Tektronix®

455/A2/B2
PORTABLE OSCILLOSCOPE
WITH OPTIONS

INSTRUCTION MANUAL

Tektronix®
COMMITTED TO EXCELLENCE

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

455/A2/B2 PORTABLE OSCILLOSCOPE WITH OPTIONS

INSTRUCTION MANUAL

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

070-1907-01
Product Group 40

Serial Number _____

First Printing MAR 1975
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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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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

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

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.

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 Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. 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 Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

For detailed information on power cords and connectors, see Section 2, Operating Instructions.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

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

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

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.

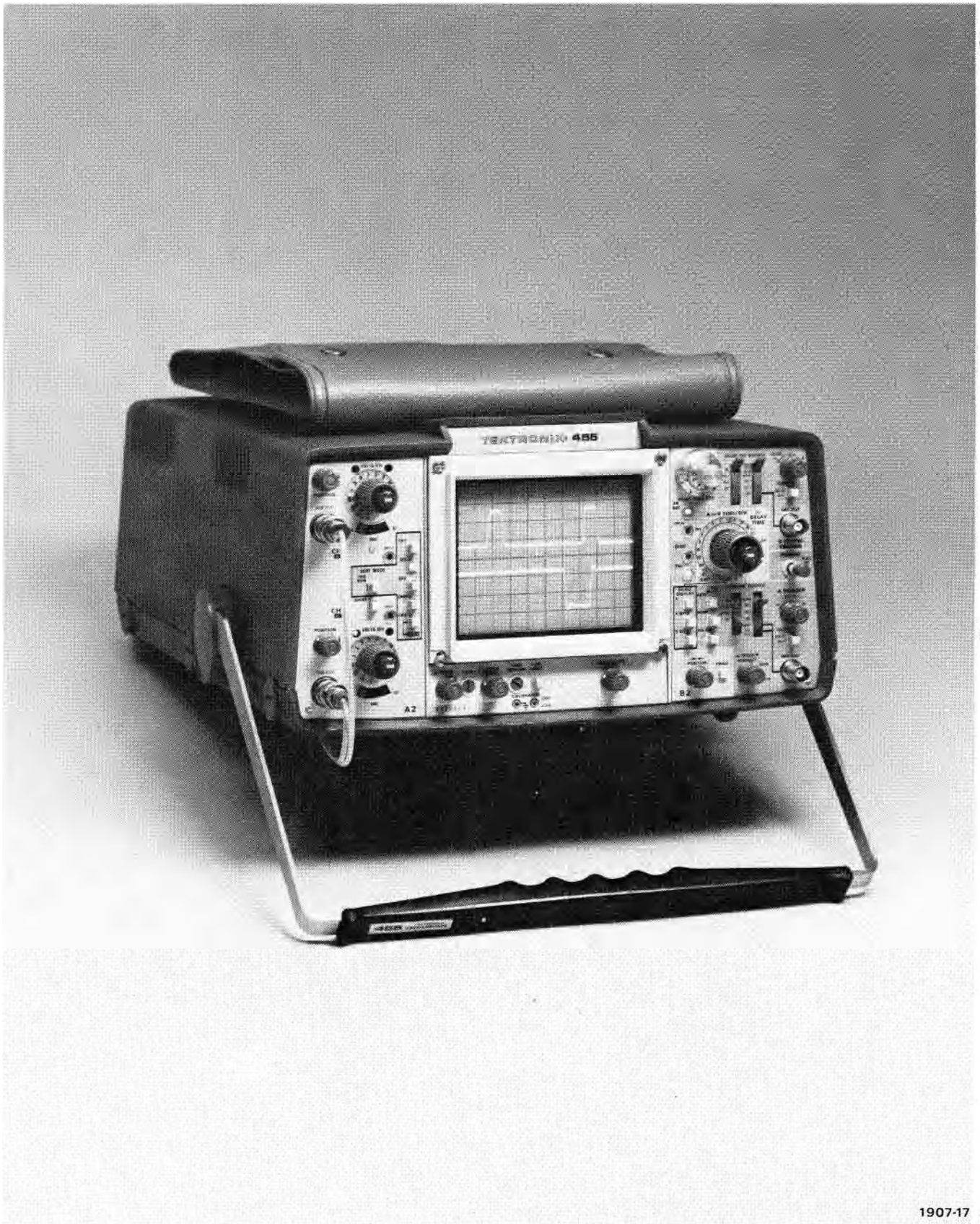
Use Care When Servicing With Power On

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 components.

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.



455/A2/B2 Portable Oscilloscope.

SPECIFICATIONS

The 455/A2/B2 is a 50 MHz, dual-channel, portable oscilloscope designed to operate in a wide range of environmental conditions.

The dual-channel dc to 50 MHz A2 vertical deflection system provides calibrated deflection factors from 5 millivolts to 5 volts/division.

The B2 horizontal deflection system provides stable triggering over the full bandwidth capabilities of the vertical system. Calibrated sweep rates are provided from 0.5 seconds to 0.05 microseconds/division along with delayed sweep features for accurate relative-time measurements. A X10 magnifier extends the calibrated sweep rate to 5 nanoseconds/division.

Standard 455 oscilloscopes can be operated from nominal 116 volt or 232 volt, 48 to 440 Hz power lines. With Option 7, the 455 can be operated from 12 or 24 volt dc power sources (or the snap-on Tektronix 1106 Battery Pack). Option 7 Specifications are located in the Options section of this manual.

The Electrical Characteristics are divided into two categories: Characteristics shown in the Performance Requirement column are instrument specifications and can be verified by the Performance Check. Information in the Supplemental Information column is provided for reference or clarification only.

The following instrument specifications apply over an ambient temperature range of −15°C to +55°C unless otherwise indicated. The adjustment procedure in Section 6, when performed completely, allows the 455/A2/B2 to meet the electrical specifications listed below.

TABLE 1-1
Electrical (455 Main Module)

Characteristic	Performance Requirement	Supplemental Information
CALIBRATOR		
Output Voltage		
0°C to +40°C	0.3 V within 1.0%.	Within 0.3% at +25°C, within 3°C.
−15°C to +55°C		0.3 V within 1.5%.
Repetition Rate	Approximately 1 kHz.	Within 25%.
Output Resistance		Approximately 60 Ω.
Z AXIS INPUT		
Sensitivity	Noticeable modulation at normal intensity with 0.5 V or more p-p signal.	
Usable frequency Range	Dc to 20 MHz.	
Input Resistance at DC	1.6 kΩ.	
Maximum Input Voltage	25 V (dc plus peak ac). 25 V p-p ac at 1 kHz or less.	
SIGNAL OUTPUTS		
CH 2 OUT		See Vertical Module Specifications.

TABLE 1-1 (continued)
Electrical (455 Main Module)

Characteristics	Performance Requirement	Supplemental Information
SIGNAL OUTPUTS (continued)		
A Gate		
Output Voltage	Approximately 5.0 V positive-going pulse.	
Output Resistance	Approximately 500 Ω.	
POWER SOURCE		
Line Voltage Ranges		
116 V	100 V to 132 V rms.	
232 V	200 V to 264 V rms.	
Line Frequency	48 Hz to 440 Hz.	
Maximum Power Consumption (455/A2/B2)	40 watts at 115 V, 60 Hz.	**NOTE** *With A2 and B2 Modules typical power consumption is about 32 watts.*
CRT DISPLAY		
Horizontal Resolution		At least 15 lines in 1 div.
Vertical Resolution		At least 15 lines in 1 div.
Display Area	8 x 10 cm.	
Geometry		0.1 div or less.
Trace Rotation Range		Adequate to align trace with horizontal center line.
Standard Phosphor	P31.	
Optional Phosphor	P11.	
Raster Distortion		0.1 div or less.
Nominal Accelerating Potential		≈12,000 V.

TABLE 1-2
Environmental

Characteristic	Performance Requirement
Temperature	
Storage	–55°C to +75°C.
Operating	–15°C to +55°C.
Altitude	
Storage	To 50,000 ft.
Operating	To 15,000 ft. Maximum operating temperature decreased 1°C/1,000 ft. above 5,000 ft.
Humidity (Operating and Storage)	5 cycles (120 hrs.) referenced to MIL-E-16400F.
Vibration (Operating)	15 min. along each of 3 major axes at a total displacement of 0.025 inch p-p (4 g's at 55 Hz) with frequency varied from 10 Hz to 55 Hz to 10 Hz in 1 min. sweeps. Hold 3 min. at each major resonance or if none present, hold 3 min. at 55 Hz.
Shock (Operating and Non-Operating)	30 g's, ½ sine, 11 ms duration, 2 shocks per axis each direction for a total of 12 shocks.

TABLE 1-3
Physical

Characteristic	Information
Weight	
455/A2/B2 with Panel Cover, Modules, Accessories and Accessory Pouch	27.0 lbs (12.2 kg).
Without Panel Cover, Accessories, and Accessory Pouch	24.0 lbs (10.9 kg).
Domestic Shipping Weight	34.2 lbs (15.5 kg).
Height	
With Feet and Pouch	9.00 in. (22.86 cm).
Without Pouch	7.00 in (17.78 cm).

TABLE 1-3 (continued)
Physical

Characteristic	Information
Width	
With Handle	13.65 in. (34.67 cm).
Without Handle	12.50 in. (31.75 cm).
Depth	
Including Panel Cover	19.50 in. (49.53 cm).
Handle Extended	21.70 in. (55.19 cm).
Transportation	Meets the limits of National Safe Transit Committee Test Procedure 1A with a 30-inch drop.
Construction	Plastic alloy cabinet, alluminum alloy chassis and panel, with glass laminate etched wiring circuit boards.
Finish	Anodized front panel and textured cabinet.

