARTS)*********		
-62	342-0567-00			1	..INSULATOR,PLATE:TRANSISTOR,SILICONE RUBB	18565	ORD BY DESCR
-63	214-2731-00			1	..HEAT SINK,DIODE:TO-3,AL	80009	214-2731-00
-64	136-0254-01			2	..SOCKET,PIN TERM:U/W 0.031 TO 0.04 DIA PI	00779	1-331892-8
-65	———			2	.CAPACITOR:(SEE C16,C17 REPL)		
					.*************(ATTACHING PARTS)***********		
-66	212-0518-00			4	.SCREW,MACHINE:10-32 X 0.312,PNH,STL,CD PL	83385	ORD BY DESCR
-67	212-0651-00			4	.SCREW MACHINE:10-32 X 0.312 INCH,PNH,NYLO	26365	ORD BY DESCR
	210-3057-00			4	.WASHER,FLAT:0.170 ID X 0.375 OD	95987	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-68	342-0419-00			2	.INSULATOR,CAP.:	80009	342-0419-00
-69	407-2111-00			1	.BRACKET,CAP.:ALUMINUM	80009	407-2111-00
-70	342-0452-00	B010100	B030230	1	.INSULATOR,FILM:CIRCUIT BOARD,POLYMIDE	80009	342-0452-00
-71	———			1	.TRANSFORMER:(SEE T110 REPL)		
					.*************(ATTACHING PARTS)***********		
-72	211-0008-00			4	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-73	348-0023-00			1	.PLUG,HOLE:	02768	207090201000101
-74	441-1423-00			1	.CHASSIS,SCOPE:TRANSFORMER	80009	441-1423-00
					.*************(ATTACHING PARTS)***********		
-75	211-0097-00			2	.SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-76	337-1490-02			1	.SHIELD,ELEC:LINE INVERTER,CKT BD BOTTOM	80009	337-1490-02
					.*************(ATTACHING PARTS)***********		
-77	211-0558-00			1	.SCREW,MACHINE:6-32 X 0.250 BDGH,NYL,SLOT	26365	921-1150-0014
-78	210-0055-00			1	.WASHER,LOCK:SPLIT,0.145 ID X 0.253 OD,S	86928	ORD BY DESCR
-79	211-0040-00			1	.SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	921-1120-0014
-80	210-0054-00			1	.WASHER,LOCK:#4 SPLIT,0.025THK STL CD PL	86928	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-81	220-0623-00			1	.NUT,BLOCK:0.375 X 0.5 X 0.448,(3)6-32	80009	220-0623-00
					.*************(ATTACHING PARTS)***********		
-82	211-0503-00			1	.SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-83	———			1	.CKT BOARD ASSY:INVERTER(SEE A23 REPL)		
					.*************(ATTACHING PARTS)***********		
-84	211-0008-00			4	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
	———			-	.CKT BOARD ASSY INCLUDES:		
-85	131-0591-00			6	..TERMINAL,PIN:0.835L X 0.025 SQ	22526	47352
-86	214-1914-00			1	..HEAT SINK,ELEC:	98978	PB1-ZCB
					..************(ATTACHING PARTS)***********		
-87	211-0012-00			1	..SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	ORD BY DESCR
-88	210-0406-00			1	..NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
					..**********(END ATTACHING PARTS)*********		
-89	361-0414-00			1	..SPACER,DIODE:	80009	361-0414-00
-90	346-0032-00			1	..STRAP,RTNING:0.075 DIA X 4.0 L,MLD RBR	98159	2859-75-4
-91	348-0005-00			1	..GROMMET,RUBBER:0.50 INCH DIA	70485	230
-92	129-0323-00			1	..POST,ELEC-MECH:HEX,0.25 X 1 INCH LONG	80009	129-0323-00
					..************(ATTACHING PARTS)***********		
-93	211-0097-00			1	..SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					..**********(END ATTACHING PARTS)*********		
-94	386-0016-00			1	..PLATE,LAMINATIO:KEEPER	80009	386-0016-00
					..************(ATTACHING PARTS)***********		
-95	211-0507-00			1	..SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
					..**********(END ATTACHING PARTS)*********		
-96	134-0158-00			4	..BUTTON,PLUG:0.187 DIA,NYLON	02768	207-080501-00
-97	337-2533-00			1	.SHIELD,ELEC:LINE INVERT,TOP	80009	337-2533-00
					.*************(ATTACHING PARTS)***********		
-98	211-0101-00			4	.SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	83385	ORD BY DESCR
-99	211-0504-00			2	.SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-100	344-0118-00			2	.CLIP,SPG TENS:CAPACITOR MTG	80033	E50008-044
					.*************(ATTACHING PARTS)***********		
-101	210-0586-00			2	.NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-102	211-0008-00			2	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-103	———			2	.TRANSISTOR:(SEE Q34,Q40 REPL)		
					.*************(ATTACHING PARTS)***********		
-104	211-0034-00			2	.SCREW,MACHINE:2-56 X 0.50 INCH,PNH	06950	ORD BY DESCR
-105	210-0053-00			2	.WASHER,LOCK:#2 SPLIT,0.02THK STL CAD PL		ORD BY DESCR
-106	210-1008-00			2	.WASHER,FLAT:#8 INTL,0.02THK,STL CD PL	T1741	1208 CADMIUM
-107	342-0421-00			2	.INSULATOR,BSHG:0.089 ID X 0.23 THK,NYLON	80009	342-0421-00
					.***********(END ATTACHING PARTS)*********		
-108	342-0420-00			2	.INSULATOR,PLATE:TRANSISTOR,PORCELAIN	80009	342-0420-00
-109	342-0202-00			2	.INSULATOR,PLATE:TRANSISTOR,MICA	01295	10-21-023-106
-110	386-2634-00			1	.PL,CHOKE MTG:	80009	386-2634-00
					.*************(ATTACHING PARTS)***********		
-111	211-0619-00			2	.SCREW,MACHINE:6-32 X 1.5 INCH,FLH STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-112	441-1420-00			1	.CHASSIS,SCOPE:LINE INVERT	80009	441-1420-00
					.*************(ATTACHING PARTS)***********		
-113	213-0041-00			2	.SCR,TPG,THD CTG:6-32 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-114	342-0193-00			1	.INSULATOR,PLATE:	80009	342-0193-00
-115	342-0103-00			1	.INSULATOR,BLOCK:HEAT-SINK SHIELD,NYLON	80009	342-0103-00
					.*************(ATTACHING PARTS)***********		
-116	210-0457-00			1	.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-117	211-0512-00			1	.SCREW,MACHINE:6-32 X 0.50" 100 DEG,FLH ST	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-118	214-1625-00			1	.SPRING,FLAT:2.0 INCH LONG,BOWED	80009	214-1625-00
-119	198-3829-00	B010100	B030199	1	.WIRE SET,ELEC:	80009	198-3829-00
	198-3829-01	B030200		1	.WIRE SET,ELEC:	80009	198-3829-01
-120	352-0161-09			1	..CONN BODY,PL,EL:3 WIRE WHITE	80009	352-0161-09
	———			-	..(A22P99 TO S99)		
-121	352-0162-04			2	..HLDR,TERM CONN:4 WIRE,YELLOW	80009	352-0162-04
	———			1	..(A22P54 TO A12P54)		
-122	352-0163-08			2	..HLDR,TERM CONN:5 WIRE,GRAY	80009	352-0163-08
	———			-	..(A22P48 TO A12P48)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-123	352-0164-02			2	..HLDR,TERM CONN:6 WIRE,RED	80009	352-0164-02
	———			-	..(A22P52 TO A12P52)		
-124	352-0165-00			2	..HLDR,TERM CONN:7 WIRE,BLACK	80009	352-0165-00
	———			-	..(A22P50 TO A12P50)		
-125	352-0200-00			2	..HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
	———			-	..(A22P50 TO A12P50)		
-126	210-0204-00			1	..TERMINAL,LUG:0.146 INCH DIA DE,45 DEG BE	78189	2157-06-01-2520N
-127	210-0202-00			2	..TERMINAL,LUG:0.146 ID,LOCKING,BRZ,TIN PL	86928	A-373-158-2
-128	131-0707-00			47	..CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
-129	131-0622-00			8	..CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241-000
	131-0792-00			8	..CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-130	131-2065-00			4	..TERM,QIK DISC:18-22 AWG,BRASS TIN PLATED	00779	2-520181-2
	———			-	..(TO POWER SWITCH)		
-131	210-0307-00			2	..TERMINAL,LUG:RING,INS,16-14 AWG,#8	09922	BA14E-8M
-132	175-0826-00			AR	..WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-133	175-0827-00			AR	..CABLE,SP,ELEC:4,26 AWG,STRD.PVC JKT,RBN	08261	111-2699-954
-134	175-0860-00			AR	..WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0522-7(1061)
-135	175-0859-00			AR	..WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0622-7(1061)
-136	175-0858-00			AR	..WIRE,ELECTRICAL:7 WIRE RIBBON	08261	SS-0722-7(1061)
-137	175-1091-00			AR	..CABLE,SP,ELEC:(4) #18 STRANDED WIRE	80009	175-1091-00
-138	334-3379-01			1	.MARKER,IDENT:MARKED GROUND SYMBOL	80009	334-3379-01
-139	———			1	.SWITCH,SLIDE:(SEE S99 REPL)		
					.************(ATTACHING PARTS)***********		
-140	210-0586-00			2	.NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-141	211-0097-00			2	.SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-142	210-0204-00			1	.TERMINAL,LUG:0.146 INCH DIA DE,45 DEG BE	78189	2157-06-01-2520N
					.************(ATTACHING PARTS)***********		
-143	210-0407-00			1	.NUT,PLAIN,HEX:6-32 X 0.25 INCH,BRS	73743	3038-402
					.***********(END ATTACHING PARTS)*********		
-144	210-0202-00			1	.TERMINAL,LUG:0.146 ID,LOCKING,BRZ,TIN PL	86928	A-373-158-2
					.************(ATTACHING PARTS)***********		
-145	210-0407-00			2	.NUT,PLAIN,HEX:6-32 X 0.25 INCH,BRS	73743	3038-402
					.***********(END ATTACHING PARTS)*********		
-146	———			1	.SWITCH,SLIDE:(SEE S12 REPL)		
					.************(ATTACHING PARTS)***********		
-147	210-0586-00			2	.NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-148	211-0097-00			2	.SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-149	200-2264-00			1	.CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-150	204-0832-00			1	.BODY,FUSEHOLDER:3AG,5 X 20MM FUSES	S3629	031.1673(MDLFEU)
-151	210-1039-00			1	.WASHER,LOCK:INT,0.521 ID X 0.625 INCH O	78189	ORD BY DESCR
-152	———			1	.FILTER,RFI:(SEE FL10 REPL)		
					.************(ATTACHING PARTS)***********		
-153	210-0586-00			2	.NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-154	211-0014-00			2	.SCREW,MACHINE:4-40 X 0.50,PHN STL,POZ	83385	ORD BY DESCR
					.***********(END ATTACHING PARTS)*********		
-155	214-2932-00			1	.HEAT SINK,ELEC:POWER SUPPLY	80009	214-2932-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
					STANDARD ACCESSORIES		
5-1	161-0066-00			1	CABLE ASSY,PWR,:3,18 AWG,115V,98.0 L	16428	CH8481,FH8481
-2	161-0066-09			1	CABLE ASSY,PWR:3,0.75MM SQ,220V,99.0 L	S3109	86511000
	----- -----			-	(OPTION A1 ONLY)		
-3	161-0066-10			1	CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L	S3109	ORD BY DESCR
	----- -----			-	(OPTION A2 ONLY)		
-4	161-0066-11			1	CABLE ASSY,PWR:3,0.75MM,240V,96.0L	S3109	SAA/3-003CCFC3X0
	----- -----			-	(OPTION A3 ONLY)		
-5	161-0066-12			1	CABLE ASSY,PWR:3,18 AWG,240V,96.0 L	70903	CH-77893
	----- -----			-	(OPTION A4 ONLY)		
-6	161-0154-00			1	CABLE ASSY,PWR:3,0.75MM SQ,240V,6A,2.5M L	S3109	86515000
	----- -----			-	(OPTION A5 ONLY)		
-7	426-0514-00			1	FRAME,MASK:PLASTIC	80009	426-0514-00
	378-0625-00			1	FILTER,LT,CRT:BLUE,5.15 X 4.4 X 0.03	80009	378-0625-00
-8	351-0375-01			1	SLIDE,DWR,EXT:W/CLOSED MOUNTING SLOTS	80009	351-0375-01
	361-0806-00			1	SPACER,INSTR:RIGHT	80009	361-0806-00
	361-0807-00			1	SPACER,INSTR:LEFT	80009	361-0807-00
	016-0099-00			1	HDW KIT,ELEK EQ:RACKMOUNT HDW	80009	016-0099-00
	070-5038-00			1	MANUAL,TECH:OPERATORS,R7103	80009	070-5038-00
	070-5039-00			1	MANUAL,TECH:INSTRUCTION,R7103	80009	070-5039-00
					OPTIONAL ACCESSORIES		
	012-0341-00			1	CABLE ASSY:CURRENT PROBE TO OSCP,12.0L	80009	012-0341-00

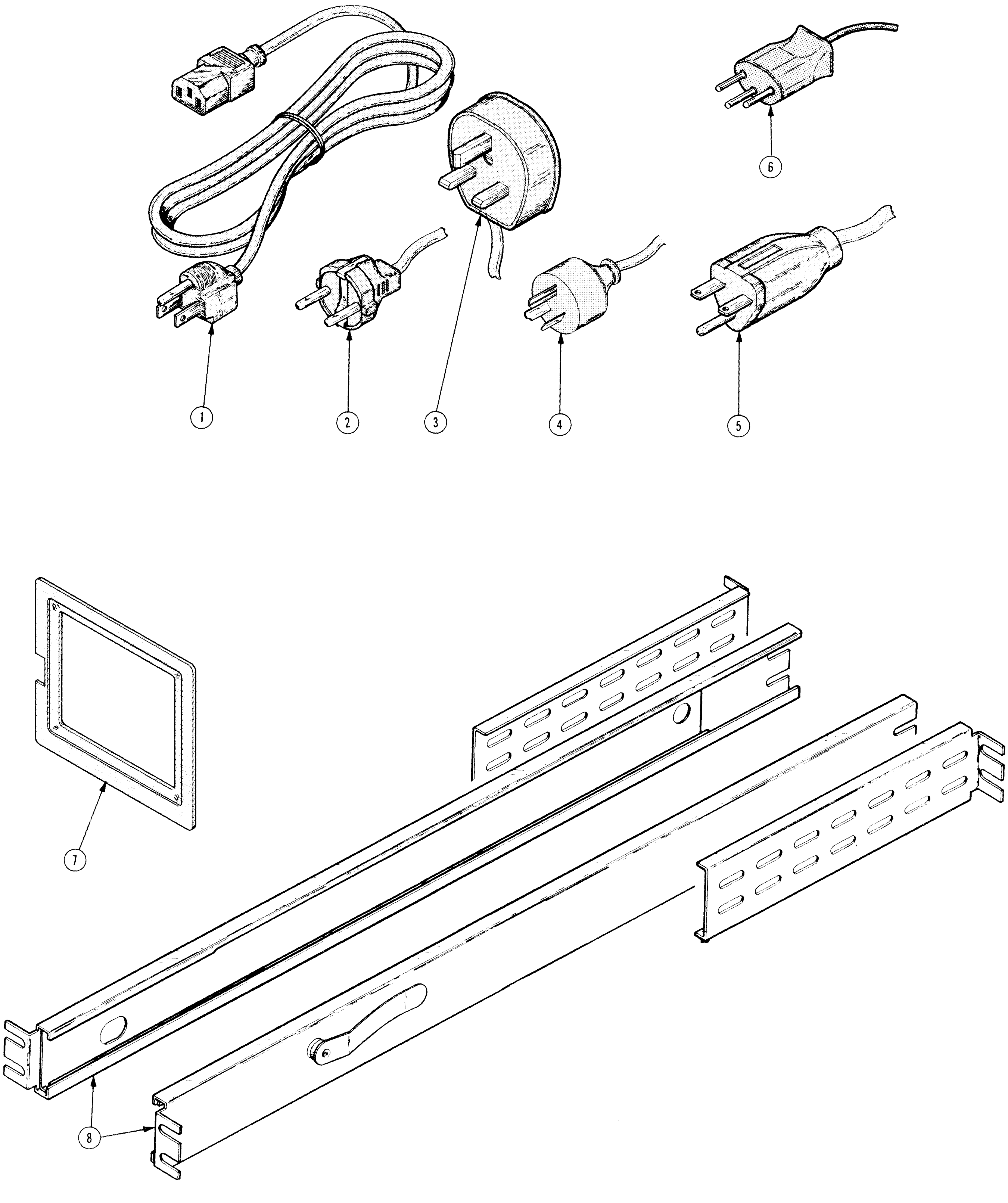

FIG. 5 ACCESSORIES

MANUAL CHANGE INFORMATION

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

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

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

Tektronix
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MANUAL CHANGE INFORMATION

Date: 5-08-85 Change Reference: M57863

Product: R7103 Manual Part No.: 070-5039-00

DESCRIPTION PG 42

Effective at serial number B030365

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A14	670-8409-01	CKT BOARD ASSY:TRIGGER SELECTOR

ADD:

A14C464	283-0175-00	CAP.,FXD,CER DI:10 PF,5%,200V

DIAGRAM CHANGES

Figure 8-7. A14 - Trigger Selector Board assembly.