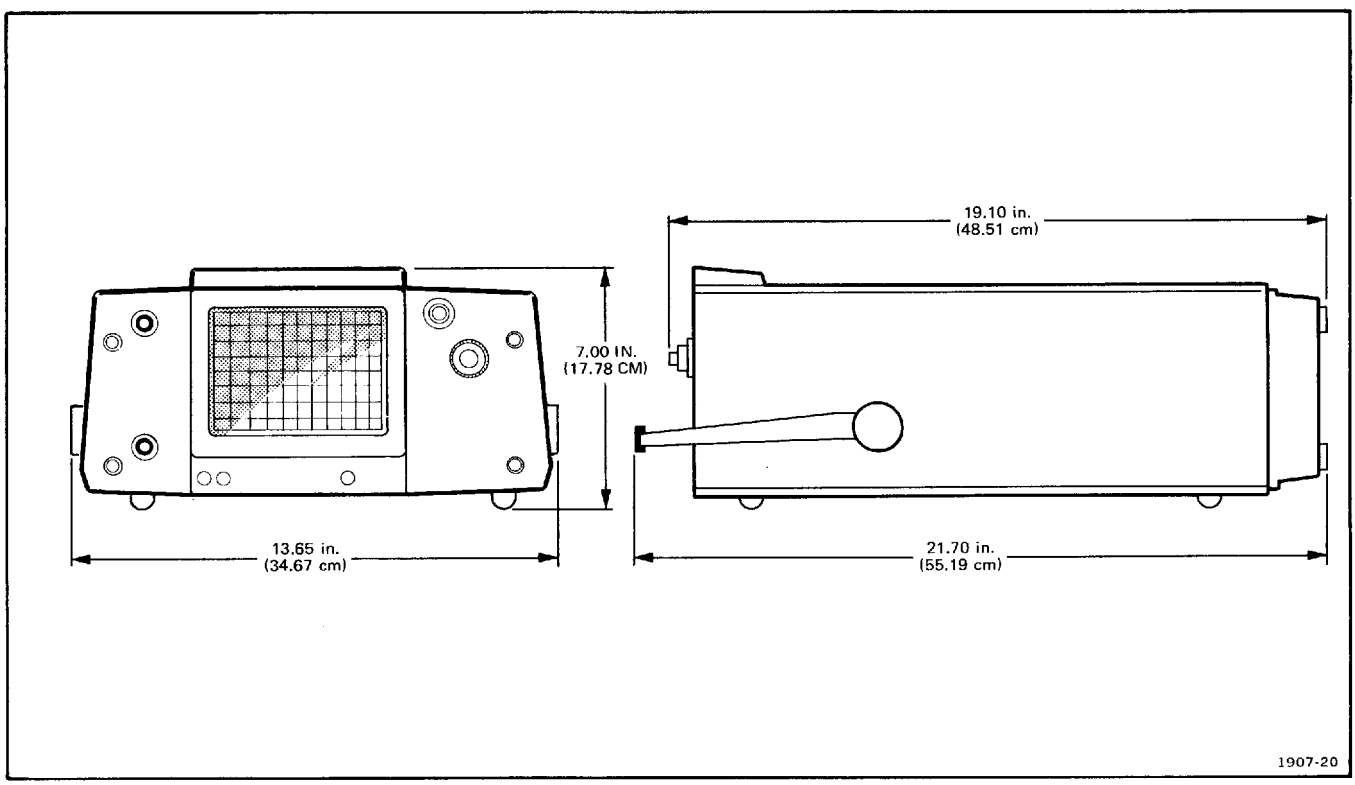


Fig. 1-1. Dimensional drawing.

TABLE 1-4
Electrical (A2 Vertical Module)

Characteristic	Performance Requirement	Supplemental Information
Deflection Factor		
Calibrated Range	5 mV to 5 V/DIV in 10 steps: 1-2-5 sequence.	
Uncalibrated (VAR) Range	Provides continuously variable deflection factors between calibrated settings. Extends deflection factor to at least 12.5 V/DIV.	At least 2.5:1.
Accuracy	Within 3%	With GAIN set at 5 mV/DIV.
Low-Frequency Linearity		0.1 div or less compression of a 2 division signal at center screen when positioned to the upper and lower extremes of the graticule area.
Frequency Response		
Bandwidth (CH 1 & CH 2)		5-div reference signal centered vertically from 25 Ω source with VAR V/DIV in calibrated position.
5 mV to 2 V/DIV	DC to at least 50 MHz.	
5 V/DIV	DC to at least 45 MHz.	
AC Coupled Lower −3 dB Point	10 Hz or less with a 1X probe. 1 Hz or less with a 10X probe.	
Step Response		5-div reference centered vertically dc coupled at all deflection factors from a 25 Ω source with VAR V/DIV control in calibrated position.
Risetime (0.35 ÷ bw in MHz) −15°C to +55°C		
5 mV to 2 V/DIV	7.0 nanoseconds or less	
5 V/DIV	7.8 nanoseconds or less	
Positive—Going Step (excluding ADD Mode)		
Aberrations 0°C to +40°C		
5 mV to 1 V/DIV		Less than +3%, −3%, 3% p-p.
2 V/DIV		Less than +5%, −5%, 5% p-p.
5 V/DIV		Less than +10%, −10%, 10% p-p.
−15°C to +55°C		
5 mV to 1 V/DIV		Less than +6%, −6%, 6% p-p.
2 V/DIV		Less than +8%, −8%, 8% p-p.
5 V/DIV		Less than +13%, −13%, 13% p-p.
Position Effect 0°C to +40°C		Total aberration less than +5%, −5%, 5% p-p.
Negative Going Step		Add 2% to all positive going step specifications.
ADD Mode Operation		Add 5% to all aberrations specifications.
CH 2 Inverted		Equal to or less than 3% in addition to the non-inverted aberrations.

TABLE 1-4 (continued)
Electrical (A2 Vertical Module)

Characteristic	Performance Requirement	Supplemental Information
Common-Mode Rejection Ratio (ADD Mode with CH 2 Inverted)		At least 10:1 at 10 MHz for common mode signals of 6 div or less with GAIN adjusted for best CMRR at 50 kHz.
Step Atten Balance +20°C to +30°C		0.2 div or less.
Trace Shift as VAR is rotated		2.0 div or less.
INVERT Trace Shift		Less than 2 div when switching from normal to inverted.
Input Gate Current −15°C to +30°C		0.5 nA or less (0.1 div at 5 mV/div).
+30°C to +55°C		4.0 nA or less (0.8 div at 5 mV/div).
Channel Isolation		At least 100:1 at 20 MHz.
Position Range		At least +12 and −12 div from graticule center.
Chopped Mode Repetition Rate	Approximately 250 kHz.	250 kHz within 20%.
Input Resistance and Capacitance	1 MΩ within 2% paralleled by approximately 20 pF within 3%.	Aberrations 2% or less using a 1 MΩ, 20 pF input time constant normalizer (+20°C to +30°C).
Maximum Input Voltage		
DC Coupled	250 V (dc + Peak ac) or 500 V p-p ac at 1 kHz or less.	
AC Coupled	250 V (dc + Peak ac) or 500 V p-p ac at 1 kHz or less.	
Cascaded Operation (CH 2 OUT into CH 1)		CH 2 OUT into CH 1 input using 50 Ω 42" cable terminated in 50 Ω at CH 1 input.
Bandwidth	DC to at least 20 MHz.	
Cascaded Sensitivity	Approximately 1 mV/div when terminated in 50 Ω at CH 1 input with both CH 1 and CH 2 VOLTS/DIV switches set at 5 mV/div.	Within −30%, +30%.
Channel 2 Signal Output (Through Main Module CH 2 OUT Connector)		
Output Voltage	Approximately 50 mV/div into 1 MΩ. Approximately 25 mV/div into 50 Ω.	
Output Resistance	Approximately 50 Ω.	
Bandwidth	DC to at least 20 MHz into 50 Ω.	
DC Level	Approximately 0 V.	

TABLE 1-5
Electrical (B2 Horizontal Module)

Characteristic	Performance Requirement	Supplemental Information
TRIGGERING		
Sensitivity	(See Fig. 1-2)	In EXT ÷ 10, multiply requirements by 10.
AC Coupled	0.4 div internal or 50 mV external from 60 Hz to 10 MHz increasing to 1.5 div internal or 250 mV external at 50 MHz.	
LF REJ Coupled	0.4 div internal or 100 mV external from 50 kHz to 10 MHz (increasing to 1.5 div internal or 250 mV external at 50 MHz. Attenuates signals below about 50 kHz.	
HF REJ Coupled	0.4 div internal or 100 mV external from 60 Hz to 50 kHz. Attenuates signals below about 60 Hz and above about 50 kHz.	
DC Coupled	0.4 div internal or 50 mV external from dc to 10 MHz increasing to 1.5 div internal or 250 mV external at 50 MHz.	
Trigger Jitter (At 50 MHz and 5 ns/div)		
0°C to +40°C	0.5 ns or less.	
−15°C to +55°C	1.0 ns or less.	

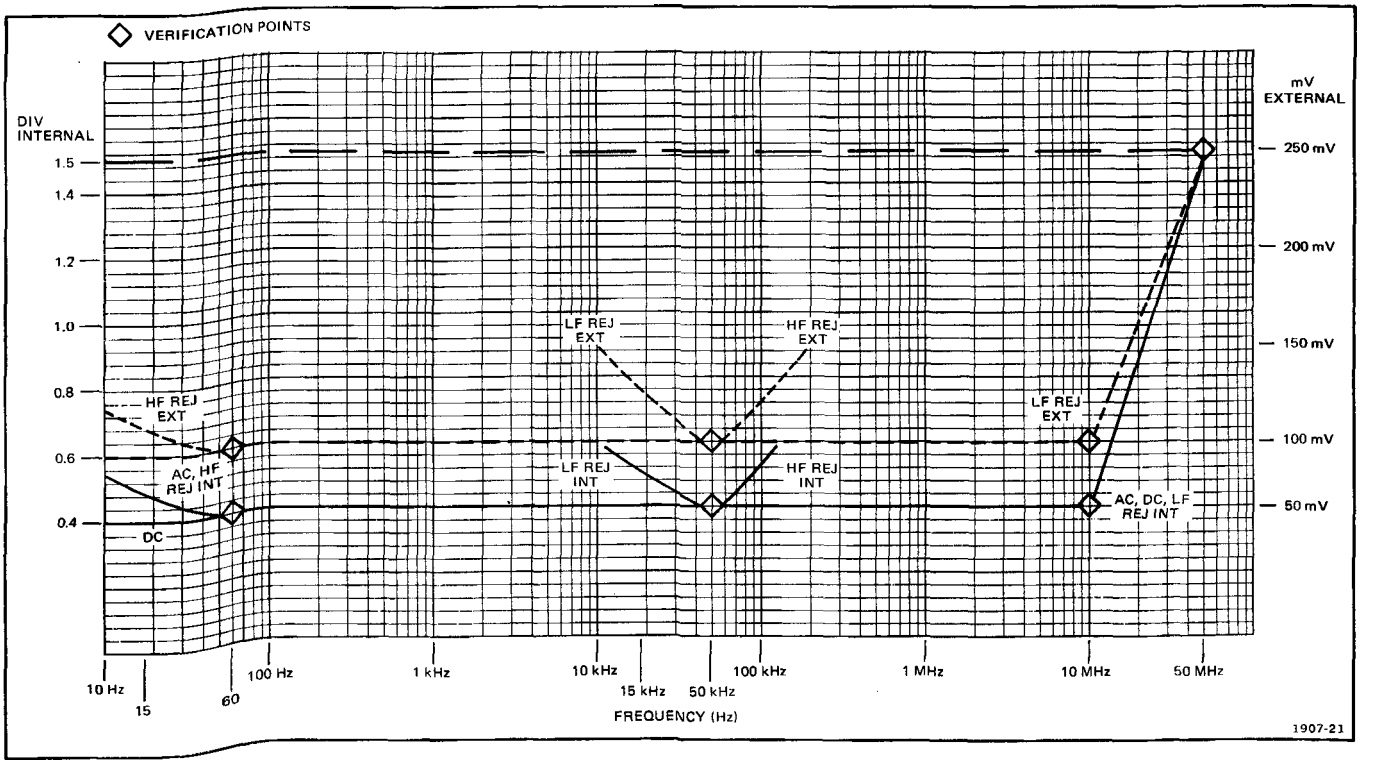


Fig. 1-2. Trigger coupling and sensitivity.

TABLE 1-5 (continued)
Electrical (B2 Horizontal Module)

Characteristics	Performance Requirement		Supplemental Information
TRIGGERING (cont.)			
External Trigger Input			
Maximum Input Voltage	250 V DC + peak ac or 250 V p-p ac (1 kHz or less).		
Input Resistance	1 MΩ within 10%.		
Input Capacitance			20 pF within 30%.
Level Control Range			
EXT	At least + and −2 V, 4 V p-p.		
EXT ÷ 10	At least + and −20 V, 40 V p-p.		
Trigger View			
Deflection Factor			
EXT	≈ 50 mV/div.		±20%, ac or dc trigger coupling only.
EXT ÷ 10	≈ 500 mV/div.		±20%, ac or dc trigger coupling only.
Risetime			⩽ 14 ns.
Delay Difference	⩽ 7.5 ns		With 5 div signal 5 ns risetime or less from a 50 Ω generator centered vertically with equal cable length from signal source to vertical channel and external trigger input, terminated in 50 Ω at each input.
Centering of Triggering Point			Within 1.0 div of center screen.
HORIZONTAL DEFLECTION SYSTEM			
Calibrated Sweep Range			
A Sweep	0.5 s/div to 0.05 μs/div in 22 steps in a 1-2-5 sequence. X10 MAG extends maximum sweep rate to 5 ns/div.		
B Sweep	50 ms/div to 0.05 μs/div in 19 steps in a 1-2-5 sequence. X10 MAG extends maximum sweep rate to 5 ns/div.		
Calibrated Sweep Accuracy	Unmagnified X1	Magnified (1) X10	Accuracy specification applies over the full 10 divisions.
+20°C to +30°C	±2%	±3%	(1) Exclude the first and last 40 ns of the sweep on 5 ns, 10 ns and 20 ns sweep rates.
−15°C to +55°C	±3%	±4%	(2) ±5%. Excludes first and last displayed divisions when checking 5 ns/div and 10 ns/div (X10 MAG on).
Over any two division portion of Full 10 Divisions (1) (2)			

TABLE 1-5 (continued)
Electrical (B2 Horizontal Module)

Characteristics	Performance Requirement		Supplemental Information
HORIZONTAL DEFLECTION SYSTEM (cont.)			
Variable Range (A only)	2.5 to 1 continuously variable between calibrated settings. Extends slowest A Sweep rate to at least 1.25 s/div.		At least 2.5:1.
Sweep Length (A only)			10.5 to 11.5 div.
Trigger Holdoff Variable	Increases A Sweep holdoff time to at least 10X the TIME/DIV switch setting, execpt at .2 s and .5 s.		
Magnifier Registration			Within 0.5 div from graticule center (MAG on to MAG off)
Position Range			Start of sweep must position to the right of graticule center. End of sweep must position to the left of graticule center. TIME/DIV switch at 1.0 ms/div.
Differential Time Measurement			
Accuracy	(See Fig. 1-3 on next page)		With the A TIME/DIV switch at .5 μs/div or .2 μs/div, the differential time measurement accuracy limit is valid only for DELAY-TIME POSITION dial setting between 1.50 and 8.50.
	For Measurements of One or More Major Dial Divisions	For Measurements of Less Than One Major Dial Division	
+15°C to +35°C	±1.5%	±0.015 Major Dial Division	Exclude delayed operation when knobs are locked at any sweep speed or when A TIME/DIV switch is at .1 μs/div or .05 μs/div.
−15°C to +55°C	±2.5%	±0.025	
Delay Time Jitter	One part or less in 20,000. (0.005%) of ten times the A TIME/DIV switch setting.		
Calibrated Delay Time (VAR Control to CAL)	Continuous from 0.1 μs to at least 5 seconds after the start of the delaying (A) sweep.		

TABLE 1-5 (continued)
Electrical (B2 Horizontal Module)

Characteristics	Performance Requirement	Supplemental Information
X-Y OPERATION		
X-Y Operation		Extreme counterclockwise position of TIME/DIV switch. CH 2 or X-Y button of VERT MODE switch must be pushed.
Sensitivity	Same as vertical system with X10 MAG turned off.	
Variable Range	Same as vertical system.	
X-Axis Bandwidth	DC to at least 3 MHz.	10 division reference signal.
Input Resistance	Same as vertical system.	
Input Capacitance	Same as vertical system.	
Maximum Useable Input Voltage Phase Difference Between X and Y Axis Amplifiers	Same as vertical system.	Within 3° from dc to 50 kHz.
Deflection Accuracy	Within 4% in CAL position.	
X-Axis Linearity		0.2 div or less compression or expansion when 2 div X-axis signal at center screen is positioned to right or left extreme of graticule area.

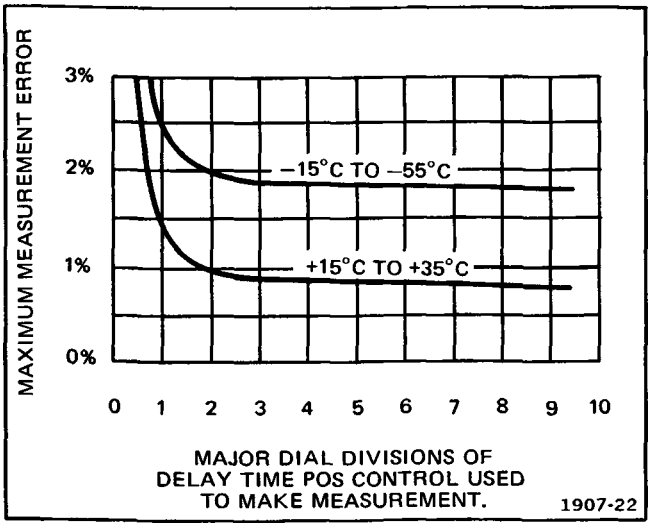


Fig. 1-3. Differential Time Measurement accuracy.

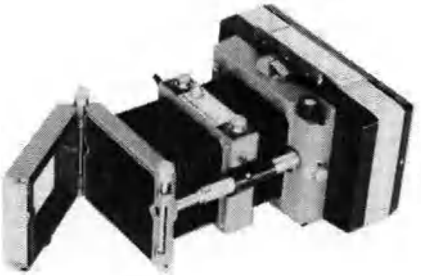
RECOMMENDED ACCESSORIES

The following accessories have been selected from our catalog specifically for your instrument. They are listed as a convenience to help you meet your measurement needs. For detailed information and prices, refer to a Tektronix Products Catalog or contact your local Tektronix Field Representative.

CAMERA

C-30A (Option 1) Compact Camera f1.9 lens; 0.8 magnification, Polaroid Land Pack film back for 3000 speed film (includes Adapter Frame/Corrector Lens, 016-0301-01).

Order. . . . . C-30A-P Option 1



PROTECTIVE COVER

Waterproof, blue vinyl.

Order. 016-0344-00

VIEWING HOODS

Folding polarized Viewing Hood.

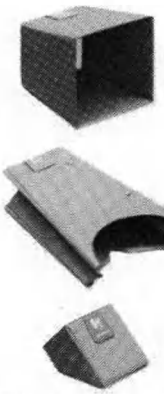
Order. 016-0180-00

Folding Viewing Hood, binocular.