Add C464 above R464 (location 1E).

5 Trigger Selector

Add C464 in parallel with R464 (location 3E).

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MANUAL CHANGE INFORMATION

Date: 8/23/85 Change Reference: M56169

Product: R7103 Oscilloscope Manual Part No.: 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

This change is effective at serial number B030490.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A24CR161	152-0725-00	SEMICOND DVC,DI:SI,SCHOTTKY,1.2PF

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MANUAL CHANGE INFORMATION

Date: 10/7/85 **Change Reference:** M59082

Product: R7103 Oscilloscope **Manual Part No.:** 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

These changes are effective at serial number B030540.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A19	672-0140-01	HORIZONTAL AMPLIFIER
A19C1036	281-0204-00	CAP.,FXD,PLSTC:2—22PF,100V

DIAGRAM CHANGES

11 Horizontal Amplifier

Change C1036 (schematic location 4F) from *2—10* to *2—22*.

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MANUAL CHANGE INFORMATION

Date: 10/24/85 Change Reference: M53385/M59099

Product: R7103 Oscilloscope Manual Part No.: 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

The following changes are effective at serial number B040592.

This information details changes to the R7103 Instruction Manual made necessary by modifications to the R7103 Readout and Main Interface circuit board assemblies.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

The following parts list is for the new A15 Readout circuit board assembly. These part numbers supercede the part numbers given in the manual for the old Readout circuit board assembly. They are to be used in conjunction with the new schematic and parts locator diagrams found in the DIAGRAM CHANGES section of this Manual Change Information insert.

A15	670-8620-01	CKT BOARD ASSY:READOUT
A15C3415	290-0804-01	CAP.,FXD,ELCTLT:10UF,20%,50VDC,AL
A15C3417	290-0920-01	CAP.,FXD,ELCTLT:33UF,20%,35V,AL
A15C3418	290-0804-01	CAP.,FXD,ELCTLT:10UF,20%,50VDC,AL
A15C3420	281-0862-00	CAP.,FXD,CER DI:0.001UF,+80-20%,100V
A15C3421	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3427	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3435	285-0698-00	CAP.,FXD,PLASTIC:0.0082UF,5%,100V
A15C3440	281-0816-00	CAP.,FXD,CER DI:82PF,5%,100V
A15C3444	281-0810-00	CAP.,FXD,CER DI:5.6PF,+/-0.5PF,100V
A15C3454	283-0728-00	CAP.,FXD,MICA DI:120PF,1%,500V
A15C3454	---- ----	(NOMINAL VALUE, SELECTED)
A15C3454	283-0630-00	CAP.,FXD,MICA DI:110PF,1%,500V
A15C3454	---- ----	(SELECTED AS NEEDED)
A15C3454	283-0796-00	CAP.,FXD,MICA DI:100PF,5%,500V
A15C3454	---- ----	(SELECTED AS NEEDED)
A15C3454	283-0644-00	CAP.,FXD,MICA DI:150PF,1%,500V
A15C3454	---- ----	(SELECTED AS NEEDED)
A15C3455	281-0158-00	CAP.,VAR,CER DI:7-45PF,25V
A15C3457	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3461	281-0765-00	CAP.,FXD,CER DI:100PF,5%,100V
A15C3483	281-0788-00	CAP.,FXD.CER DI:470PF,10%,100V
A15C3485	281-0774-00	CAP.,FXD.CER DI:0.022UF,20%,100V
A15C3487	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3501	283-0114-00	CAP.,FXD,CER DI:1500PF,5%,200V
A15C3502	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3503	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V

DESCRIPTION

A15C3504	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3511	281-0762-00	CAP.,FXD,CER DI:27PF,20%,100V
A15C3512	283-0666-00	CAP.,FXD,MICA DI:890PF,2%,100V
A15C3513	283-0640-00	CAP.,FXD,MICA DI:160PF,1%,100V
A15C3521	281-0788-00	CAP.,FXD.CER DI:470PF,10%,100V
A15C3539	281-0788-00	CAP.,FXD.CER DI:470PF,10%,100V
A15C3544	281-0774-00	CAP.,FXD.CER DI:0.022UF,20%,100V
A15C3546	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3551	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3559	OPEN	(NOMINAL VALUE, SELECTED)
A15C3563	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3564	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
A15C3576	281-0762-00	CAP.,FXD,CER DI:27PF,20%,100V
A15C3577	283-0666-00	CAP.,FXD,MICA DI:890PF,2%,100V
A15C3579	283-0640-00	CAP.,FXD,MICA DI:160PF,1%,100V
A15C3597	OPEN	(NOMINAL VALUE, SELECTED)
A15CR3424	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3425	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3437	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3439	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3445	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3446	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3453	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3457	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3461	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3462	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3487	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3529	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3550	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3570	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15CR3571	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA
A15E3440	276-0532-00	SHLD BEAD,ELEK:FERRITE,0.138 OD X 0.047 ID X 0.118
A15J3401	136-0252-07	SOCKET,PIN,CONN:W/O DIMPLE
A15J3401	131-1003-00	CONN,RCPT,ELEC:CKT BD MT,3 PRONG
A15J3402	136-0252-07	SOCKET,PIN,CONN:W/O DIMPLE
A15J3402	131-1003-00	CONN,RCPT,ELEC:CKT BD MT,3 PRONG
A15J3432	136-0252-07	SOCKET,PIN,CONN:W/O DIMPLE
A15J3432	131-1003-00	CONN,RCPT,ELEC:CKT BD MT,3 PRONG
A15J3596	136-0252-07	SOCKET,PIN,CONN:W/O DIMPLE
A15J3596	131-1003-00	CONN,RCPT,ELEC:CKT BD MT,3 PRONG
A15J3599	131-0252-07	SOCKET,PIN,CONN:W/O DIMPLE
A15J3599	136-1003-00	CONN,RCPT,ELEC:CKT BD MT,3 PRONG
A15L3512	108-0800-00	COIL,RF:FIXED,820UH
A15L3577	108-0800-00	COIL,RF:FIXED,820UH

DESCRIPTION

A15P3446	258-0534-00	WIRE,NONELECTRIC:0.025 THK X 0.025W
A15P3467	258-0534-00	WIRE,NONELECTRIC:0.025 THK X 0.025W
A15P3475	258-0534-00	WIRE,NONELECTRIC:0.025 THK X 0.025W
A15P3484	131-0993-00	BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK
A15P3484	258-0534-00	WIRE,NONELECTRIC:0.025THK X 0.025 WIDE
A15Q3431	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3432	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3438	151-0188-00	TRANSISTOR:SILICON,PNP
A15Q3442	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3451	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3452	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3453	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3481	151-0188-00	TRANSISTOR:SILICON,PNP
A15Q3489	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3523	151-0232-00	TRANSISTOR:SILICON,NPN
A15Q3526	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3527	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3529	151-0188-00	TRANSISTOR:SILICON,PNP
A15Q3543	151-0190-00	TRANSISTOR:SILICON,NPN
A15Q3550	151-0188-00	TRANSISTOR:SILICON,PNP
A15Q3555	151-1021-00	TRANSISTOR:SILICON,FET,N-CHAN
A15Q3596	151-1021-00	TRANSISTOR:SILICON,FET,N-CHAN
A15R3401	315-0512-00	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W
A15R3422	315-0432-00	RES.,FXD,CMPSN:4.3K OHM,5%,0.25W
A15R3435	315-0393-00	RES.,FXD,CMPSN:39K OHM,5%,0.25W
A15R3423	315-0683-00	RES.,FXD,CMPSN:68K OHM,5%,0.25W
A15R3427	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
A15R3431	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
A15R3432	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
A15R3434	315-0302-00	RES.,FXD,CMPSN:3K OHM,5%,0.25W
A15R3435	315-0393-00	RES.,FXD,CMPSN:39K OHM,5%,0.25W
A15R3437	315-0752-00	RES.,FXD,CMPSN:7.5K OHM,5%,0.25W
A15R3439	315-0242-00	RES.,FXD,CMPSN:2.4K OHM,5%,0.25W
A15R3440	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
A15R3441	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
A15R3442	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
A15R3444	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
A15R3446	315-0152-00	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W
A15R3450	315-0183-00	RES.,FXD,CMPSN:18K OHM,5%,0.25W
A15R3451	315-0362-00	RES.,FXD,CMPSN:3.6K OHM,5%,0.25W
A15R3452	315-0622-00	RES.,FXD,CMPSN:6.2K OHM,5%,0.25W
A15R3453	315-0301-00	RES.,FXD,CMPSN:300 OHM,5%,0.25W

DESCRIPTION

A15R3454	321-0350-00	RES.,FXD,FILM:43.2K OHM,1%,0.125W
A15R3455	321-0350-00	RES.,FXD,FILM:43.2K OHM,1%,0.125W
A15R3457	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
A15R3481	321-0386-00	RES.,FXD,FILM:102K OHM,1%,0.125W
A15R3482	321-0361-00	RES.,FXD,FILM:56.2K OHM,1%,0.125W
A15R3483	311-2230-00	RES.,VAR,NONWW,TRMR:500 OHM,20%
A15R3484	321-0262-00	RES.,FXD,FILM:5.23K,1%,0.125W
A15R3485	307-0445-00	RES NTWK,FXD,FI:(9)4.7K OHM,20%
A15R3486	315-0241-00	RES.,FXD,CMPSN:240 OHM,5%,0.25W
A15R3487	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
A15R3488	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
A15R3489	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
A15R3501	315-0471-00	RES.,FXD,CMPSN:470 OHM,5%,0.25W
A15R3502	315-0182-00	RES.,FXD,CMPSN:1.8K OHM,5%,0.25W
A15R3503	315-0511-00	RES.,FXD,CMPSN:510 OHM,5%,0.25W
A15R3504	307-0446-00	RES NTWK,FXD,FI:(9)10K OHM,20%
A15R3506	321-0376-00	RES.,FXD,FILM:80.6K OHM,1%,0.125W
A15R3507	321-0405-00	RES.,FXD,FILM:162K OHM,1%,0.125W
A15R3508	321-0434-00	RES.,FXD,FILM:324K OHM,1%,0.125W
A15R3510	311-2232-00	RES.,VAR,NONWW:TRMR,2K OHM,20%,0.5W
A15R3511	315-0332-00	RES.,FXD,CMPSN:3.3K OHM,5%,0.25W
A15R3512	321-0218-00	RES.,FXD,FILM:1.82K OHM,1%,0.125W
A15R3513	321-0221-00	RES.,FXD,FILM:1.96K OHM,1%,0.125W
A15R3516	321-0396-00	RES.,FXD,FILM:130K OHM,1%,0.125W
A15R3517	321-0425-00	RES.,FXD,FILM:261K OHM,1%,0.125W
A15R3518	321-0452-00	RES.,FXD,FILM:499K OHM,1%,0.125W
A15R3522	315-0133-00	RES.,FXD,CMPSN:13K OHM,5%,0.25W
A15R3523	315-0124-00	RES.,FXD,CMPSN:120K OHM,5%,0.25W
A15R3524	315-0751-00	RES.,FXD,CMPSN:750 OHM,5%,0.25W
A15R3525	321-0299-00	RES.,FXD,FILM:12.7K OHM,1%,0.125W
A15R3526	321-0212-00	RES.,FXD,FILM:1.58K OHM,1%,0.125W
A15R3527	315-0152-00	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W
A15R3529	315-0512-00	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W
A15R3530	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
A15R3535	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
A15R3536	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
A15R3537	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
A15R3538	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
A15R3539	315-0303-00	RES.,FXD,CMPSN:30K OHM,5%,0.25W
A15R3542	321-0259-00	RES.,FXD,FILM:4.87K OHM,1%,0.125W
A15R3543	311-2230-00	RES.,VAR,NONWW:TRMR,500 OHM,20%
A15R3544	321-0326-00	RES.,FXD,FILM:24.3K OHM,1%,0.125W
A15R3545	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
A15R3546	307-0445-00	RES NTWK,FXD,FI:(9)4.7K OHM,20%
A15R3550	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
A15R3551	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W

DESCRIPTION

A15R3552	321-0202-00	RES.,FXD,FILM:1.24K OHM,1%,0.125W
A15R3553	321-0202-00	RES.,FXD,FILM:1.24K OHM,1%,0.125W
A15R3554	321-0254-00	RES.,FXD,FILM:4.32K OHM,1%,0.125W
A15R3555	321-0301-00	RES.,FXD,FILM:13.3K OHM,1%,0.125W
A15R3557	321-0251-00	RES.,FXD,FILM:4.02K OHM,1%,0.125W
A15R3558	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
A15R3559	315-0272-00	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W
A15R3560	311-2232-00	RES.,VAR,NONWW:TRMR,2K OHM,20%,0.5W
A15R3563	307-0696-00	RES.,NTWK,FXD,FI:(7)10K OHM,2%,0.15W
A15R3564	321-0318-00	RES.,FXD,FILM:20.0K OHM,1%,0.125W
A15R3565	321-0259-00	RES.,FXD,FILM:4.87K OHM,1%,0.125W
A15R3566	321-0430-00	RES.,FXD,FILM:294K OHM,1%,0.125W
A15R3567	321-0399-00	RES.,FXD,FILM:140K OHM,1%,0.125W
A15R3568	321-0367-00	RES.,FXD,FILM:64.9K OHM,1%,0.125W
A15R3569	321-0331-00	RES.,FXD,FILM:27.4K OHM,1%,0.125W
A15R3571	315-0183-00	RES.,FXD,CMPSN:18K OHM,5%,0.25W
A15R3576	321-0251-00	RES.,FXD,FILM:4.02K OHM,1%,0.125W
A15R3577	321-0218-00	RES.,FXD,FILM:1.82K OHM,1%,0.125W
A15R3579	321-0221-00	RES.,FXD,FILM:1.96K OHM,1%,0.125W
A15R3580	321-0254-00	RES.,FXD,FILM:4.32K OHM,1%,0.125W
A15R3586	307-0651-00	RES NTWK,FXD,FI:(5)3.3K OHM,5%,0.15W
A15R3588	321-0353-00	RES.,FXD,FILM:46.4K OHM,1%,0.125W
A15R3589	321-0335-00	RES.,FXD,FILM:30.1K OHM,1%,0.125W
A15R3590	321-0321-00	RES.,FXD,FILM:21.5K OHM,1%,0.125W
A15R3591	321-0310-00	RES.,FXD,FILM:16.5K OHM,1%,0.125W
A15R3592	321-0301-00	RES.,FXD,FILM:13.3K OHM,1%,0.125W
A15R3593	321-0304-00	RES.,FXD,FILM:14.3K OHM,1%,0.125W
A15R3596	321-0251-00	RES.,FXD,FILM:4.02K OHM,1%,0.125W
A15R3597	321-0254-00	RES.,FXD,FILM:4.32K OHM,1%,0.125W
A15R3598	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
A15U3420	156-0043-03	MICROCKT,DGTL:QUAD 2-INP NOR GATE
A15U3426	155-0021-01	MICROCKT,DGTL:SCAN OSCILLATOR & LOGIC
A15U3427	156-1172-01	MICROCKT,DGTL:DUAL 4 BIT BIN CNTR
A15U3457	156-0730-02	MICROCKT,DGTL:QUAD 2-INP NOR BFR
A15U3459	155-0017-00	MICROCKT,DGTL:BCD DECIMAL
A15U3462	156-0388-03	MICROCKT,DGTL:DUAL D FLIP-FLOP
A15U3485	155-0014-01	MICROCKT,DGTL:A-D CONVERTER
A15U3486	156-1177-01	MICROCKT,DGTL:STET LINE PRIORITY ENCODER
A15U3502	156-1172-01	MICROCKT,DGTL:DUAL 4 BIT BIN CNTR
A15U3503	160-2997-00	MICROCKT,DGTL:4096 X 8 EPROM,PRGM

DESCRIPTION

A15U3504	156-0865-02	MICROCKT,DGTL:OCTAL D FF W/CLEAR
A15U3510	156-1191-00	MICROCKT,LINEAR:DUAL BI-FET OPNL AMPL
A15U3532	155-0018-00	MICROCKT,DGTL:ZERO LOGIC
A15U3544	155-0014-01	MICROCKT,DGTL:A-D CONVERTER
A15U3546	156-1177-01	MICROCKT,DGTL:STET LINE PRIORITY ENCODER
A15U3551	156-0730-02	MICROCKT,DGTL:QUAD 2-INP NOR BFR
A15U3557	156-1191-00	MICROCKT,LINEAR:DUAL BI-FET OPNL AMPL
A15U3563	156-0140-02	MICROCKT,DGTL:HEX BUFFERS W/OC HV OUT
A15U3564	156-0480-02	MICROCKT,DGTL:QUAD 2-INP & GATE
A15U3576	156-1191-00	MICROCKT,LINEAR:DUAL BI-FET OPNL AMPL
A15VR3485	152-0405-00	SEMICOND DVC,DI:ZEN,15V,5%,1W
A15VR3486	152-0405-00	SEMICOND DVC,DI:ZEN,15V,5%,1W
A15VR3487	152-0405-00	SEMICOND DVC,DI:ZEN,15V,5%,1W

The following Replaceable Electrical Parts List changes result from modifications to the portion of the Readout System found on the A6 Main Interface board.

CHANGE TO:

A6	670-8412-01	CKT BOARD ASSY:MAIN INTERFACE
A6R241	321-0344-00	RES.,FXD,FILM:37.4K OHM,1%,0.125W

REMOVE:

A6CR241	152-0141-02	SEMICOND DVC,DI:SW,SI,30V,150MA,30V
A6R251	315-0154-00	RES.,FXD,CMPSN:150K OHM,5%,0.25W
A6R252	321-0335-00	RES.,FXD,FILM:30.1K OHM,1%,0.125W
A6R253	321-0344-00	RES.,FXD,FILM:37.4K OHM,1%,0.125W
A6R254	321-0335-00	RES.,FXD,FILM:30.1K OHM,1%,0.125W
A6R255	315-0513-00	RES.,FXD,CMPSN:51K OHM,5%,0.25W
A6R256	315-0154-00	RES.,FXD,CMPSN:150K OHM,5%,0.25W
A6R257	321-0335-00	RES.,FXD,FILM:30.1K OHM,1%,0.125W
A6R258	321-0335-00	RES.,FXD,FILM:30.1K OHM,1%,0.125W

ADD:

A6W241	131-0566-00	BUS CONDUCTOR:DUMMY RES,2.375,22 AWG

DESCRIPTION

TEXT CHANGES

Checks and Adjustment Part II
Adjustment and Performance Check

The following procedure is for the new Readout circuit and is to be used in conjunction with the new Readout System schematic diagram and parts locator diagram in the DIAGRAM CHANGES section of this Manual Change Information insert. It replaces the Adjustmnet and Performance Check procedure in Section 5 of the manual.

G. READOUT SYSTEM

Equipment Required: (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. Test Oscilloscope
3. Amplifier (dual trace)
4. Time base
13. 10X Passive Probe (two required)
19. Screwdriver, low capacitance

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options, and the Change Information at the rear of this manual for and modifications which may affect this procedure.

(3) See the **Test Point and Adjustment Locations G** foldout page in Section 8 of the Instruction Manual and the **Diagram Changes** portion of this Manual Change Information insert.

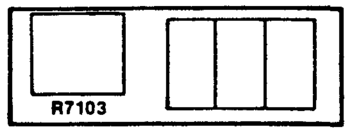
READOUT SYSTEM PRELIMINARY CONTROL SETTINGS

POWER	On
VERTICAL MODE	RIGHT
TRIGGER SOURCE	VERT MODE
INTENSITY	Midrange
READOUT INTENSITY	OFF (in detent)
GRAT ILLUM	Midrange

DESCRIPTION

G1. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
No equipment necessary.

5039-531

G1. ADJUST READOUT VERTICAL SEPARATION AND CENTERING (R3560, R701, R1025, R1035)

a. Move P3484 (on the A15 Readout Board) to connect pins 2 and 3 (the arrow etched on the circuit board indicates pin 1).

b. Set the READOUT control for visible characters (all zeros).

NOTE

The following tolerances are provided as guides to correct instrument operation and are not instrument specifications.

c. **EXAMINE** - the crt display for two rows of zeros, 30 zeros to a row. The two rows of zeros should be located vertically in the middle of the top and bottom divisions of the graticule.

NOTE

The MVA Center (Main Vertical Amplifier) adjustment, R740, must be correct before making the next adjustment. Refer to F. Vertical System procedure.

d. **ADJUST** - Vertical Separation adjustment R3560 (on the A15 Readout board) and R/O Center adjustment, R701 (on the A17 Vertical Amplifier board), to position the two rows of readout characters to the middle of the top and bottom divisions of the graticule.

e. **EXAMINE** - the display for two rows of zeros, 30 zeros to each row. Total length of each row of characters is between 9.5 and 10 divisions.

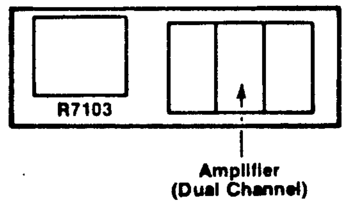
f. **ADJUST** - RO Ctr adjustment, R1025, and RO Gain, R1035 (both on the A19 Horizontal board), to horizontally center the zeros display and set the length of each row of characters between 9.5 and 10 divisions.

g. Move P3484 (on the A15 Readout board) to connect pins 1 and 2.

DESCRIPTION

G2. SETUP CONDITIONS

R7103 Controls:
POWER .... On
VERTICAL MODE .... RIGHT



Test Equipment Controls:
Amplifier
Volts/Div, both .... 50 mV/div
Display Mode .... Dual trace

5039-532

G2. ADJUST CHARACTER GENERATOR CLOCK (C3455)

NOTE

If the preceding step was not performed, first refer to the Readout System Preliminary Control Settings, then proceed.

a. Install the dual-trace amplifier unit in the RIGHT VERTICAL compartment.

b. Set the amplifier unit for a deflection factor of 50 millivolts/division.

c. **EXAMINE** - the displayed characters for completeness and accuracy. If the display is incorrect, the following adjustment may be required (steps d through h).

d. Connect test oscilloscope Channel 1 to pin 12 of U3502 (on the A15 Readout Board) with a 10X probe.

e. Set the test oscilloscope time base sweep rate for 5 mS/div, negative triggers.

f. Set the test oscilloscope amplifier unit Trigger Source to CH 1 and connect Channel 2 to pin 13 of U3502 (on the A15 Readout Board) with a 10X probe.

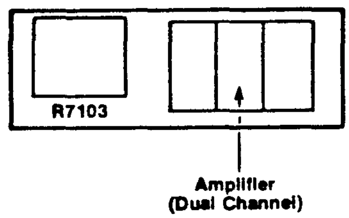
g. **ADJUST** - C3455 (on the A15 Readout board) for seventeen positive pulses on the test oscilloscope.

h. Remove the 10X probes.

DESCRIPTION

G3. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Amplifier
Display Mode .... Alt

5039-533

G3. ADJUST COLUMN AND ROW MATCH (R3543, R3483)

NOTE

If the preceding step was not performed, first refer to the Readout System Preliminary Control Settings, then proceed.

a. Set the amplifier unit for a dual-trace display mode.

b. Press and hold the amplifier trace-identify buttons.

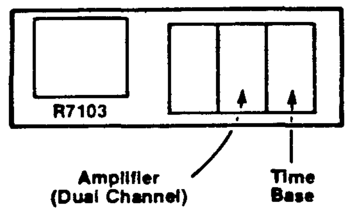
c. **EXAMINE** - the readout display for correct indication of "IDENTIFY". If the readout is incorrect or unstable, adjustment is required.

d. **ADJUST** - Column Match adjustment R3543 and Row Match adjustment R3483 (on the A15 Readout board) for correct readout of "IDENTIFY". Set these adjustments to the center of the adjustment range which provides correct readout indication. Release the amplifier unit trace-identify buttons.

DESCRIPTION

G4. SETUP CONDITIONS

R7103 Controls:
No change in settings.



Test Equipment Controls:
Time Base
Time/Div .... 1 ms
Triggering .... Auto, AC, Internal

5039-534

G4. CHECK READOUT MODES

NOTE

If the preceding step was not performed, first refer to the Readout System Preliminary Control Settings, then proceed.

a. Install a time-base unit in the A HORIZ compartment.

b. Set the time-base unit for a free-running sweep.

c. Set the READOUT INTENSITY control for a visible display.

d. **CHECK** - set the time-base unit on several sweep rates throughout the time-division switch range and check that the readout characters are are displayed independently of the sweep.

e. Set the READOUT +GATE or EXT switch to +GATE and READOUT INTENSITY control to PULSED.

f. Set the READOUT PRESET control for a visible readout display.

g. Set the time-base unit for a free-running (not triggered) sweep at a rate of 0.2 second/division.

h. **CHECK** - that the readout characters are blanked out while the sweep is running, and are displayed immediately after the end of the sweep; each character encoded by the plug-in units is displayed only once for each sweep.

i. Set the READOUT +GATE or EXT swtch to EXT.

j. **CHECK** - Press the READOUT MAN pushbutton and notice that one frame of readout is displayed.

DESCRIPTION

Theory of Operation

The following Theory of Operation applies to the new Readout System and is to be used in conjunction with the new Readout schematic and parts locator diagrams in the DIAGRAM CHANGES portion of this Manual Change Information insert. It replaces the Readout System Theory of Operation given in Section 3 of the manual.

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

The following terms are used to describe the Readout System:

Character – A single number, letter, or symbol displayed on the CRT, either alone or in combination with other characters.

Word – A group of related characters. In the Readout System, a word can consist of up to 10 characters.

Frame – A display of all words for a given operating mode and plug-in combination. Up to 6 words can be displayed in one frame. Figure 1 shows the position of each word in a complete frame.

Column – One of the vertical lines in the Character Selection Matrix (see Fig. 2). Columns C-0 (column zero) through C-10 (column 10) can be addressed by the system.

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

Time-Slot – A location in a pulse train. In the Readout System, the pulse train consists of 10 negative-going pulses. Each time-slot pulse is assigned a number between 1 and 10. 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.

Hexidecimal – The hexidecimal numbering system uses the numerals 0 through 9 and the letters A through F to represent the sixteen possible cominations of four binary digits.

Octal – The octal numbering system uses the numerals 0 through 7 to represent the eight possible combinations of three binary digits.

Binary Coded Decimal – The Binary Coded Decimal system uses ten unique combinations of four binary digits to represent the decimal numbers 0 through 9.

DESCRIPTION

NOTE

The 7000-series Readout System is compatible with both three- and four-compartment mainframes. However, since three-compartment mainframes do not have a B Horizontal plug-in compartment, the B Horizontal channels are not used. In these instruments, a Jump command is encoded on the Main Interface for this compartment during time-slot one (see the discussion for Jump in the Column and Row Decoder portion of this Circuit Description). The Jump command (Row 14 current) is applied to pins 16 and 15 (B Horizontal channels 1 and 2 respectively) of U232. Column data current is not required for a Jump command. This allows the Readout System to sense a "jump" during time-slot one at channel 2, which causes it to "jump" the remaining nine time slots for that channel and go to channel 1, where it again senses a "Jump" command during time-slot one. This permits it to "jump" the remaining nine time-slots in channel 1 and the Readout System begins a new frame. The unused horizontal channels will be ignored in the following discussions.

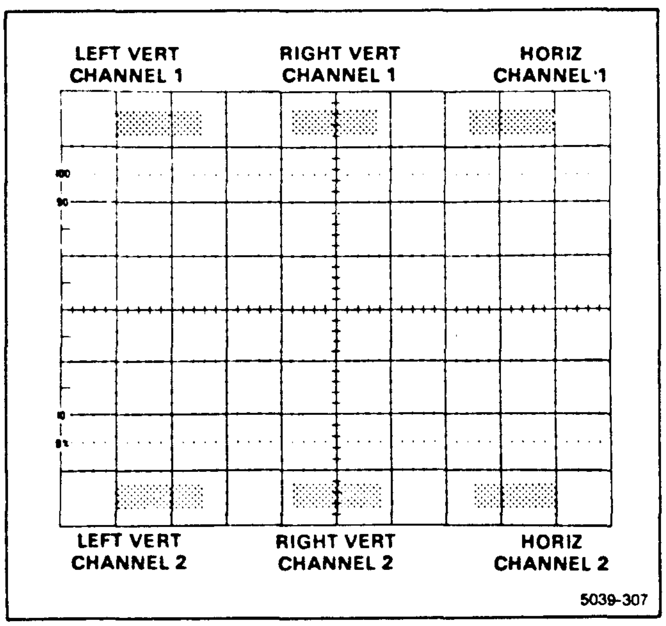


Figure 1. Location of readout display on the crt identifying the originating plug-in and channel.