Order. 016-0566-00

Folding Viewing Hood, light-shielding.

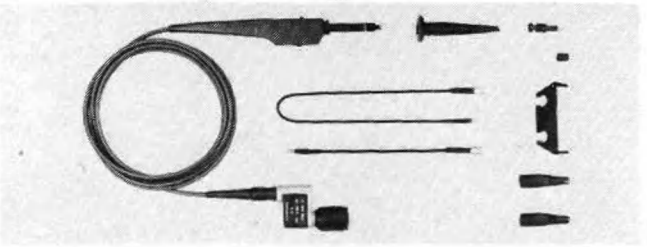
Order. 016-0592-00



PROBES

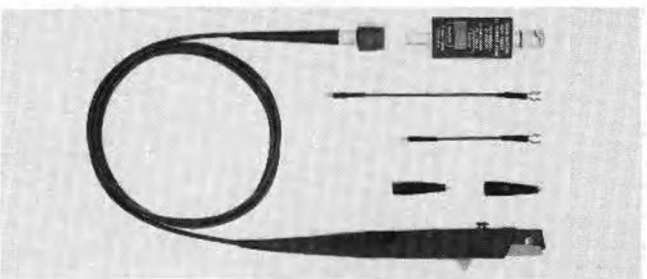
P6062A 1X or 10X Probe Package. Provides dc to 15 MHz in 1X position or dc to 50 MHz in 10X position.

Order. 010-6062-13



P6021 Current Probe with Passive Termination. Provides 120 Hz to 39 MHz bandwidth.

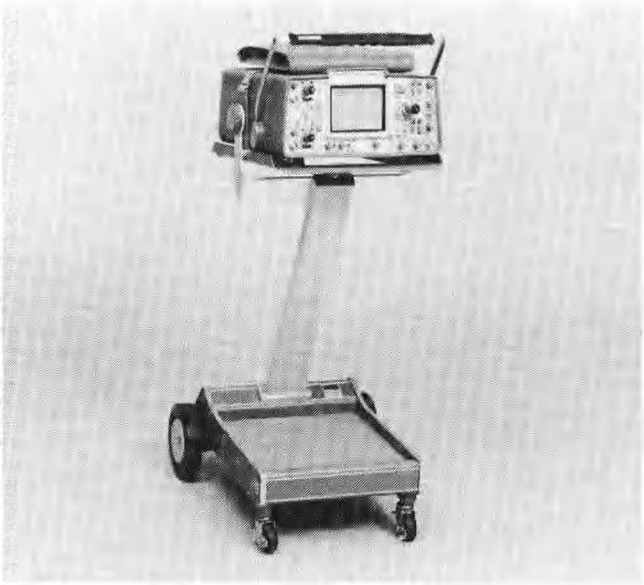
Order. 015-0140-02



SCOPE-MOBILE® CART

Occupies less than 18 inches aisle space; has storage area in base.

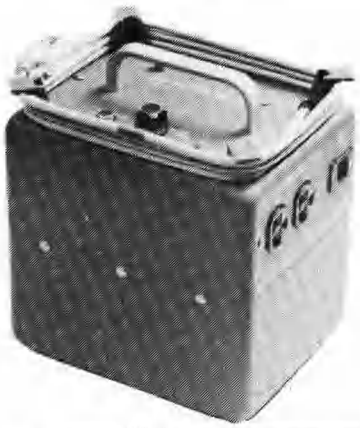
Order 200-C



1105 BATTERY POWER SUPPLY

Portable power supply suitable for powering portable oscilloscopes or other instruments in the field.

Order . . . . . 1105 Battery Power Supply



1106 BATTERY PACK

A convenient, snap-on battery power supply for operating the 455 Option 7 oscilloscopes.

Order . . . . . 1106 Battery Pack

MESH FILTER

Improves Display Contrast.

Order 378-0726-01

OPERATING INSTRUCTIONS

OPERATING VOLTAGE

This instrument operates from either a 116 volt or 232 volt nominal ac line-voltage source, 48 to 440 Hz. The line-voltage selector switch at the rear of the instrument must indicate the applied line voltage (116 V or 232 V).

CAUTION

The instrument can be damaged if operated on 232 volt nominal line-voltage source when the line-voltage selector is set at 116 V.

To convert from one line voltage range to the other, move the line-voltage selector switch, located on the rear of the instrument, to indicate the correct nominal line voltage. Change the fuse to the correct value; 1.0 amp, fast blow for 116 volt operation and 0.5 amp, fast blow for 232 volt operation.

This instrument has a 3-wire cord with a 3-terminal polarized plug for connection to the power source and safety-earth. The ground terminal of the plug is directly connected to the metal parts of the instrument. For electric-shock protection, insert this plug in a mating outlet with a safety-earth contact. If a 3-to-2 wire adapter is used to connect this instrument to a 2-wire ac power system, be sure to connect the ground lead of the adapter to earth (ground). Failure to complete the ground system may allow the metal parts of this instrument to be elevated above ground potential and create a shock hazard.

Power Cord Conductor Identification

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

SAFETY INFORMATION

This instrument is designed to operate from a single-phase power source with one of the current-carrying conductors (the neutral conductor) at ground (earth) potential. Operation from power sources where both current-carrying conductor has over-current (fuse) protection within the instrument.

INSTRUMENT COOLING

To maintain adequate instrument cooling, the ventilation holes in the equipment cabinet must remain open, and the air filter must be cleaned or replaced when it gets dirty.

FUNCTIONS OF CONTROLS, CONNECTORS AND INDICATORS

455 MAIN MODULE

Front Panel (Fig. 2-1)

1 **INTERNAL GRATICULE**—Eliminates parallax. Rise-time amplitude and measurement points are indicated at the left edge of the graticule.

2 **INTEN**—Controls the brightness of the crt display.

3 **ASTIG**—A screwdriver adjustment used in conjunction with the FOCUS control to obtain a well-defined display. Requires little or no adjustment once set.

4 **FOCUS**—Adjusts for optimum display definition.

5 **TRACE ROTATION**—Aligns trace with horizontal graticule lines.

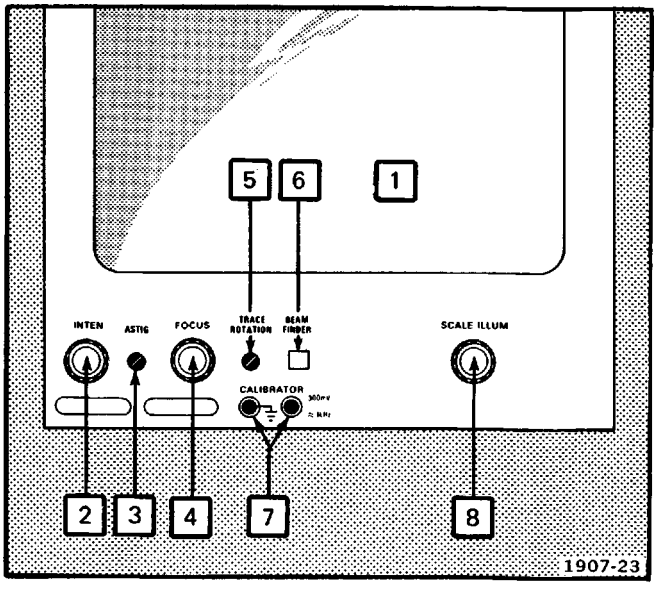


Fig. 2-1. 455 Main Module (front).

6 **BEAM FINDER**—Used to locate an off-screen display. When pushed, a compressed display is visible within the graticule area independent of display position intensity setting, or applied signals.

To locate an off-screen display, use the following procedure:

1. Set the vertical POSITION control and the INTENSITY control to midrange and rotate the horizontal POSITION control clockwise.

2. If a display or dot still is not visible, press the BEAM FINDER button and hold it in. This causes a compressed display or dot to appear.

a. The appearance of a dot indicates inadequate triggering. Set the TRIG MODE switch to AUTO to obtain a reference display. Center the reference display with the vertical and horizontal POSITION controls. Release the BEAM FINDER button and adjust the trigger controls for a stable display.

b. If a compressed display appears, adjust the VOLTS/DIV switch and the horizontal and vertical POSITION controls to center the display. Release the BEAM FINDER button and adjust the trigger controls for a stable display.

7 **CALIBRATOR**—Provides a 300 mV, approximately 1 kHz, square-wave output for compensating voltage probes and checking vertical gain. The CALIBRATOR output is not intended for verifying timing accuracy.

NOTE

The CALIBRATOR output can also be used to calibrate current probes by attaching a current loop to the output terminals. To make a plug-in current loop, order Tektronix Part 012-0259-00 and modify it by replacing the 50 Ω resistor (inside) with a bare wire. A current loop also can be made from 5 turns of insulated wire.

8 **SCALE ILLUM**—Controls graticule illumination.

Rear Panel (Fig. 2-2)

9 **FUSE HOLDER**—Houses the line fuse; 1.0 amp, fast blow for 116 volt operation or 0.5 amp, fast blow for 232 volt operation.

10 **CHASSIS GROUND JACK**—Provides chassis (earth) ground point. Accepts the plug tip with binding post accessory (Tektronix Part 134-0016-01).

11 **CH 2 OUT**—Provides an output sample of the signal connected to the CH 2 vertical input. The output amplitude of this signal is normally about 50 mV/division of crt display. It can be used to increase the vertical sensitivity in cascaded operation, trigger external equipment, etc.

12 **+ GATE OUT**—Provides a positive-going, rectangular pulse coincident with the A or B sweep. A shorting plug, P2800 (located near U2740 on the sweep board) can be moved to select A gate or B gate.

13 **EXT Z AXIS IN**—Permits intensity modulation of the crt display. Does not affect display waveshape. Signals must be time-related to the display for a stable display. Useful for uncalibrated modes of operation and adding time markers.