Hexidecimal from U3486	Row Number	Hexidecimal from U3546 → / Column Number → / Current (mA)	F	E	D	C	B	A	9	8	7	6	F
		Column Number	C-0	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
		Current (mA)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	≥1.0
E	R-1	0	SKIP*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
D	R-2	0.1		↓	<	I	/	+	−	+	*C*	*Δ*	>
C	R-3	0.2		Add one zero*	Add two zeros*	Reduce one prefix*	Reduce prefix and add one zero*						*IDENTIFY**
B	R-4	0.3		*m*	*μ*	*n*	*p*	*X*	*K*	*M*	*G*	*T*	*R*
A	R-5	0.4		*S*	*V*	*A*	*W*	*H*	*d*	*B*	*c*	*Ω*	*E*
9	R-6	0.5		*U*	*N*	*L*	*Z*	*Y*	*P*	*F*	*J*	*Q*	*D*
8	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*			
7	R-8	0.7										•	
6	R-9	0.8											
F	R-10	0.9	Add space in display*										
F	R-14	1.3	JUMP*										

* Operational address.

☐ Unused locations. Available for future expansion of Readout System.

Figure 2. Character selection matrix.

DISPLAY FORMAT

Up to 6 words of readout information can be displayed on the CRT. The position of each word is fixed and is directly related to the plug-in unit from which it originated. Figure 1 shows the area of the graticule where the readout from each plug-in unit is displayed. Notice that Channel 1 of each plug-in unit is displayed within the top division of the CRT, and Channel 2 is displayed directly below within the bottom division. Figure 3 shows a typical display where only Channel 2 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 2 and 7 characters per word. The characters are selected from the Character Selection Matrix shown in Figure 2. In addition, 13 operational addresses are provided for special instructions to the Readout System. The unused locations in the Matrix (shaded area) are available for future expansion of the Readout System. The method of addressing the locations in the Character selection Matrix is described in the following discussion.

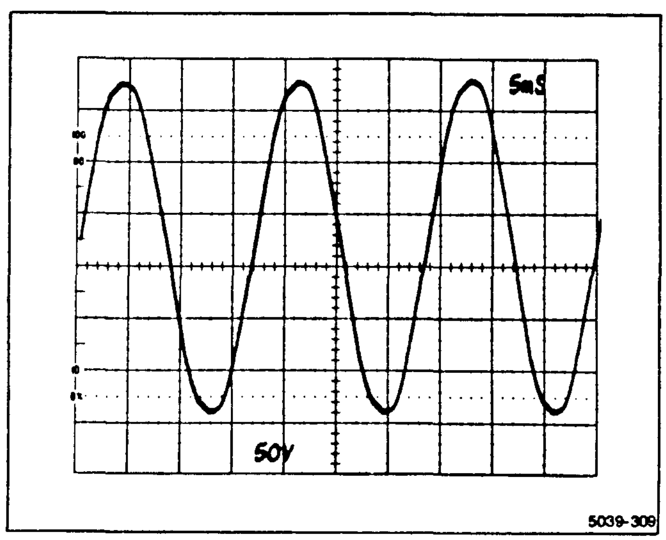


Figure 3. Typical readout display where only channel 2 of the Right Vertical unit is displayed.

DEVELOPING THE DISPLAY

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

Two output lines (row and column) are connected from each channel of the plug-in unit back to the Readout System. Data is typically encoded on these output lines by connecting resistors between them and the time-slot input lines. The resultant output is a sequence of 10 analog current levels that range from 0 to 1 millampere (100 microamperes/step) on the row and column output lines. This row and column corresponds to the row and column of the Character Selection Matrix in Figure 2. The standard format for encoding information onto the output lines is given in Table 1 (Special-purpose plug-in units may have their own format for readout and these special formats will be defined in the manuals for these units).

TABLE 1
Standard Readout Format

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

DESCRIPTION

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 current from the 6 data lines (2 channels from each of the 3 plug-in compartments) and produce a time-multiplexed analog voltage output containing all of the column and row information from the plug-ins. The Column Data Switch and Row Data Switch are sequenced by the binary Channel Address Code from the Channel Counter.

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

The analog outputs of the Column Data Switch and Row Data Switch are connected to the Column Decoder and Row Decoder stages respectively. These stages sense the magnitude of the analog voltage input and produce an output current on one of ten lines. The outputs of the Column Decoder stage are identified as C-1 through C-10 (column 1 through 10) corresponding to the encoded column information. Likewise, the outputs of the Row Decoder stage are identified as R-1 through R-10 (row 1 through 10) corresponding to the encoded row information. The row and column outputs are then converted to Binary Coded Decimal and used to address memory locations within the Character Generator. 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 the memory until time-slots 5, 6, or 8. After storing this information, it triggers the Display-Skip Generator stage so that there is no display during time-slot 1 (as defined by Standard Readout Format; see Table 1). When time-slots 5, 6, and 8 occur, the memory is addressed and any information stored there during time-slot 1 is transferred to the input of the Column Decoder stage to modify the analog data during the applicable time-slot.

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 connected with the Row Decimal-to-BCD Converter and the Row and Column Data Switches. This output level connects the Column Data Switch with a coding network within the Readout system to produce an analog current during time-slots 2 through 9. The current is then converted to Binary Coded Decimal and combined with the Row Decimal-to-BCD Converter output to address locations within the Character Generator necessary to display "IDENTIFY" on the CRT. The Zeros Logic and Memory stage is reset after each word by the End-of-Word pulse.

Each character displayed on the CRT consists of a series of connected points within an 8-point by 8-point grid. The Character Generator contains grid locations of the points required to create any of the 50 possible characters shown in the Character Selection Matrix of Figure 2. The row and column data encoded during a time-slot are converted to BCD and used to address a location within the Character Generator containing the first grid point of the character to be displayed. The 4-bit binary output from the Lower Order Address Generator is combined with the address created by the row and column data to provide the other grid points necessary to complete the character.

DESCRIPTION

Only one character is addressable in any one time-slot or a space can be added into the displayed word by the Horizontal Character Position Counter stage, when encoded by the plug-in. The latter stage counts the number of characters generated and produces an output current to step the display one character position to the right for each character. In addition, the character position is advanced once during each of time-slots 1, 2, and 3, whether a character is generated during these time-slots or not. This action fixes the starting point of the standard-format display such that the first digit of the scaling factor always starts at the same point within each word regardless of the information encoded in time-slot 1, 2, or 3 preceding this digit. Also, by encoding row 10 and column 0 during any time-slot, a blank space can be added to the display. Decimal points can be added to the display at any time by addressing the appropriate row and column (See Character Selection Matrix for location of decimal points). The Horizontal Character Position Counter stage is reset after each word by the Word Trigger pulse.

The Character Generators binary output is shaped by the X and Y Vector Generators into the appropriate X and Y-Axis signals to create characters. The Vector Amplifier outputs are amplified by the X and Y Output Amplifiers for use by the instruments horizontal and vertical deflection systems. The Channel Counter output is also used by these stages 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. 1). The character positioning current or decimal positioning current generated by the Horizontal Character Position Counter or Decimal Point Logic stages is added to the X (horizontal) signal at the input to the X Output Amplifier, providing horizontal positioning of the characters within each word.

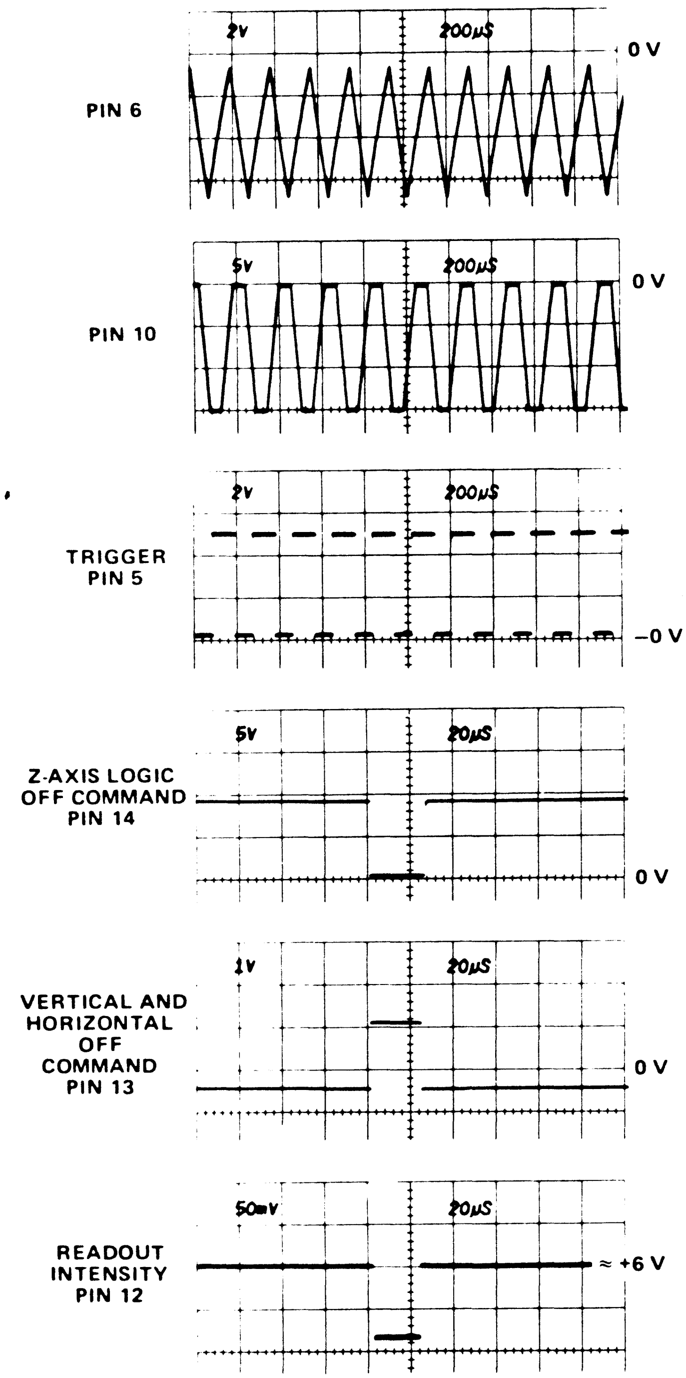
The Word Trigger stage produces a trigger from the End-of-Word pulse generated by the Time-Slot Counter stage after the tenth time-slot. This Word Trigger pulse advances the Channel Counter to display the information from the next channel or plug-in. This Word Trigger stage can also be advanced to jump a complete word, or a portion of a word, when a Jump Command is received from the Row Data Switch stage.

TIMER

The Timer stage produces the timing sequence for all circuits within the Readout System. This stage produces six time-related output waveforms (see Fig. 4). 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 R3435 and C3435. The triangle waveform is clipped and amplified by U3426 to form the trapezoidal output signal at pin 10. The amplitude of this output signal is exactly 15 volts, as determined by U3426 (exact amplitude is 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.

The signals at pin 12, 13, and 14 are produced only when the triangle waveform is on its negative slope and the trapezoidal waveform has reached the lower level. The timing sequence of these waveforms is important to the operation of the Readout System (see expanded waveforms in Fig. 5). The Z-Axis inhibit command at pin 14 is produced first. This negative-going signal provides a blanking pulse to the Z-Axis Logic stage to blank the CRT before the display is switched to the Readout System. It also produces the strobe pulse through Q3438 and CR3439 which is connected to pin 15 of U3532.

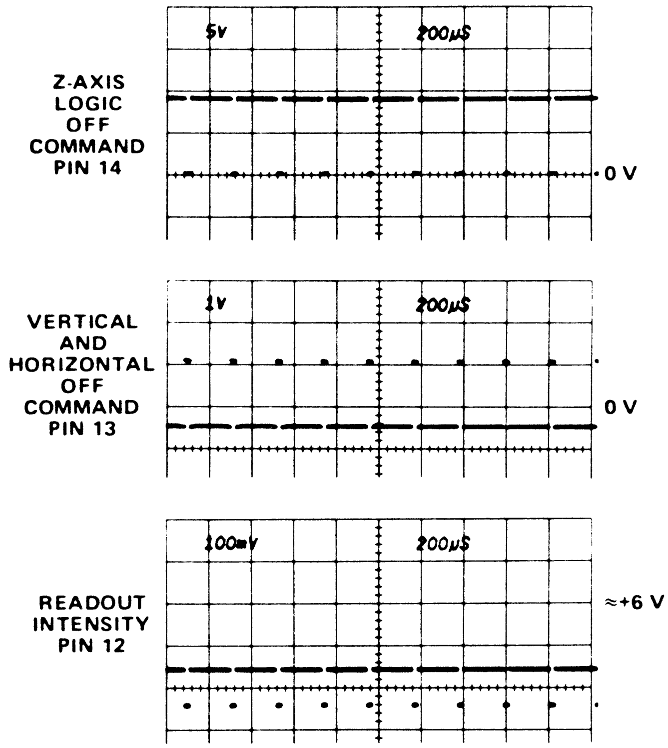
DESCRIPTION



NOTE: TEST OSCILLOSCOPE EXTERNALLY TRIGGERED FROM PIN 5 OF U3427.

Figure 4. Output waveforms of the Timer stage.

DESCRIPTION



NOTE: TEST OSCILLOSCOPE EXTERNALLY TRIGGERED FROM PIN 5 OF U3427.

Figure 5. Detail of output at pins 12, 13, and 14 of U3426.

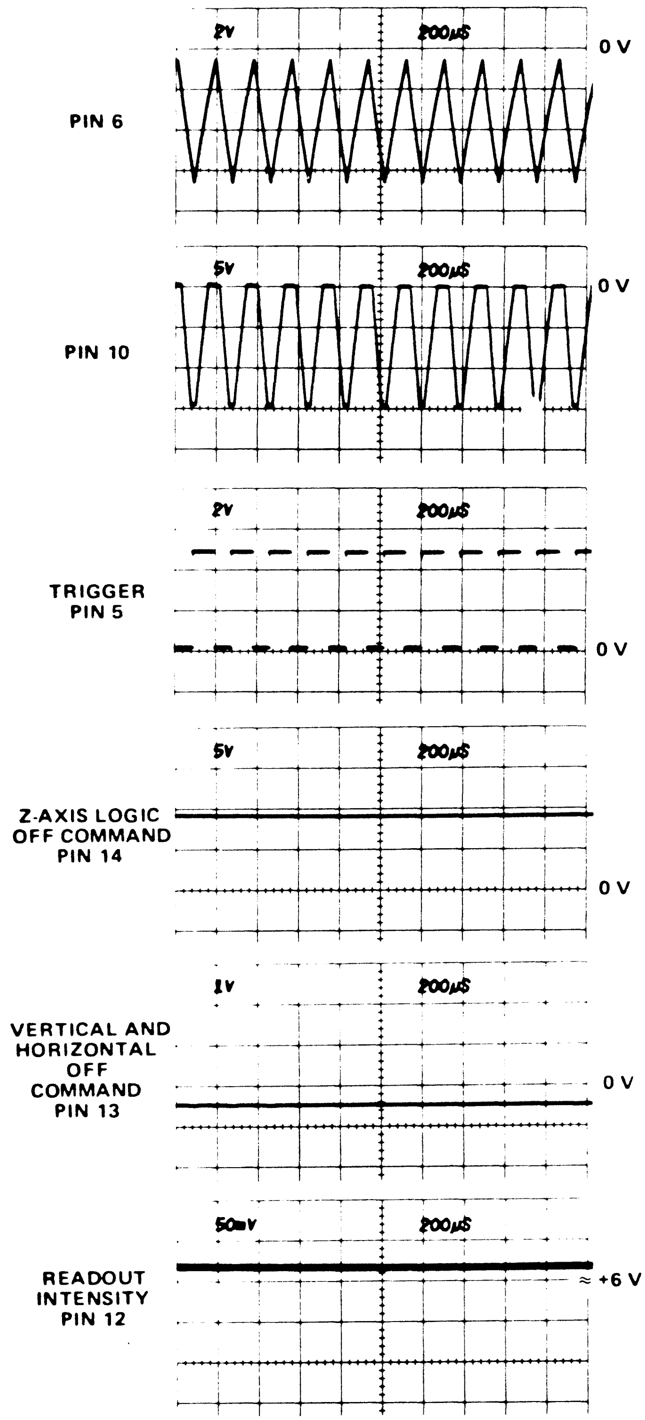
The purpose of this configuration is to prevent the Zeros Logic and Memory stage U3532 from storing incorrect data during the quiescent period of the strobe pulse. When the strobe pulse goes positive, CR3439 is reverse biased to disconnect Q3438 and allow U3532 to operate in the normal manner.