14 **LINE-VOLTAGE SELECTOR**—Selects either 116 volt or 232 volt nominal line voltage.

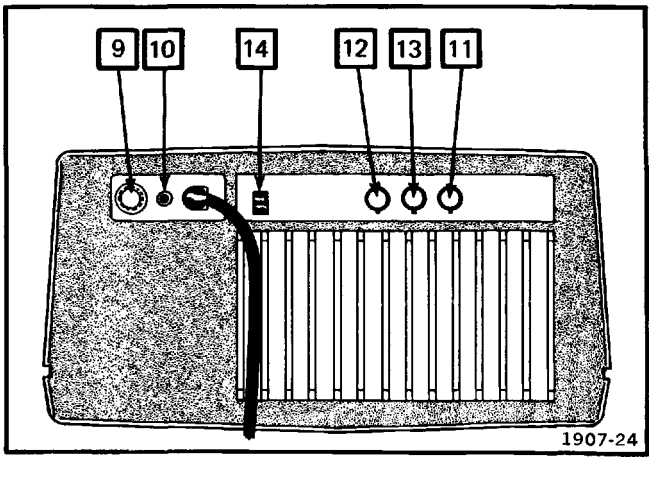


Fig. 2-2. 455 Main Module (rear).

A2 VERTICAL MODULE (FIG. 2-3)

15 **CH 1 or X and CH 2 or Y**—Input connectors for application of external signals to the inputs of the vertical amplifier. Included on each input connector is a coding ring for 10X Probes with scale-factor switching. In the X-Y mode, the signal connected to the CH 1 or X connector provides horizontal deflection and the signal connected to the CH 2 or Y connector provides vertical deflection.

16 **POSITION**—Positions the display vertically. In the X-Y mode of operation, the CH 1 POSITION control positions the display on the X-axis (horizontally) and the CH 2 POSITION control positions the display on the Y-axis (vertically).

17 **Deflection Factor Indicator**—Two small light-emitting diodes (LED) located above the skirt of each VOLTS/DIV knob. Only one LED at a time lights up to indicate the correct deflection factor. Use of a 1X probe, or no probe, causes the left LED to light up. Use of a 10X probe, with a scale-factor switching connector, causes the right LED to light up.

NOTE

Use of a 10X probe, without a scale-factor switching connector, causes the left LED to light up and indicate the wrong deflection factor. In this case, read the correct deflection factor adjacent to the dark LED.

18 **CH 1 and CH 2 VOLTS/DIV**—Selects the deflection factor in a 1-2-5 sequence (VAR control must be in the detent position to obtain indicated deflection factors).

19 **VAR**—Provides continuously variable uncalibrated deflection factors between the calibrated steps of the VOLTS/DIV switches. Extends the maximum deflection factor to 12.5 volts per division in the 5 V position of the VOLTS/DIV switch (125 volts per division when using a 10X probe). The VAR control must be in the detent position for calibrated deflection factors.

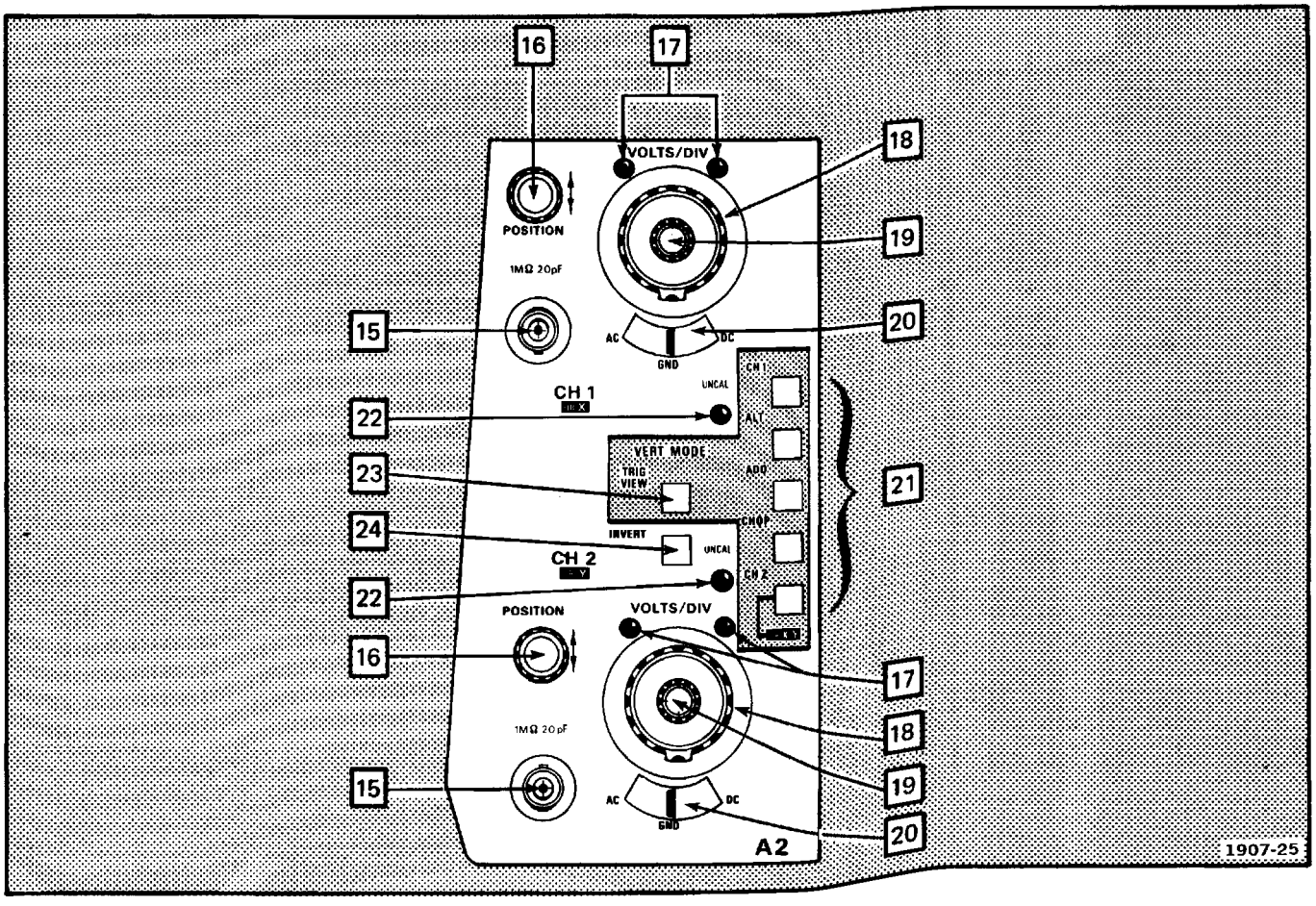


Fig. 2-3. A2 Vertical Module.

20 **AC-GND-DC**—Selects the method for coupling the input signal to the vertical input amplifier.

AC: Signals are coupled capacitively. Any dc signal component is blocked. Low frequencies are attenuated (3 db down—0.707 X input amplitude at about 10 Hz directly or 1 Hz using a 10X probe). Ac coupling causes tilting of square wave below about 1 kHz.

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

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

21 **VERT MODE**—Selects the vertical amplifier operating mode.

CH 1: Displays only signals applied to the CH 1 input connector.

CH 2 (or X-Y): Displays only signal applied to the CH 2 input connector. This button must be depressed for X-Y operation.

ALT (Alternate): The display switches between the signals applied to the CH 1 and the CH 2 input connectors. This switching occurs at the end of each sweep during retrace. This mode is useful for viewing both input signals at sweep rates of 0.5 ms/div or faster. At sweep rates slower than 0.5 ms/div, the display flickers. Use the CHOP mode at slower sweep rates.

To obtain the best triggering results for non time-related signals, set trigger coupling to low-frequency reject, trigger source to normal, and carefully adjust the trigger level. For time-related signals, set trigger coupling to low-frequency reject and trigger source to channel 1.

CHOP: The display switches between the signals applied to the CH 1 and the CH 2 input connectors. This switching occurs at a fixed rate of about 250 kHz. This mode is useful for viewing both input

signals at sweep rates slower than 0.5 ms/di
sweep rates of 0.5 ms/div or faster, the chop
ments become visible. Use the alternate mod
faster sweep rates.

Do not use normal triggering because the display triggers o
the chopping transients. To obtain the best triggering results, set trigger source to channel 1 and trigger coupling to high-frequency reject. If the input signals are not time related, the channel 2 display will be unstable, and alternate (ALT) mode should be used.

ADD: Displays the algebraic sum of the signals applied to the CH 1 and CH 2 input connectors.

NOTE

When using the Add mode, keep both vertical position controls as near midrange as possible.

The channel 2 INVERT switch allows display of channel 1 plus channel 2 (INVERT button-out) or channel 1 minus channel 2 (INVERT button-in). The channel 1 minus channel 2 mode is useful for common mode rejection or dc offset measurements.

22 ***UNCAL Lamps***—*Light up to indicate uncalibrated deflection factors when the VAR controls are moved out of their detent positions.*

23 ***TRIG VIEW***—*This switch, when pressed, causes a sample of the signal present in the A Trigger Amplifier to be displayed on the crt. Particularly useful for viewing external triggers.*

24 ***INVERT***—*This switch, when set to the in position, inverts the channel 2 display.*

B2 HORIZONTAL MODULE (FIG. 2-4)

25 **DELAY TIME POS**—Provides variable sweep delay from 0.00 to 10.00 times the delay time indicated by the A TIME/DIV switch.

26 **X10 MAG Indicator**—Lights when the X10 magnifier is on.

27 **UNCAL Indicator**—Lights when the A Sweep rate is uncalibrated (VAR control out of the calibrated detent).