The next signal to be produced is the X-Y Inhibit Command at pin 13. This positive-going signal disconnects the plug-in signals from the vertical and horizontal deflection systems. The Ready signal is also derived from this output and connected to the Character Generator stage and the two Output Amplifier stages.

The Z Readout output at pin 12 is produced next. This current is connected to the CRT circuit to unblank the CRT to the intensity level determined by the voltage on the Readout Intensity line.

The Timer stage operates in one of two modes as controlled by the Display-Skip level at pin 4. The basic mode just described is a condition that does not occur unless all ten characters of each word (60 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 U3426 through CR3425 from the Display-Skip Generator stage. This signal causes the Timer to shorten its period of operation to about 210 microseconds. The waveforms in Figure 6 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, and 14 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.

DESCRIPTION



NOTE: TEST OSCILLOSCOPE EXTERNALLY TRIGGERED FROM PIN 5 OF U3427.

Figure 6. Timer stage operation when display-skip condition occurs.

DESCRIPTION

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

A negative voltage on the readout intensity line sets the intensity of the readout display independently of the A or B INTENSITY controls. The Readout Intensity line also provides a means of turning the Readout System off when a readout display is not desired. When the Readout Intensity line is left open, the current from pin 11 of U3426 is interrupted, and at the same time, a positive voltage is applied to pin 4 through CR3424. The positive voltage switches the stage to the same conditions as were present under the Display-Skip condition. Therefore, the CRT display is not interrupted to present characters. However, time-slot pulses continue to be generated.

TIME-SLOT COUNTER

Time-Slot Counter U3459 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, causing the output signal to be sequenced consecutively from time-slot 1 through time-slot 10. Figure 7 shows the time relationship of the time-slot pulses. Notice that only one line carries a time-slot pulse at any given time. When time-slot 10 is completed, a negative-going end-of-word pulse is produced at pin 2. The end-of-word pulse provides a drive pulse for the Word Trigger stage and also provides an enabling level to the Display-Skip Generator during time-slot 1 only.

Pin 16 is a reset input for the Time-Slot Counter. When this pin is held LO, the Time-Slot Counter resets to time-slot 1.

WORD TRIGGER

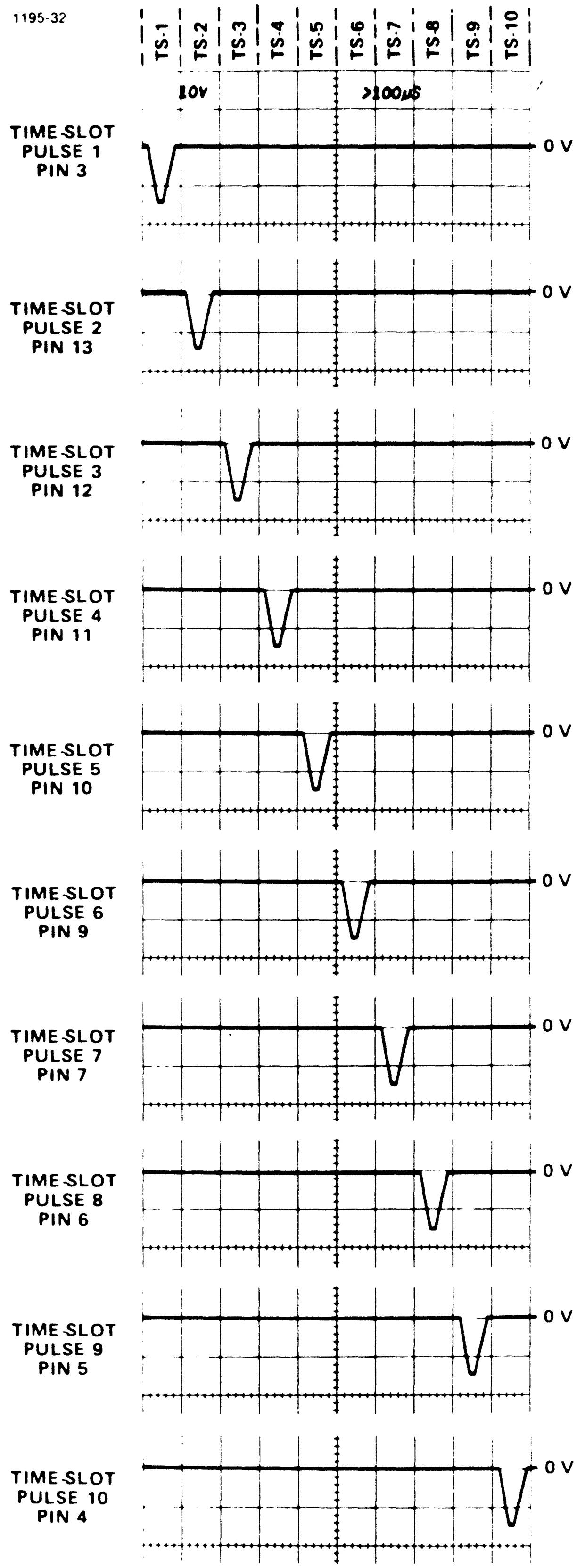
The Word Trigger U3427B is a single-shot multivibrator that provides a reset pulse for the Horizontal Character Position Counter stage. The negative-going end-of-word pulse from pin 2 of U3459 triggers the single shot and causes its output to go high at pin 11.

CHANNEL COUNTER

Channel Counter U3427A is a binary counter that produces the Channel Address Code for the Column and Row Decoder stages and the Output Amplifier stages. This code instructs these stages to sequentially select and display the 6 channels of data from the plug-ins. Table 2 gives the 6 combinations of the Channel Address Code and the resultant channel selected with each combination.

DESCRIPTION

Figure 7. Timing relationship of the time-slot (TS) pulses produced by U3459.



NOTE: TEST OSCILLOSCOPE EXTERNALLY TRIGGERED FROM TIME-SLOT PULSE 1. SWEEP RATE UNCALIBRATED.

DESCRIPTION

TABLE 2
Channel Address Code

Pin 5 U3427	Pin 4 U3427	Pin 3 U3427	Channel Displayed
LO	LO	LO	Channel 1 Left vertical
LO	LO	HI	Channel 2 Left Vertical
LO	HI	LO	Channel 1 Right Vertical
LO	HI	HI	Channel 2 Right Vertical
HI	LO	LO	Channel 1 Horizontal
HI	LO	HI	Channel 2 Horizontal

SINGLE-SHOT LOCKOUT

The Single-Shot Lockout stage allows a single readout frame (6 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. Integrated circuit U3420A and U3420B are connected to form a bistable flip-flop. For free-run operation, pin 8 of U3420C is held HI. This activates U3420C and results in a LO output level at pin 10, enabling the Timer stage to operate in a free-running manner.

The output of the Single-Shot Lockout stage remains LO to allow U3426 to operate in the free-running mode until a LO is received at pin 8 of U3420C. When this occurs, the output level at pin 10 of U3420C does not change immediately. However, the Single Shot Lockout circuit is now enabled.

If the Channel Counter has not completed word 6, the Readout System continues to operate in the normal manner. When word 6 is completed, the negative-going end-of-frame pulse is produced at pin 5 of U3427A as the Channel Counter shifts to the code necessary to display word one. This pulse is applied to pin 8 of U3420C, which produces a HI at pin 6 of U3420B because of the momentary LO at pin 9. The HI at pin 6 produces a LO at pin 4, which causes pin 3 of U3420A to go LO. Because pin 2 is already LO, pin 1 goes HI. This disables the Timer stage, so it operates in the Display-Skip mode.

The Single-Shot Lockout stage remains in this condition until a positive-going trigger pulse is applied to pin 2 of U3420A. This trigger pulse produces a LO at pin 1 of U3420A to enable U3426 and disable U3420B. Now, the Timer stage can operate in the normal manner for another complete frame. When word 6 is completed, the Channel Counter produces another end-of-frame pulse to again lock out the Timer stage.

ENCODING THE DATA

Data is conveyed from the plug-in units to the Readout System in the form of an analog (current level) code. The characters that can be selected by the encoded data are shown on the Character Selection Matrix (see Fig. 2). Each character or special function requires two currents to define it (except Jump, which requires only one). These currents are identified as the column current and the row current, corresponding to the column and row of the matrix. The column and row data is encoded by programming the plug-in units. Figure 8 shows a typical encoding scheme using resistors for a voltage-sensing amplifier plug-in unit. Notice that the 10 TS (time slot) pulses produced by the Time-Slot Counter stage are connected to the plug-in unit. However, time-slots 5, 6, and 10 are not used by the plug-in unit to encode data when using the Standard Readout Format (See Table 1 for Standard Readout Format). The amplitude of the time-slot pulse is exactly -15 volts as determined by the Timer stage. Therefore, the resultant output current from the plug-in units can be accurately controlled by the programming resistors in the plug-in units.

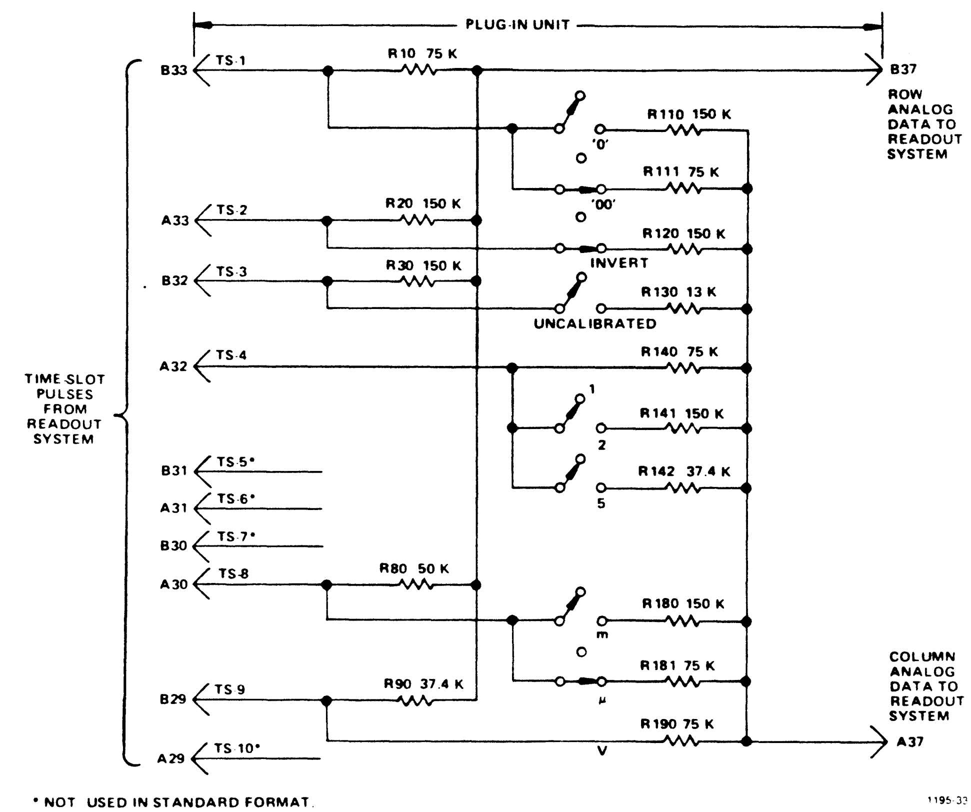
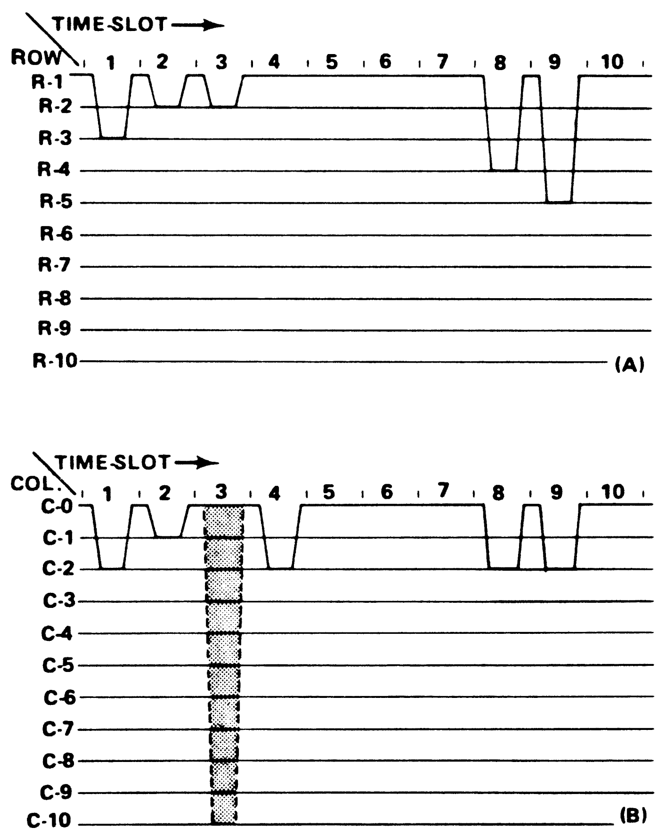


Figure 8. Typical encoding scheme for voltage-sensing plug-in unit. Coding shown for deflection factor of 100 microvolts.

DESCRIPTION

For example, in Figure 8 resistors R10 through R90 control the row analog data, which is connected back to the Readout System. Figure 9 shows an idealized output current waveform of row analog data resulting from the time-slot pulses. Each of the row-current levels shown in these waveforms correspond to 100 microamperes of current. The row numbers on the left-hand side of the waveform correspond to the rows in the Character Selection Matrix (see Fig. 2). The row analog data is connected back to the Readout System via terminal B37 of the plug-in interface.

The column analog data is defined by resistors R110 through R190. The program resistors are connected to the time-slot lines by switch closures to encode the desired data. The data, as encoded by the circuit shown in Figure 8, indicates a 100 microvolt sensitivity, with the CRT display showing inverted and calibrated deflection factors. This results in the idealized output current waveforms shown in Figure 9 at the column analog data output, terminal A37 of the plug-in interface.



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

1195-34

Figure 9. Idealized current waveforms of (A) Row analog data and (B) Column analog data.

DESCRIPTION

Resistor R111, connected between time-slot 1 and the column analog data output, encodes two units of current during time-slot 1. Referring to the Character Selection Matrix, Figure 2, two units of column current, along with the two units of row current encoded by resistor R10 (row 3), indicates that two zeros should be added to the display. Resistor R120 adds one unit of column current during time-slot 2 and, along with the one unit of current from the row output, the Readout System is instructed to add an invert arrow to the display. Resistor R130 is not connected to the time-slot 3 line, since the deflection factor is calibrated. Therefore, there is no display on the CRT during TS-3. (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, resulting in the numeral 1 being displayed on the CRT. Neither row nor column analog data is encoded during time-slots 5, 6 and 7 as defined by the Standard Readout Format. During time-slot 8, two units of column current and three units of row current are encoded by resistors R181 and R80, respectively. This addresses the μ prefix in the Character Selection Matrix. The final data output is provided from time-slot 9 by R190 connected to the column output and R90 to the row output. These resistors encode two units of column current and four units of row current to cause a V (volts) symbol to be displayed. Time-slot 10 is not encoded, in accordance with the Standard Readout Format. The resultant CRT readout will be 100μV.