28 **READY Indicator**—When in the single-sweep mode, this indicator lights when the A Sweep is reset. Upon receipt of an adequate trigger signal, a single-sweep display is presented. If the indicator is not lit when operating in the single-sweep mode, single-sweep displays will not be presented until the SGL SWP button is pushed to reset the sweep.

29 **TRIG Indicator**—Lights to indicate that the A Sweep is triggered and will produce a stable display. Useful for setting up the A Trigger circuit when a trigger signal is available without a display on the crt (for example, when using external or line triggers).

NOTE

When the TRIG MODE switch is set to AUTO and the TRIG light blinks, a stable display may be difficult to obtain. This may occur when using low-frequency or low-repetition-rate trigger signals. For better triggering results, set the TRIG MODE switch to NORM and readjust the A LEVEL control if necessary.

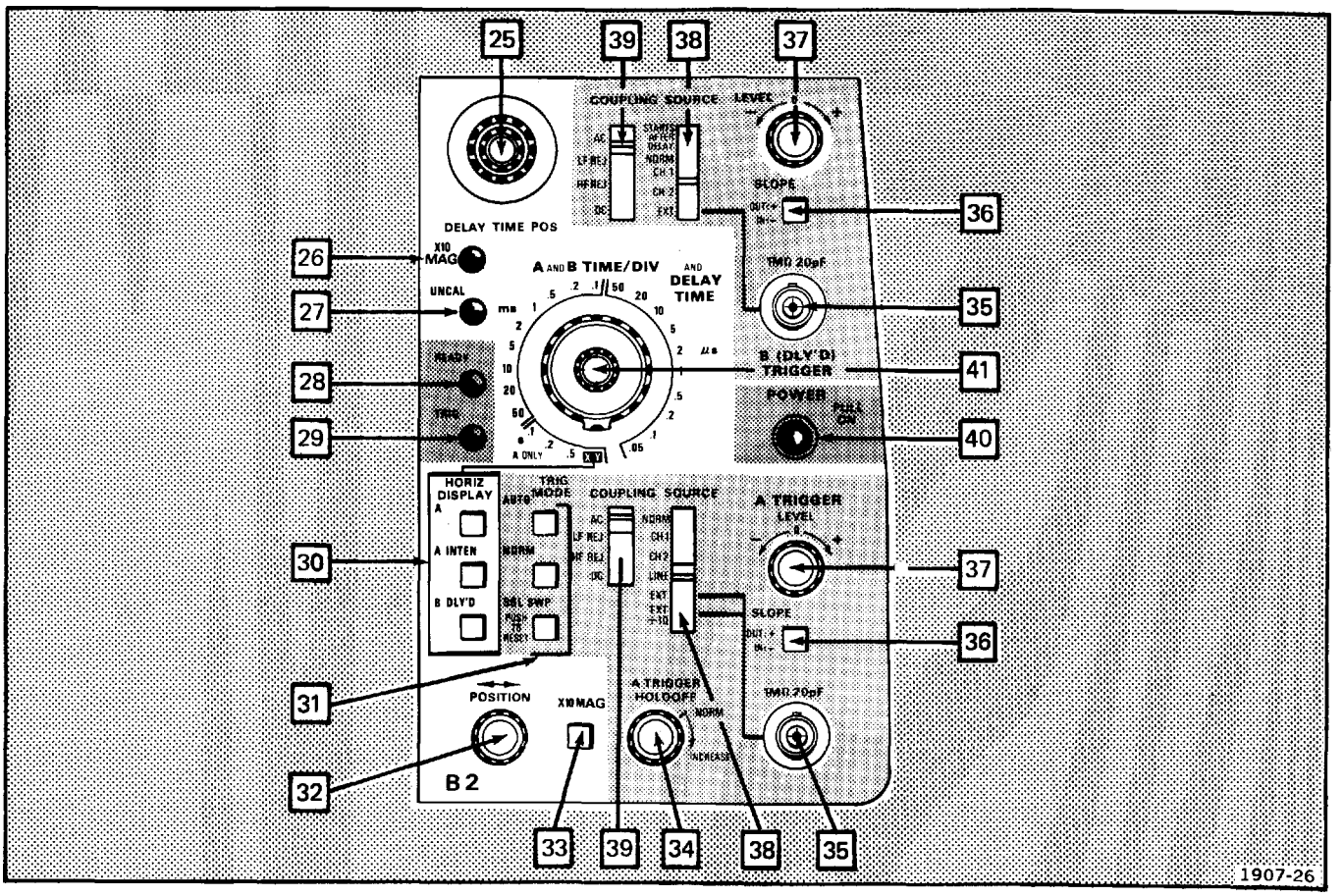


Fig. 2-4. B2 Horizontal Module.

30 **HORIZ DISPLAY**—Determines the mode of operation for the horizontal deflection system.

A: Horizontal deflection is provided by the A sweep generator at a rate determined by the A TIME/DIV switch. The B sweep generator is inoperative.

A INTEN: Horizontal deflection is provided by the A sweep generator at a rate determined by the A TIME/DIV switch. The B sweep generator is running to produce an intensified zone on the A sweep display. The location of the intensified zone is determined by the DELAY TIME POS control. The duration of the intensified zone is about 10 times the B TIME/DIV switch setting except when the intensified zone is positioned where A sweep ends before B sweep. The A INTEN mode is useful for determining the portion of the A sweep display which is presented in the B DLY'D mode. The A INTEN mode also can be used to make differential time measurements (see Applications in this section).

B DLY'D: Horizontal deflection is provided by the B sweep generator at a rate determined by the B TIME/DIV switch. The A sweep generator continues to operate. With the B SOURCE switch set to STARTS AFTER DELAY, the start of B sweep is delayed from the start of A sweep by a time determined by the A TIME/DIV switch and the DELAY TIME POS control. In other positions of the B SOURCE switch, the start of B sweep is further delayed until a trigger signal occurs. To find the duration of this delay, multiply the A TIME/DIV switch setting by the DELAY TIME POS control setting.

31 **TRIG MODE**—Determines the mode of operation for the A Trigger circuit.

AUTO: With the proper A LEVEL control setting, A sweep can be initiated by trigger signals with repetition rates above about 20 Hz and within the frequency range determined by the setting of the A COUPLING switch. In the absence of an adequate trigger signal, or when the A LEVEL control is misadjusted, the A sweep generator free runs to provide a reference display. If the trigger signal repetition rate is too low (or TRIG indicator blinks), set the TRIG MODE switch to NORM.

NORM: With the proper A TRIGGER LEVEL control setting, A sweep can be initiated by trigger signals within the frequency range set by the A COUPLING switch. In the absence of an adequate trigger signal, or when the A TRIGGER LEVEL control is misadjusted, the A sweep generator does not run and no display is visible. Use the NORM mode when the trigger signal repetition rate is too low for the AUTO mode indicated by the TRIG light blinking.

SGL SWP: The SGL SWP switch is a momentary contact, spring return push button switch. When the SGL SWP button is pushed, the A Trigger circuit operates in the same manner as in the NORM mode. However, upon receipt of an adequate trigger signal, only one sweep is presented. Another single sweep cannot be presented until the SGL SWP button is pushed again.

32 **POSITION**—Positions the display horizontally except in the X-Y mode (A TIME/DIV switch fully counterclockwise). In the X-Y mode, the vertical amplifier CH 1 POSITION control positions the display horizontally.

33 **X10 MAG**—Increases the displayed sweep rate by a factor of 10. It extends the fastest sweep rate to 5 ns/div. The magnified sweep is the center division of the unmagnified display (0.5 division either side of the graticule vertical center line).

34 **A TRIGGER HOLDOFF**—Provides continuous control of the time between sweeps. Allows triggering on aperiodic signals (such as complex digital words). Use the A trigger controls for the best possible display before using the A TRIG HOLDOFF control.

35 **External Trigger Input**—Input connector for external trigger signals.

36 **SLOPE**—Selects the slope of the trigger signal that starts the sweep.

OUT: +: Sweep can be triggered from the positive-going portion of a trigger signal.

IN: —: Sweep can be triggered from the negative-going portion of a trigger signal.

37 **A TRIGGER LEVEL**—Selects the amplitude point on the trigger signal at which the sweep is triggered. It is usually adjusted for the desired display after trigger SOURCE, COUPLING, and SLOPE have been selected.

38 **SOURCE**—Determines the source of the trigger signal coupled to the input of the trigger circuit.

NORM: The trigger signal is obtained from the signal(s) displayed on the crt. Does not show the time-relationship of the channel 1 and channel 2 signals in the alternate vertical mode. The NORM setting is not recommended for use with the CHOPPED vertical mode because the display triggers on the switching transients.

CH 1: A sample of the signal present in the channel 1 preamplifier is used as a trigger signal. The channel 2 display can be unstable if it is not time-related to the channel 1 signal.

CH 2: A sample of the signal present in the channel 2 preamplifier is used as a trigger signal. The channel 1 display can be unstable if it is not time-related to the channel 2 signal.

LINE (A Trigger circuit only): A sample of the power-line frequency is used as a trigger signal. It is useful when the input signal is time-related (multiple or sub-multiple) to the line frequency or when it is desirable to provide a stable display of a line-frequency component in a complex waveform.

EXT: Signals connected to the External Trigger Input connectors are used for triggering. External trigger signals must be time-related to the displayed signal for a stable display. It is useful when the internal signal is too small or contains undesired signals that could cause unstable triggering. It is also useful when operating in the chopped mode.

EXT ÷ 10 (A Trigger circuit only): External trigger signal attenuated by a factor of 10.

STARTS AFTER DELAY (B Trigger circuit only): B sweep runs immediately after the delay time selected by the A TIME/DIV switch and the DELAY TIME POS control. No B trigger is required. In any other B SOURCE switch position, a trigger is required after the delay time before B sweep will run.

39 **COUPLING**—Determines the method used to couple signals to the trigger generator circuit.

AC: Signals are capacitively coupled to the input of the trigger generator. Dc is rejected and signals below about 60 Hz are attenuated.

LF REJ: Signals are capacitively coupled to the input of the trigger circuit. Dc is rejected and signals below about 50 kHz are attenuated. It is useful for providing a stable display of the high-frequency components of a complex waveform.

HF REJ: Signals are capacitively coupled to the input of the trigger circuit. Dc is rejected and signals below about 60 Hz and above 50 kHz are attenuated. It is useful for providing a stable display of the low-frequency components of a complex waveform.

DC: All components of a trigger signal are coupled to the input of the trigger circuit. It is useful for providing a stable display of low-frequency or low-repetition rate signals.

40 **POWER**—Turns instrument power on (out) and off (in).

41 **A and B TIME/DIV**—The A TIME/DIV switch (clear plastic skirt) selects the sweep rate for the A sweep generator circuit and selects the basic delay time for delayed sweep operation. Multiply the A TIME/DIV switch setting by the DELAY TIME POS control to compute the delay time. The VAR control must be in the detent position for calibrated A sweep rate and delay times.

The B TIME/DIV switch (grey knob, pull out and turn to unlock) selects the B sweep rate for delayed sweep operation.

When A TIME/DIV switch is fully counterclockwise (X-Y position), horizontal deflection is provided by the signal connected to the vertical CH 1 input connector.

BASIC APPLICATIONS AND MEASUREMENTS

Peak-to-Peak Amplitude Measurements

To measure the amplitude of a signal, multiply the vertical deflection (in divisions) by the VOLTS/DIV Switch setting.

Example:

The display amplitude is 3 divisions (see Fig. 2-5) and the VOLTS/DIV switch is set to .5 V. Substituting the given values:

Amplitude = 3 divisions x 0.5 volts/division =

1.5 V peak-to-peak.

Instantaneous Amplitude Measurement

The following procedure explains how to measure the amplitude of any point on a waveform with respect to ground.

1. Set the AC-GND-DC switch to DC.

2. Apply the signal to be measured to one of the vertical input connectors. Set the VERT MODE switch to select the channel used.

3. Obtain a stable display, centered vertically.

4. Set the AC-GND-DC switch to GND. Adjust the trace to some reference line (see Fig. 2-6).

5. Set the AC-GND-DC switch to DC. If the waveform appears above the reference line, the voltage is positive. If the waveform appears below the reference line, the voltage is negative.

6. Measure the vertical difference (in divisions) between the reference line and the desired point on the waveform and multiply by the volts/div switch setting.

Example:

The vertical difference is 5 divisions (see Fig. 2-6). The VOLTS/DIV switch is set to 10 mV. The waveform appears above the reference line.

Substituting the given values:

Instantaneous Amplitude = 5 divisions x 10 mV/division =

50 mV

Instantaneous Amplitude = +50 mV.

Dual Trace Phase Difference Measurement

Phase comparison between two signals of the same frequency can be made using the dual-trace feature. This method of phase difference measurement can be used up to the frequency limit of the vertical system. It is also more accurate and easier to use than the X-Y method. To make the comparison, use the following procedure:

1. Set the AC-GND-DC switches to AC.

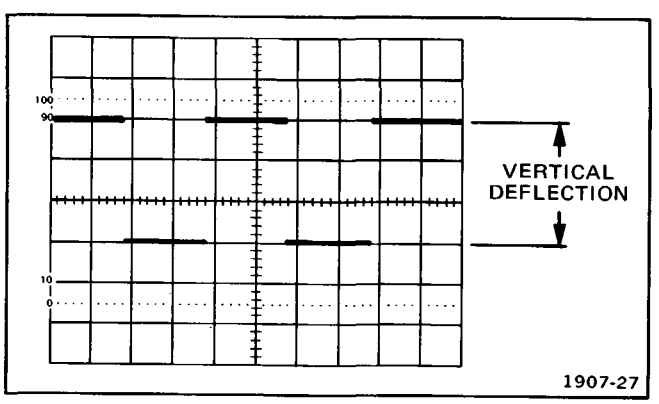


Fig. 2-5. Peak-to-peak voltage measurement.

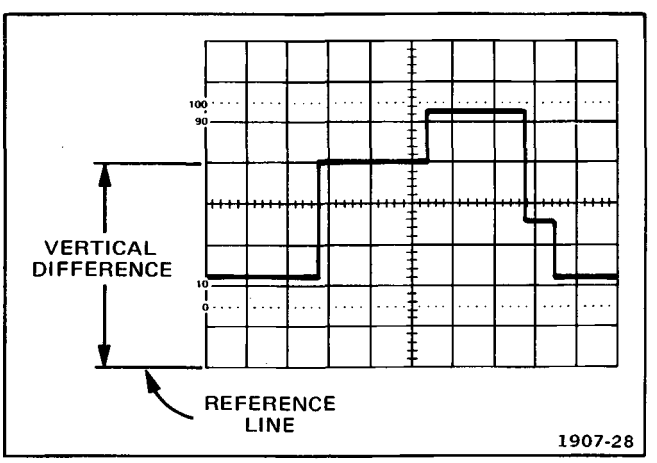


Fig. 2-6. Instantaneous voltage measurement.

2. Set the VERT MODE switch to either CHOP or ALT. In general, CHOP is more suitable for low-frequency signals and the ALT position is more suitable for high-frequency signals. Position both traces to the graticule horizontal centerline.

3. Set the triggering SOURCE switch to CH 1.

4. Connect the reference signal to the CH 1 input connector and the comparison signal to the CH 2 input connector. Use coaxial cables or probes which have equal time delay to connect the signals to the input connectors.

5. If the signals are of opposite polarity, set the INVERT switch in to invert the Channel 2 display. (Signals may be of opposite polarity due to 180° phase difference; if so, take this into account in the final calculation.)

6. Set the CH 1 and CH 2 VOLTS/DIV switches and the CH 1 and CH 2 VAR controls so the displays are equal and about five divisions in amplitude.

7. Set the TIME/DIV switch to a sweep rate which displays about one cycle of the reference waveform.

8. Turn the VAR TIME/DIV control until one cycle of the reference signal (Channel 1) occupies exactly eight divisions between the first and ninth graticule lines (see Fig. 2-7). Each division of the graticule represents 45° of the cycle (360° ÷ 8 divisions = 45°/division). The sweep rate can be stated in terms of degrees as 45°/division.

9. Measure the horizontal difference between corresponding points on the waveforms.

10. Multiply the measured distance (in divisions) by 45°/division (sweep rate) to obtain the exact amount of phase difference.

Example:

Assume a horizontal difference of 0.6 division with a sweep rate of 45°/division as shown in Fig. 2-7.

Substituting the given values.

Phase difference = 0.6 division x 45°/division.

Phase difference = 27°

High Resolution Phase Measurement

For phase differences less than 45°, measurement accuracy is increased by using X10 sweep magnification as follows:

1. Perform steps 1 through 8 of Dual-Trace Phase-Difference Measurements.

2. Move the measurement points to the graticule horizontal centerline.

3. Set the horizontal magnifier on. The sweep rate is now 4.5°/division (45°/division ÷ 10).

4. Slightly readjust the horizontal position control to move the measurement points within the graticule area (see Fig. 2-8).

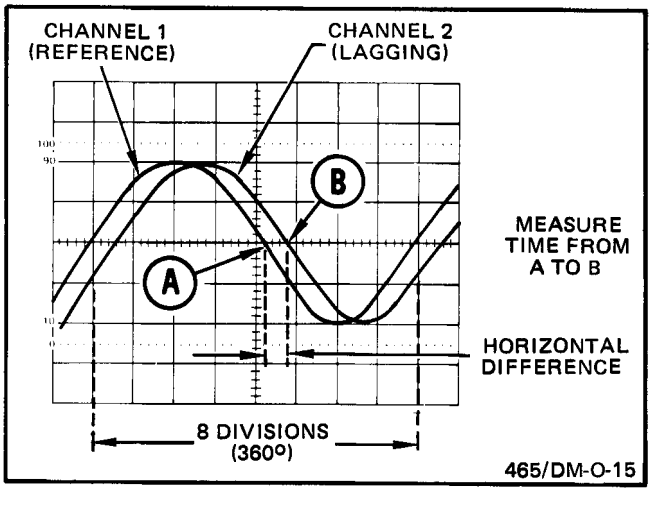


Fig. 2-7. Phase difference.

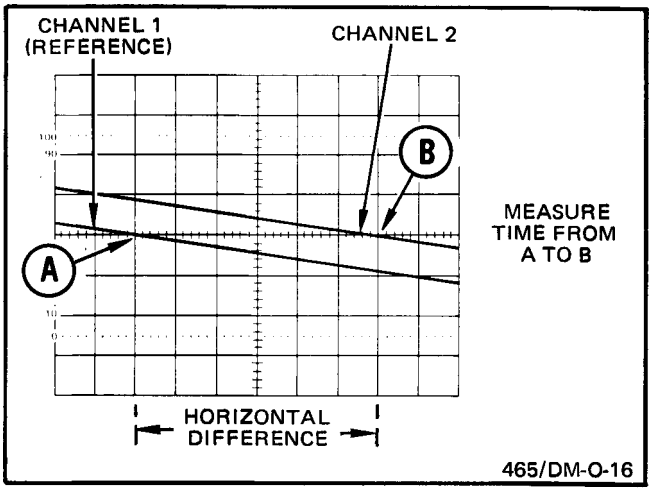


Fig. 2-8. High-resolution phase difference.

5. Measure the horizontal difference (in divisions) between corresponding points on the waveforms.

6. Multiply the horizontal difference by the magnified sweep rate (4.5°/division).

Example:

The horizontal distance measured is 6 divisions (see Fig. 2-8). The magnified sweep rate is 4.5°/division.