In the above example, the row analog data was programmed to define which row of the Character Selection Matrix was addressed to obtain information in each time-slot. The column data changes to encode the applicable readout data as the operating conditions change. For example, if the variable control of the plug-in unit was activated, R130 would be connected between time-slot 3 and the column analog data output line. This encodes 10 units of column current (see shaded area in time-slot 3 of the waveform shown in Fig. 9). Since one unit of row current is also encoded during this time-slot by R30, a $>$ (greater than) symbol is added to the display. The crt readout will now show $>$ 100μV. In a similar manner, the other switches can change the encoded data for the column output and thereby change the readout display. See the descriptions which follow for decoding this information.

The column analog data encoded by most plug-in units can be modified by attenuator probes connected to the input connectors of amplifier plug-in units. A special coding ring around the input connector of the plug-in unit senses the attenuation ratio of the probe (with readout-encoded probes only). The probe contains a circuit that provides additional column current. For example, if a 10X attenuator probe is connected to a plug-in unit encoded for 100 microvolts as shown in Figure 9, an additional unit of current is added to the column analog data during time-slot 1. Since two units of current were encoded by R111, this additional current results in a total of three units of column analog current during this time-slot. Referring to the Character Selection Matrix, three units of column current, along with the two units of row current encoded by R10, indicates that the prefix should be shifted one column to the left. Since this instruction occurs in the same time-slot that previously indicated that two zeros should be added to the display and only one instruction can be encoded during a time-slot, the zeros do not appear in the display. The CRT readout will now be changed to 1mV (readout program produced by plug-in same as for previous example).

Three other lines of information are connected from the plug-in compartments to the Readout System. The column and row analog data from channel 2 of a dual-channel plug-in are connected to the Readout System through terminals A38 and B38 of the plug-in interface, respectively. Force readout information is encoded on terminal A35 and the function of this input is described under Column and Row Data Switches. The preceding information gave a typical example of encoding data from an amplifier plug-in unit. Specific encoding data and circuitry is shown in the individual plug-in unit manuals.

DESCRIPTION

COLUMN AND ROW DATA SWITCHES

The encoding data from the plug-in units is connected to the Column and Row Data Switch stages. A column-data line and a row-data line convey analog data from each of the 6 data sources (2 channels from each of the 3 plug-in compartments).

The Column Data Switch U262 and the Row Data Switch U232 receive the Channel Address Code from the Channel Counter (refer to the schematic at the rear of this insert). This binary code directs the Column Data Switch and the Row Data Switch to the channel which should be the source of the encoding data. Table 2 gives the six combinations of the Channel Address Code and the resultant channel selected with each combination. These stages have nine inputs and provide a time-multiplexed output at pin 7, which includes the information from all of the input channels. Eight of the nine inputs to each stage originate in the plug-in units and the ninth input to U262 comes from a special data-encoding network composed of resistors R241 through R248 (See Zeros Logic and Memory description for further information on ninth channel).

In addition to the encoding data inputs from the plug-in units, inputs are provided to the Column Data Switch from the VERTICAL MODE and HORIZONTAL MODE switches to inhibit the readout for any plug-in unit(s) not selected for display. When a unit is not selected, the line corresponding to the opposite channel is HI to forward bias the associated diodes: CR212 through CR215. The forward-biased diodes cause the channel switches to bypass the encoded data from the inhibited channel. However, since it may be desired to display information from special-purpose plug-in units (even through they do not produce a normal waveform display on the CRT), a feature is provided to over-ride the channel inhibit. This is done by applying a LO to the associated Force Readout input. The LO level diverts the HI channel-inhibit current and allows the data from this plug-in unit to reach the Column Data Switch, even though it has not been selected for display by the mode switch.

Row Match adjustment, R3483, sets the gain of the Row Data Switch to match the gain of the Row Decoder for correct output. Column Match adjustment, R3543 performs the same function for the Column Data Switch stage.

DISPLAY-SKIP GENERATOR

The Display-Skip Generator is made up of Q3523, Q3526, Q3527 and Q3529. This stage monitors the time-multiplexed column data at the output of the Column Data Switch during each time-slot to determine if the information is valid data that should result in a CRT display. Quiescently, about 100 microamperes of current flows through R3542 from Q3543 and the Zeros Logic and Memory stage. (The purpose of this quiescent current will be discussed in connection with the Zeros Logic and Memory stage). This current biases Q3523A so that its base is about 0.2 volt more positive than the base of Q3523B in the absence of column data. Therefore, since Q3523A and Q3523B are connected as a comparator, Q3523A will remain on unless its base is pulled more negative than the base of Q3523B.

The analog data output from the Column Data Switch produces a 0.5 volt (approximately) change for each unit of column current that has been encoded by the plug-in unit. Whenever any information appears at the output of the Column Data Switch, the base of Q3523A is pulled more negative than the base of Q3523B, resulting in a negative (LO) Display-Skip output to the Timer stage through Q3529. 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.

DESCRIPTION

Transistors Q3526 and Q3527 also provide Display-Skip action. The end-of-word level connected to their emitters is LO only during time-slot 1. This means they are enabled only during this time-slot. These transistors allow the Zeros Logic and Memory stage to generate a Display-Skip signal during time-slot 1 when information that is not to be displayed on the CRT has been stored in memory (further information is given under Zeros Logic and Memory).

COLUMN AND ROW DECODERS

The Column Decoder U3544 and Row Decoder U3485 sense the magnitude of the analog voltages at their inputs (pin 10) and produce a binary output on one of ten lines corresponding to the column or row data encoded by the plug-in unit. These outputs provide the Column Digital Data and Row Digital Data, which is encoded by the Decimal-to-BCD converters to create the address used by the Character Generator in determining which character will be displayed. The column and row data is also used throughout the Readout System to perform other functions.

The input current at pin 9 of the Column Decoder stage is steered to only one of the ten Column Digital Data outputs. When a Display-Skip signal is present (collector of Q3529 HI), pin 9 is pulled HI through CR3529. 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 Q3481 and its associated components, is a Row-14 detector that produces the Jump Command. This row current is encoded by special-purpose plug-ins to cause all or part of a word to be jumped. Whenever row 14 (13 units of row current, or 1.3 millamperes) is encoded, the base of Q3481 pulled negative enough so that this transistor is forward biased to produce a LO Jump Command output at its emitter. The Jump Command is connected to the set input of RS flip-flop U3462B, whose reset input is connected to the Trigger Signal from pin 5 of the Timer. When the Jump Command and Trigger inputs are low, U3462B produces a LO output to reset the time-slot Counter as well as advancing the Horizontal Character Position Counter and the Channel Counter. U3462B also produces a HI output to signal Display Skip at pin 4 of the Timer.

ZEROS LOGIC AND MEMORY

The Zeros Logic and Memory stage U3532 stores data encoded by the plug-in units to provide zeros-adding and prefix-shifting logic for the Readout System. The Strobe pulse at pin 15 goes positive when the data has stabilized and can be inspected. This activates the Zeros Logic and Memory stage so that it can store the encoded data.

Typical output waveforms of the five possible input conditions that can occur are shown in Figure 10. When time-slot 1 occurs, a store command is given to all of the memories. If the plug-in units encoded data for column 1, 2, 3, 4, or 10 during time-slot 1, the appropriate memory (or memories) is set. Notice that row 3 information from the Row Decoder must also be present at pin 16 for data to be stored in the memory of U3532.

If data was encoded during time-slot 1, a negative-going output is produced at pin 7 while the memories are being set. This negative-going pulse is connected to the base of Q3527 in the Display-Skip Generator to produce a Display-Skip output. Since the information encoded during time-slot 1 was only provided to set the memories and not intended to be displayed on the CRT at this time, the Display-Skip output prevents a readout display during this time-slot.

DESCRIPTION

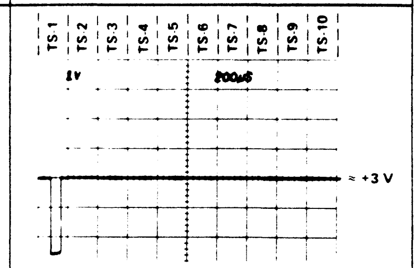
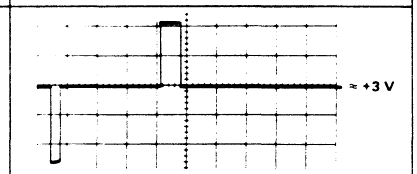
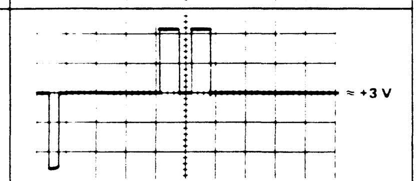
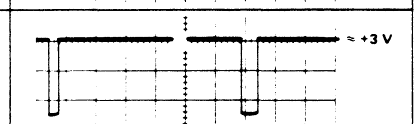
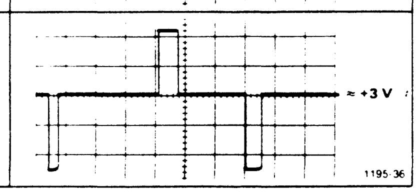
INPUT PIN OF U2232 ACTIVATED	COMMAND	TIME SLOTS
14	IDENTIFY	
12	ADD ONE ZERO	
13	ADD TWO ZEROS	
10	DECREASE PREFIX	
11	DECREASE PREFIX AND ADD ONE ZERO	

Figure 10. Typical output waveforms for Zeros Logic and Memory stage operation (at pin 7 of U3532).

During time-slot 5, a memory within U3532 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 Q3543 to add one unit of current at the input of the Column Decoder. This produces a zero after the character displayed during time-slot 4. During time-slot 6, another memory within U3532 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 0 in the CRT display.

Finally, another memory within U3532 is interrogated during time-slot 8 to determine whether the prefix should be changed, or left at the value that was encoded. If data has been encoded that calls for a shift in prefix, a negative-going output level is produced at pin 7. This negative level subtracts one unit of column current from the data at the input to the Column Decoder. Notice, on the Character Selection Matrix of Figure 2, that when row 4 is programmed, a reduction of one column results in a one-column shift of the prefix. For example, with the 100μV program shown in Figure 9. If the data received from the plug-in called for a shift in prefix, the CRT readout would be changed to 1mV (zeros deleted by program; see Encoding the Data).

The 100 microamperes of quiescent current through R3542 provided by Q3543 (see Display-Skip Generator) allows the prefix to be shifted from m (100 microamperes of column current, column 1) to no prefix (0 column current, column 0) 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.

DESCRIPTION

A further feature of the Zeros Logic and Memory is the Identify function. If 10 units of column current are encoded by the plug-in unit along with row 3 during time-slot 1, the Zeros Logic and Memory produces a negative-going output pulse at pin 1 to switch the Column Data Switch and Row Data Switch to the ninth channel. Then, time-slot pulses 2 through 9 encode an output current through resistors R241-R248 for column data and enable pin 10 of U3486. This provides the addresses necessary to display the word IDENTIFY in the word position allotted to the channel that originated the Identify command. After completion of this word, the Column Data Switch and Row Data Switch continue with the next word in the sequence.

The end-of-word signal from the Time-Slot Counter is connected to pin 9 of U3532 through C3539. 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 GENERATOR

Each character to be displayed on the instrument CRT consists of a series of connecting points developed on a possible 8-point by 8-point grid (see Fig. 11). The 8-bit binary output from the Character Generator is used to determine the location of points within the grid, whether or not to provide a trace connecting two points, and the point at which a character has been completed. The Character Generator stage consists of an oscillator, the Lower Order Address Generator, and an EPROM connected to a latch.

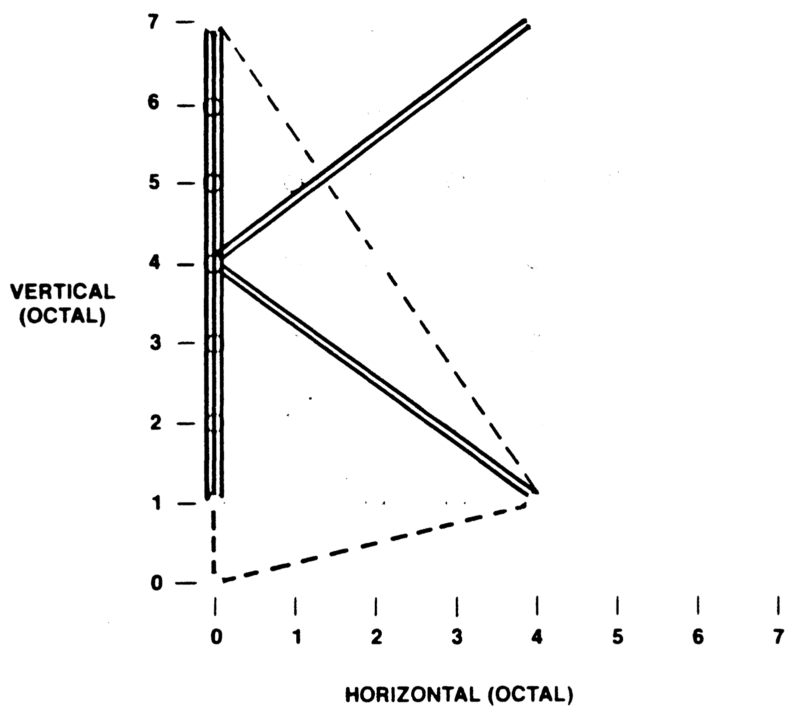
Q3451 and Q3452 form a square-wave oscillator whose frequency is adjustable with C3455 to provide 16 cycles within the time allotted for developing a character. The base of Q3452 goes LO when the Timer produces a negative going Ready pulse at pin 13. This starts the oscillator by turning Q3452 on. The emitter of Q3451 becomes more negative as C3454 and C3455 discharge through R3454. The capacitors continue to discharge until the emitter-base junction of Q3451 becomes forward biased. Q3451 then begins to conduct and causes the oscillator to begin changing states. As Q3451 conducts, the discharge through C3454 and C3455 stops and causes a collector current reduction in Q3452. The current reduction causes the emitter and base of Q3452 to rise positive which pulls the emitter of Q3451 along with them through C3454 and C3455. This positive shift on the emitter of Q3451 turns it off. Now with C3451 conducting and Q3452 turned off, the voltage on the emitter of Q3452 begins to go negative with C3454 and C3455 beginning to charge through R3455. When the emitter-base junction of Q3452 becomes forward biased, the oscillator again changes states and completes one cycle.

The signal produced by the oscillator at the collector of Q3452 switches Q3453 on and off to create the clock pulses used by the Lower Order Address Generator and the EPROM latch. The oscillator will continue to run until the Timer Ready output at pin 13 goes positive and pulls up the base of Q3452.

The Lower Order Address Generator is a 4-bit binary counter and consists of U3502B. The negative going Timer Ready pulse is inverted by Q3442 and used to reset U3502B. The oscillator is also enabled by the Ready signal and begins providing the clock input at pin 13. The counter then begins at 0000 and counts at the frequency of the oscillator, continuing to do so until the Ready signal goes positive. The Lower Order Address Generator's 4-bit output is connected to the four lower order address inputs on the Character Generator, U3503.

Product: R7103 Oscilloscope Date: 10/24/85 Change Reference: M53385/M59099

DESCRIPTION



"K" CHARACTER				
CHARACTER GENERATOR ADDRESS (HEXIDECIMAL)	CHARACTER GENERATOR OUTPUT		BIT 7	BIT 8
	BINARY 8 7 6 5 4 3 2 1	OCTAL	MOVE - - - - DRAW ———	END OF CHARACTER?
B 9 0	0 0 0 0 0 0 0 0	0 0 0	MOVE	NO
B 9 1	0 0 0 0 1 0 0 0	0 1 0	MOVE	NO
B 9 2	0 1 1 1 1 0 0 0	1 7 0	DRAW	NO
B 9 3	0 1 0 0 1 0 0 0	1 1 0	DRAW	NO
B 9 4	0 1 1 1 1 0 0 0	1 7 0	DRAW	NO
B 9 5	0 0 0 0 1 1 0 0	0 1 4	MOVE	NO
B 9 6	0 1 1 0 0 0 0 0	1 4 0	DRAW	NO
B 9 7	0 1 1 1 1 1 0 0	1 7 4	DRAW	NO
B 9 8	0 1 1 0 0 0 0 0	1 4 0	DRAW	NO
B 9 9	0 1 0 0 1 1 0 0	1 1 4	DRAW	NO
B 9 A	1 0 0 0 0 0 0 0	2 0 0	MOVE	YES

Figure 11. Developing a typical character on the crt.

DESCRIPTION

U3504 is an octal D-type flip-flop used as a latch to stabilize and synchronize the Character Generator EPROM output. It is reset by the same signal that starts the oscillator and is clocked at pin 11 by the oscillator output from Q3453. Q3504 will be considered to be part of the Character Generator in the discussion that follows.

The Character Generator U3503 is a 4k X 8-bit EPROM which contains the binary words used by the output stages in creating the signals necessary to form readout characters. There are twelve address inputs, with the lower four coming from the Lower Order Address Generator, the center four from the Column Decimal-to-BCD Converter, and the upper four from the Row Decimal-to-BCD Converter. As previously mentioned, each character is developed on an 8-point by 8-point grid (see Fig. 11 for a typical character). The Character Generator's 8-bit output provides the information necessary to move the instrument beam around within the grid, to turn the beam on and off, and to indicate when a character is complete.

The row and column data cause a 4-bit binary code to be generated at the outputs of the Row and Column Decimal-to-BCD Converters when a readout character is to be displayed. The Lower Order Address Generator is enabled and also provides a 4-bit binary code. These twelve bits are combined to form the EPROM address containing the 8-bit binary word which will locate the instrument beam at the character's starting grid location.

The 8-bit word can be broken down into four parts. The lower three bits are the horizontal grid coordinate, bits 4 through 6 are the vertical coordinate, bit 7 turns the Z Readout on and off, and bit 8 indicates whether or not the character is complete.

The character grid (Fig. 11) can be thought of as having vertical and horizontal coordinates numbered 0 through 7, with location "0,0" in the lower left corner. The 8-bit binary word from the Character Generator is converted to octal to easier recognize the vertical and horizontal coordinates. A binary "00001010" becomes octal "012". This number would cause the instrument CRT beam to point at grid coordinates vertical "1" and horizontal "2". The fact that the first octal digit is "0" indicates two things. First it shows that bit 7 of the binary word is LO which turns off Q3432 and the Z Readout signal to the instrument. It also shows that bit 8 is LO so the character is not complete. When bit 7 is HI, it advances the Horizontal Character Position Counter for the next character within the readout word.

The 4-bit outputs from the Row and Column Decimal-to-BCD Converters remain the same until the character is complete. However, the Lower Order Address Generator keeps counting and combines with the Row and Column Decimal-to-BCD Converter's outputs to address all the EPROM locations necessary to form the readout character.

Suppose the next address produces a Character Generator output of "01111010" or octal "172". The octal digit "1" indicates binary bit 7 is high which will turn on Q3432 and the Z Readout output to the instrument. The instrument will now provide a trace from the previous vertical and horizontal coordinates to the new ones, vertical "7" and horizontal "2". Thus the character is formed by a series of binary words causing the instrument CRT beam to move or draw between points.

DESCRIPTION

HORIZONTAL CHARACTER POSITION COUNTER

The Horizontal Character Position Counter U3502A is a 4-bit binary counter. Its output is converted to current by R3566 through R3569 and added to the X (horizontal) signal for spacing readout characters horizontally on the CRT. The counter is reset to "0000" with a Word Trigger pulse from U3427B and is advanced with inputs from two possible sources. The first is a HI End-of-Character signal from pin 19 of U3504. The counter can also be advanced when a Space instruction is encoded by the plug-in unit to cause a space to be left between two characters on the CRT. A Space instruction occurs when row 10 from the Row Decoder goes LO and is inverted by U3457D to advance the Horizontal Character Position Counter. No character could be displayed in this situation as no character information is stored at the Character Generator addresses formed using row 10.

Time slots 1, 2, and 3 are also connected to the Space instruction through VR3485, VR3486, and VR3487 respectively. This configuration adds a space to the displayed word during time slots 1, 2, and 3, even if information is not encoded during these time slots. 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 display does not shift positions as normal/invert or cal/uncal information is encoded by the plug-in.

DECIMAL POSITION LOGIC

The Decimal Position Logic stage allows decimal points to be displayed at five possible locations within a readout word (see Fig. 12). The decimal location encoded by a plug-in during time-slot one is achieved by adding positioning current to the X (horizontal) readout signal. Circuitry for this stage includes five 2-input NOR gates in U3457 and U3551 with precision resistors connected to their outputs. One input of each NOR gate is connected to row 7 on the Row Decoder and the other to one of columns 3 through 7 on the Column Decoder. When a decimal is to be displayed, row 7 goes LO and disables the Horizontal Character Position Counter by keeping the four outputs of U3564 LO. It also sets one input of each of the five NOR gates to LO. One of columns 3 through 7 also goes LO, depending on which decimal position is encoded, causing the NOR gate to which it's connected to go HI. This high adds current to the X (horizontal) signal in the amount determined by the resistor connected to the NOR gate's output. Each Character Generator location addressed by row 7 and column 3 through 7 contains information necessary to form a decimal point on the CRT in the position indicated. The Horizontal Character Position Counter resumes normal operation and the Decimal Position Logic is disabled when row 7 goes back up at the end of the time-slot.

Some plug-ins require decimal points at locations in the readout word other than the five provided by the Decimal Position Logic stage. An additional decimal point can be displayed in any position normally available to characters by encoding row 8 with column 9. The Horizontal Character Position Counter provides positioning current in this mode and the Decimal Position Logic stage is disabled.

DESCRIPTION

VECTOR GENERATORS

The Y Vector Generator is in two stages and consists of U3510A and B. Vertical character size adjustment is provided with R3510 as a variable feedback resistor for U3510A. Input to the Vector Generator is provided by the three bits of vertical character information from pins 9, 12, and 15 of the Character Generator latch U3504. The digital highs and lows across R3506, R3507 and R3508 are mixed as stepped current levels at pin 2 of U3510A. These sudden analog steps are converted into a smooth transition from one level to the next by RCL network R3512, C3512, and L3512. U3510B current buffers the resulting signal to be mixed with the Channel Counter vertical information at the input of the Y Output Amplifier.

The X Vector Generator operates similarly to the Y Vector Generator. Gain for the stage is fixed by the circuit components and its output is current buffered to be mixed at the input of the X Output Amplifier.

OUTPUT AMPLIFIERS

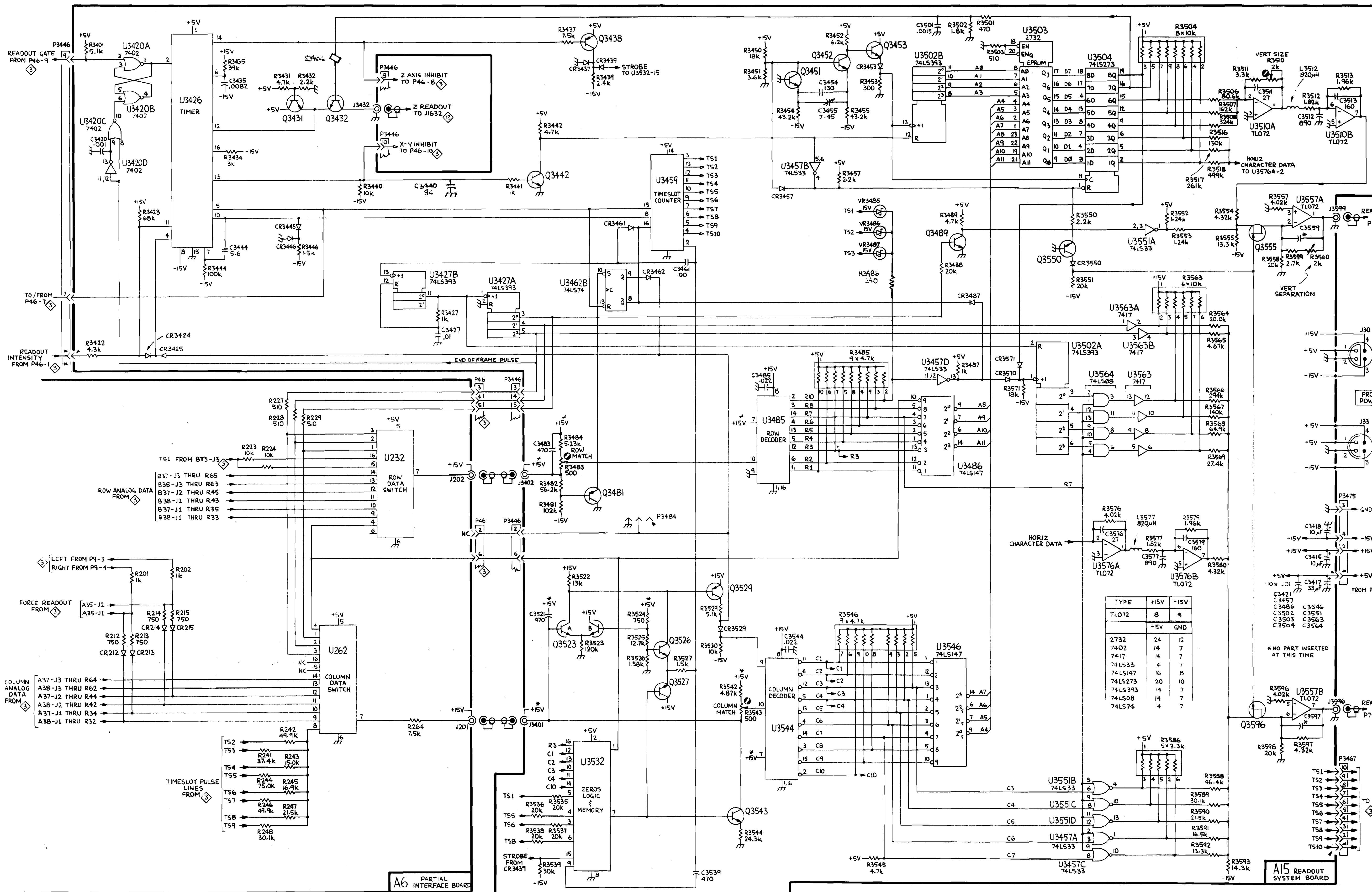
The Y Output Amplifier provides the Y (vertical) signal to the instrument by combining the signal from the Y Vector Generator with the channel 1 or 2 information from the Channel Counter. The amplifier consists of U3557B with Q3555 in its input circuit. Amplifier gain is adjustable with R3560 to control the vertical separation between readout words displayed at the top and bottom of the graticule area. Q3555 switches the amplifier input on and off with the Timer Ready signal, using Q3550 to provide impedance matching. The channel 1 or 2 information from pin 3 of the Channel Counter U3427A is inverted by U3551A and converted to current by R3552 and R3553. The Channel Counter produces a LO at pin 3 when the readout word is to be displayed at the top of the graticule. The LO is inverted to HI by U3551A and adds current to the Y (vertical) readout signal.

The X Output Amplifier consists of U3557A and Q3596. It operates similarly to the Y Output Amplifier to provide the X (horizontal) signal to the instrument. Input to the amplifier is a combination of outputs from the X Vector Generator, Horizontal Character Position Counter, Decimal Position Logic, and horizontal word position information from the Channel Counter. The gain of this stage is fixed by the resistor values in the circuit.

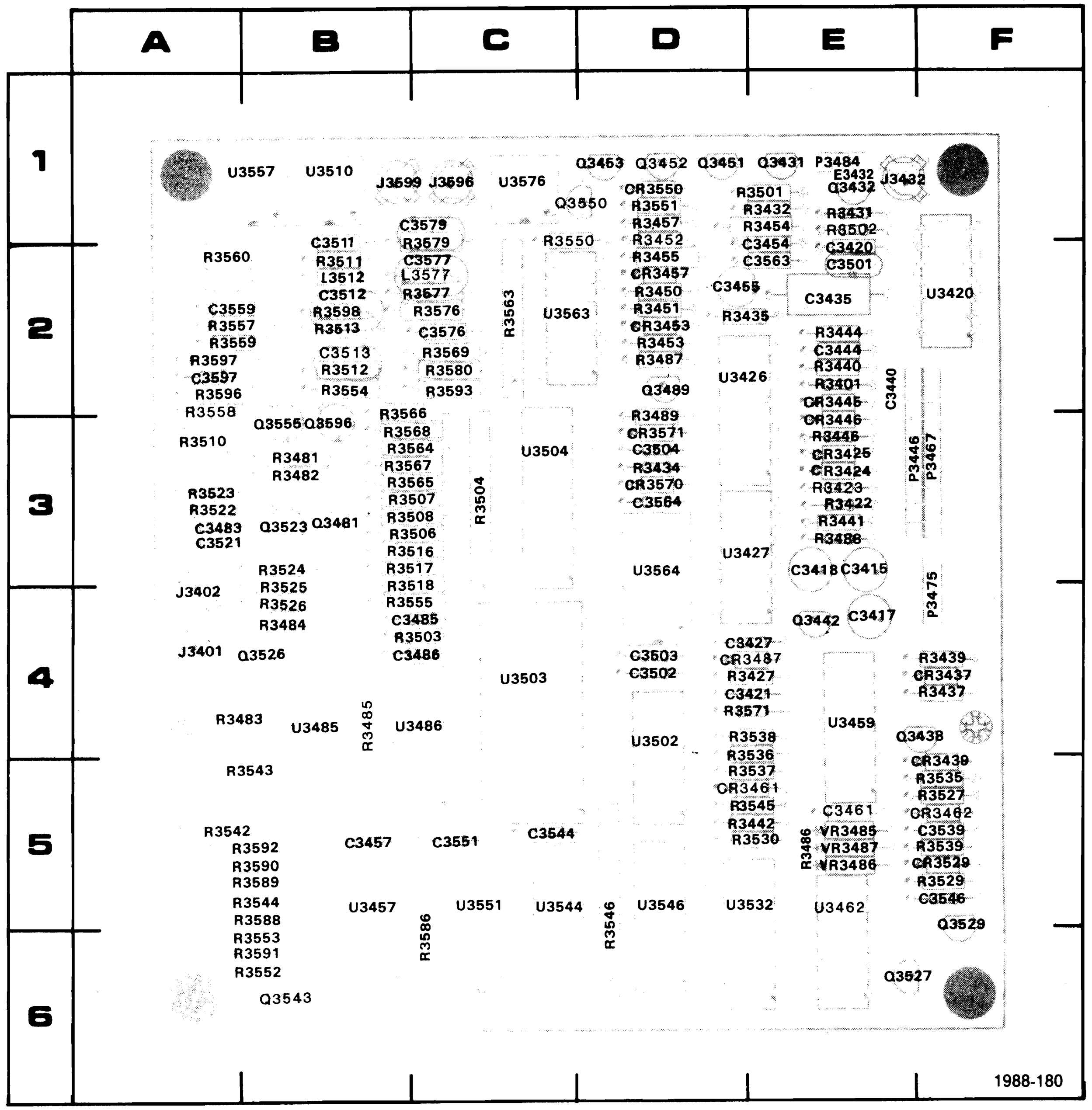
DESCRIPTION

DIAGRAM CHANGES

The following schematic and parts locator diagrams are for the new Readout circuit board. They supercede those currently found in Section 8 of the manual and are to be used in conjunction with the new Replaceable Electrical Parts List, Theory of Operation, and Performance Check/Adjustment found in other portions of this Manual Change Information insert.


READOUT GATE FROM P46-9
TO/FROM P46-7
READOUT INTENSITY FROM P46-1
U3420A 7402
U3420B 7402
U3420C 7402
U3420D 7402
U3426 TIMER
Z AXIS INHIBIT TO P46-8
Z READOUT TO J1632
X-Y INHIBIT TO P46-10
STROBE TO U3532-15
U3459 TIMESLOT COUNTER
TS1 TS2 TS3 TS4 TS5 TS6 TS7 TS8 TS9 TS10
U3427B 74LS393
U3427A 74LS393
U3462B 74LS74
END OF FRAME PULSE
U3502B 74LS393
U3503 2732 EPROM
U3504 74LS273
U3510A TL072
U3510B TL072
VERT SIZE
HORIZ CHARACTER DATA TO U3576A-2
U3457B 74LS33
U3551A 74LS33
U3557A TL072
Y READOUT TO P790
VERT SEPARATION
U3563A 7417
U3563B 7417
U3502A 74LS393
U3564 74LS08
U3563 7417
PROBE POWER
U3457D 74LS33
U3485 ROW DECODER
U3486 74LS147
U232 ROW DATA SWITCH
TS1 FROM B33-J3
ROW ANALOG DATA FROM
B37-J3 THRU R65
B38-J3 THRU R63
B37-J2 THRU R45
B38-J2 THRU R43
B37-J1 THRU R35
B38-J1 THRU R33
ROW MATCH
LEFT FROM P9-3
RIGHT FROM P9-4
FORCE READOUT FROM
A35-J2
A35-J1
U262 COLUMN DATA SWITCH
COLUMN ANALOG DATA FROM
A37-J3 THRU R64
A38-J3 THRU R62
A37-J2 THRU R44
A38-J2 THRU R42
A37-J1 THRU R34
A38-J1 THRU R32
TIMESLOT PULSE LINES FROM
HORIZ CHARACTER DATA
U3576A TL072
U3576B TL072
U3544 COLUMN DECODER
COLUMN MATCH
U3546 74LS147
U3532 ZEROS LOGIC & MEMORY
STROBE FROM CR3439
U3551B 74LS33
U3551C
U3551D
U3457A 74LS33
U3457C 74LS33
U3557B TL072
X READOUT TO P790
FROM P75
TO P67
* NO PART INSERTED AT THIS TIME
A6 PARTIAL INTERFACE BOARD
A15 READOUT SYSTEM BOARD
TYPE | +15V | -15V
TL072 | 8 | 4
| +5V | GND
2732 | 24 | 12
7402 | 14 | 7
7417 | 14 | 7
74LS33 | 14 | 7
74LS147 | 16 | 8
74LS273 | 20 | 10
74LS393 | 14 | 7
74LS08 | 14 | 7
74LS74 | 14 | 7

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C3415	3E	CR3425	3E	Q3452	1D	R3481	3B	R3542	5A	R3597	2A
C3417	4E	CR3437	4F	Q3453	1D	R3482	3B	R3543	5B	R3598	2B
C3418	3E	CR3439	5F	Q3481	3B	R3483	4B	R3544	5B		
C3420	2E	CR3445	2E	Q3489	2D	R3484	4B	R3545	5E	U3420	2F
C3421	4E	CR3446	3E	Q3523	3B	R3485	4B	R3546	5D	U3426	2D
C3427	4E	CR3453	2D	Q3526	4B	R3486	5E	R3550	1C	U3427	3D
C3435	2E	CR3455	2D	Q3527	6E	R3487	2D	R3551	1D	U3457	5B
C3440	2E	CR3457	2D	Q3529	5F	R3488	3E	R3552	6B	U3459	4E
C3444	2E	CR3461	5E	Q3543	6B	R3489	3D	R3553	6B	U3462	5E
C3454	2E	CR3462	5F	Q3550	1D	R3501	1E	R3554	2B	U3485	4B
C3457	5B	CR3487	4E	Q3555	3B	R3502	1E	R3555	4B	U3486	4C
C3461	5E	CR3529	5E	Q3596	3B	R3503	4C	R3557	2A	U3502	4D
C3483	3A	CR3550	1D			R3504	3C	R3558	2A	U3503	4C
C3485	4C	CR3570	3D	R3401	2E	R3506	3B	R3559	2A	U3504	3C
C3486	4C	CR3571	3D	R3422	3E	R3507	3B	R3560	2A	U3510	1B
C3501	2E			R3423	3E	R3508	3B	R3563	2C	U3532	5E
C3502	4D	E3432	1E	R3427	4E	R3510	3A	R3564	3B	U3544	5C
C3503	4D			R3431	1E	R3511	2B	R3565	3B	U3546	5D
C3504	3D	J3401	4A	R3432	1E	R3512	2B	R3566	2B	U3551	5C
C3511	1B	J3402	4A	R3434	3D	R3513	2B	R3567	3B	U3557	1B
C3512	2B	J3432	1E	R3435	2D	R3516	3B	R3568	3B	U3563	2C
C3513	2B	J3596	1C	R3437	4F	R3517	3B	R3569	2C	U3564	3D
C3521	3A	J3599	1B	R3439	4F	R3518	3B	R3571	4E	U3576	1C
C3539	5F			R3440	2E	R3522	3A	R3576	2C		
C3544	5C	L3512	2B	R3441	3E	R3523	3A	R3577	2C	VR3485	5E
C3546	5F	L3577	2C	R3442	5E	R3524	3B	R3579	1C	VR3486	5E
C3551	5C			R3444	2E	R3525	4B	R3580	2C	VR3487	5E
C3559	2A	P3446	3E	R3446	3E	R3526	4B	R3586	6C		
C3563	2E	P3467	3F	R3450	2D	R3527	5F	R3588	5B		
C3564	3D	P3475	4F	R3451	2D	R3529	5E	R3589	5B		
C3576	2C	P3484	1E	R3452	1D	R3530	5E	R3590	5B		
C3577	2C			R3453	2D	R3535	5F	R3591	6B		
C3579	1C	Q3417	4E	R3454	1E	R3536	4E	R3592	5B		
C3597	2A	Q3431	1E	R3455	2D	R3537	5E	R3593	2C		
		Q3432	1E	R3457	1D	R3538	4E	R3596	2A		
CR3424	3E	Q3438	4F			R3539	5F				
		Q3451	1D								



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COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 11/14/85 Change Reference: M53385/M59099 (Add. 1)

Product: R7103 Oscilloscope Manual Part No.: 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

The following change applies to the A15 Readout circuit board assembly parts list given in Manual Change Information insert M53385/M59099 for instruments with serial number B040592 and above.

CHANGE TO:

A15	**670-8622-01**	CKT BOARD ASSY:READOUT

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MANUAL CHANGE INFORMATION

Date: 10/30/85 Change Reference: M56231

Product: R7103 Oscilloscope Manual Part No.: 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

These changes are effective at serial number B040595.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A24	**670-5959-04**	CKT BOARD ASSY:CONTROL RECTIFIER
A24C52	**285-1340-00**	**CAP.,FXD,MTLZD:0.01UF,10%,63V**
A24C66	**285-1340-00**	**CAP.,FXD,MTLZD:0.01UF,10%,63V**
A24C67	**290-0573-00**	**CAP.,FXD,ELCTLT:2.7UF,20%,50V**
A24C70	**285-1338-00**	**CAP.,FXD,MTLZD:1UF,10%,50V**
A24C71	**285-1338-00**	**CAP.,FXD,MTLZD:1UF,10%,50V**
A24C77	**283-0084-00**	**CAP.,FXD,CER DI:270PF,5%,100V**
A24C78	**283-0084-00**	**CAP.,FXD,CER DI:270PF,5%,100V**
A24P40	**258-0534-00**	**WIRE,NONELECTRIC:0.025 THK X 0.025 WIDE**
A24P48	**258-0534-00**	**WIRE,NONELECTRIC:0.025 THK X 0.025 WIDE**
A24P50	**258-0534-00**	**WIRE,NONELECTRIC:0.025 THK X 0.025 WIDE**
A24P52	**258-0534-00**	**WIRE,NONELECTRIC:0.025 THK X 0.025 WIDE**
A24P54	**258-0534-00**	**WIRE,NONELECTRIC:0.025 THK X 0.025 WIDE**
A24R93	**311-2273-00**	**RES.,VAR,NONWIR:2K OHM,20%,0.5W**
A24TP126	**258-0534-00**	**WIRE,NONELECTRIC:0.025 THK X 0.025 WIDE**

ADD:

A24C154	290-0898-01	CAP.,FXD,ELCTLT:2600UF,+75−10%,35V

REMOVE:

A23C154	290-0898-00	CAP.,FXD,ELCTLT:2600UF,+75−10%,35V

DIAGRAM CHANGES

14 **CONVERTER/RECTIFIERS**

Change C67 from 2.2μF to 2.7μF.

Change C77 and C78 from SEL to 270.

Change C154 from 2200μF to 2600μF.

Change R93 from 2.5k to 2k.

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MANUAL CHANGE INFORMATION

Date: 12/17/85 Change Reference: M58688

Product: R7103 Oscilloscope Manual Part No.: 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

These changes are effective at serial number B040639.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A25	670-5960-04	CKT BOARD ASSY:LOW VOLTAGE REGULATOR

ADD:

A25R122	315-0201-00	RES,FXD,FILM:200 OHM,5%,0.25W

DIAGRAM CHANGES

Figure 8-17. A25—Regulator Board assembly.

Add R122 just below Q122 (board location 1F).

Add R122 to the locator table for ASSEMBLY A25, with schematic location 3D and board location 1F.

15 Low-Voltage Regulators

Add 200Ω resistor R122 between the base and emitter of Q122 (schematic location 3D).

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MANUAL CHANGE INFORMATION

Date: 3/18/86 Change Reference: M60367

Product: R7103 Oscilloscope Manual Part No.: 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

These changes are effective at serial number B040666.

The following changes are associated with a previous change to the A15 Readout circuit board assembly at serial number B040592.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

If the components indicated for change cannot be found in the Replaceable Electrical Parts List section of your manual, check for related change information at the rear of the manual.

CHANGE TO:

A15	670-8622-02	CKT BOARD ASSY:READOUT
R3457	315-0621-00	RES.,FXD,FILM:620 OHM,5%,0.25W
R3550	315-0621-00	RES.,FXD,FILM:620 OHM,5%,0.25W
R3551	315-0472-00	RES.,FXD,FILM:4.7K OHM,5%,0.25W

ADD:

C3441	281-0767-00	CAP.,FXD,CER DI:330PF,20%,100V
C3559	281-0762-00	CAP.,FXD,CER DI:27PF,20%,100V
C3559	----- -----	(NOMINAL VALUE,SELECTED)
C3559	281-0808-00	CAP.,FXD,CER DI:7PF,20%,100V
C3559	----- -----	(C3559 SELECTABLE)
C3559	281-0811-00	CAP.,FXD,CER DI:10PF,10%,100V
C3559	----- -----	(C3559 SELECTABLE)
C3559	281-0797-00	CAP.,FXD,CER DI:15PF,10%,100V
C3559	----- -----	(C3559 SELECTABLE)
C3559	281-0759-00	CAP.,FXD,CER DI:22PF,10%,100V
C3559	----- -----	(C3559 SELECTABLE)
C3559	281-0819-00	CAP.,FXD,CER DI:33PF,5%,50V
C3559	----- -----	(C3559 SELECTABLE)
C3559	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V
C3559	----- -----	(C3559 SELECTABLE)
C3559	281-0798-00	CAP.,FXD,CER DI:51PF,1%,100V
C3559	----- -----	(C3559 SELECTABLE)
C3559	281-0799-00	CAP.,FXD,CER DI:62PF,2%,100V
C3559	----- -----	(C3559 SELECTABLE)
C3597	281-0762-00	CAP.,FXD,CER DI:27PF,20%,100V
C3597	----- -----	(NOMINAL VALUE,SELECTED)
C3597	281-0808-00	CAP.,FXD,CER DI:7PF,20%,100V
C3597	----- -----	(C3597 SELECTABLE)

Product R7103 Oscilloscope Date: 3/18/86 Change Reference M60367

DESCRIPTION

C3597	281-0811-00	CAP.,FXD,CER DI:10PF,10%,100V
C3597	----- -----	(C3597 SELECTABLE)
C3597	281-0797-00	CAP.,FXD,CER DI:15PF,10%,100V
C3597	----- -----	(C3597 SELECTABLE)
C3597	281-0759-00	CAP.,FXD,CER DI:22PF,10%,100V
C3597	----- -----	(C3597 SELECTABLE)
C3597	281-0819-00	CAP.,FXD,CER DI:33PF,5%,50V
C3597	----- -----	(C3597 SELECTABLE)
C3597	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V
C3597	----- -----	(C3597 SELECTABLE)
C3597	281-0798-00	CAP.,FXD,CER DI:51PF,1%,100V
C3597	----- -----	(C3597 SELECTABLE)
C3597	281-0799-00	CAP.,FXD,CER DI:62PF,2%,100V
C3597	----- -----	(C3597 SELECTABLE)

DIAGRAM CHANGES

If the diagrams indicated for change cannot be located in Section 8 of your manual, check for related change information at the rear of the manual.

Assembly A15 (SN B040592 & UP) & component locator

Figure 8-8A. A15—Readout System Board assembly (SN B040592 & Up).

Add C3441 across R3441 on the component locator diagram of Figure 8-8A.

READOUT SYSTEM (SN B040592 & UP) 6

Add 330 pF capacitor C3441 across resistor R3441.

Change R3457 and R3550 from 2.2k to 620.

Change R3551 from 20k to 4.7k.

Add **SEL** (selectable) as the value of C3559 and C3597.

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MANUAL CHANGE INFORMATION

Date: 5-1-86 **Change Reference:** M60732

Product: R7103 Oscilloscope **Manual Part No.:** 070-5039-00

DESCRIPTION Manual Insert for Product Group 42

These changes are effective at serial number B040664.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A15	670-8622-04	CIRCUIT BOARD ASSY:READOUT
C3487	281-0770-00	CAP,FXD,CER,DI:0.001μF,20%,100V

DIAGRAM CHANGES

READOUT SYSTEM B040592-UP ⟨6⟩

Add C3487 between ground and pin 13 of U3457D.

ASSEMBLY A15

Figure 8-8A. A15—Readout System Board assembly (SN B040592-Up).

Add C3487 at location C5 as shown in the following diagram.

Product R7103 Oscilloscope Date: 5-1-86 Change Reference M60732

DESCRIPTION