Substituting the given values:

Phase Difference = 6 divisions x 4.5°/division.

Phase Difference = 27°

Common-Mode Rejection

Some signals may contain undesirable components. Common-mode rejection can eliminate or reduce these components from the measurement.

Example:

The displayed signal contains an undesired line-frequency component (see Fig. 2-9A).

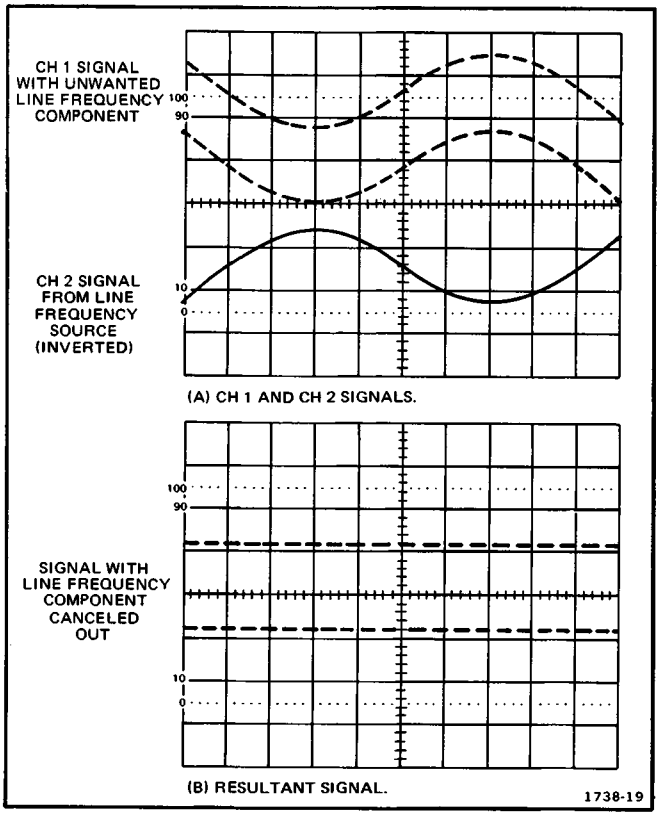


Fig. 2-9. Common-mode rejection.

Use the following procedure to reduce or eliminate the line-frequency component:

1. Apply the signal to the CH 1 input connector.

2. Apply the line-frequency signal to the CH 2 input connector.

3. Set the VERT MODE switch to ALT.

4. Set the INVERT button so that the Channel 2 display is opposite in polarity.

5. Adjust the channel 2 VAR control to make the Channel 2 display amplitude about equal to the undesired component of the channel 1 display.

6. Set the VERT MODE switch to ADD and slightly readjust the Channel 2 VAR control for maximum rejection of the undesired signal component (see Fig. 2-9B).

Cascaded Operation

Maximum vertical sensitivity can be increased to approximately 1 mV/div by cascading the CH 1 and CH 2 amplifiers as follows:

1. Connect the CH 2 OUT signal (rear of main module) to the CH 1 input via a 50 Ω cable and a 50 Ω termination.

2. Set the VERT MODE switch to CH 1.

3. Apply the input signal to the CH 2 input connector.

NOTE

In this mode, bandwidth is limited to about 20 MHz.

Time-Duration and Frequency Measurements

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

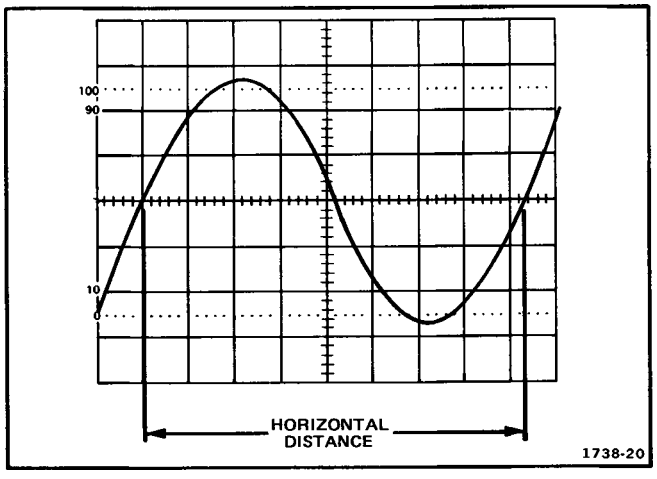


Fig. 2-10. Time duration.

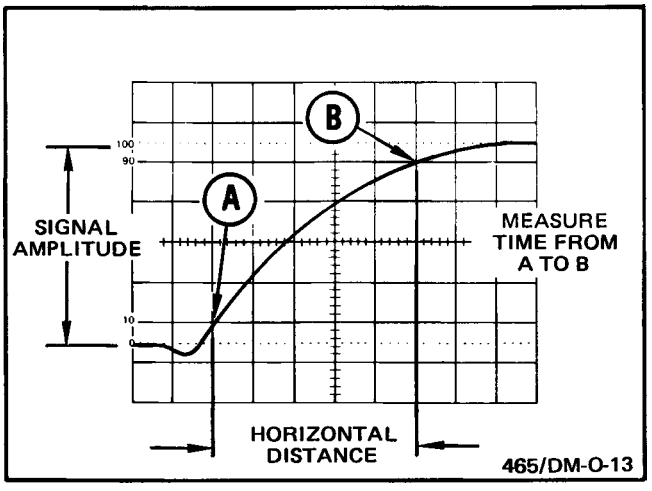


Fig. 2-11. Risetime.

Example:

The horizontal distance measured is 8.3 divisions (see Fig. 2-10). The TIME/DIV switch is set to 2 ms.

Substituting the given values:

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

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

$$\text{Time Duration} = 16.6 \text{ ms}$$

and

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

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

Risetime Measurements

Risetime measurements are made in the same manner as time duration measurements, except the measurements are made between the 10% and 90% points of the waveform amplitude (see percentage markings on the left edge of the graticule).

Use the following procedure to measure risetime:

1. Adjust the VOLTS/DIV and VAR controls for a display amplitude of exactly 5 divisions.

2. Adjust the vertical POSITION control so that the display bottom just touches the 0% graticule line and the display top just touches the 100% graticule line (see Fig. 2-11).

3. Measure the horizontal distance (divisions) between the 10% and 90% points on the waveform (point A to point B, Fig. 2-11).

4. Use the following formula to find risetime:

$$\text{Risetime} = \text{horizontal distance (divisions)} \times \text{TIME/DIV setting}$$

Example:

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

Substituting the given values:

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

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

Differential-Time Measurements

Very accurate time duration measurements can be made using either the A Intensified or B Delayed modes.

A INTENSIFIED DIFFERENTIAL TIME MEASUREMENTS. Use the following procedure to make differential time measurements using the A Intensified mode.

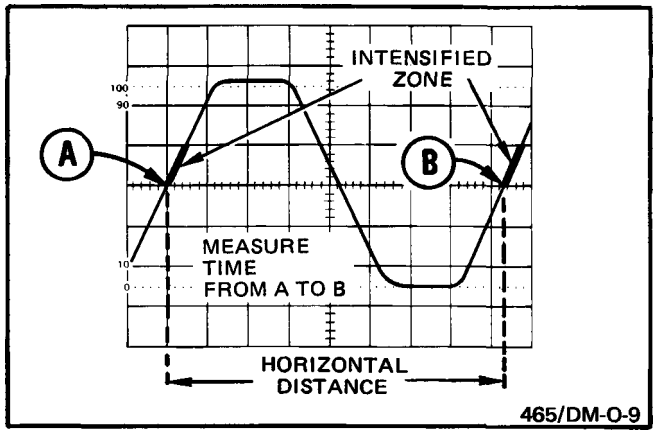


Fig. 2-12. Time duration between points on a waveform.

1. Set the A TIME/DIV switch and the horizontal POSITION control to locate both time measurement points within the graticule area (see Fig. 2-12).

2. Set the HORIZ DISPLAY switch to A INTEN and the B TRIGGER SOURCE switch to STARTS AFTER DELAY.

3. Unlock the B TIME/DIV switch and rotate clockwise to obtain the shortest usable intensified zone.

4. Use the DELAY TIME POS (DTP) control to move the left edge of the intensified zone to just touch the first time measurement point (see Fig. 2-12, point A). Note the DTP control setting.

5. Use the DTP control to move the left edge of the intensified zone to just touch the second time measurement point (see Fig. 2-12, point B). Note the DTP control setting.

6. Use the following formula to find the time difference.

$$\text{Time Difference} = \left[\begin{matrix}\text{second DTP setting}\end{matrix} - \begin{matrix}\text{first DTP setting}\end{matrix}\right] \times \begin{matrix}\text{A TIME/DIV switch setting}\end{matrix}$$

Example:

The A TIME/DIV switch was set to 2 ms and the B TIME/DIV switch was set to 0.1 ms. The first DTP control setting was 1.23 (at point A, Fig. 2-12) and the second was 9.56 (at point B, Fig. 2-12).

Substituting the given values:

$$\text{Time Difference} = (9.56 - 1.23) \times 2\text{ms}$$

$$\text{Time Difference} = 16.7\text{ ms}$$

B DELAYED DIFFERENTIAL TIME MEASUREMENTS. Use the following procedure to make differential time measurements using the B Delayed mode.

1. Set the A TIME/DIV switch and the horizontal POSITION control to locate both time measurement points within the graticule area (see Fig. 2-13, A).

2. Set the HORIZ DISPLAY switch to A INTEN and the B TRIGGER SOURCE switch to STARTS AFTER DELAY.

3. Unlock the B TIME/DIV switch and rotate it 3 or 4 positions more clockwise than the A TIME/DIV switch if possible.

4. Rotate the DELAY TIME POS (DTP) control so that the first time measurement point is in the center of the intensified zone (see Fig. 2-13, A).

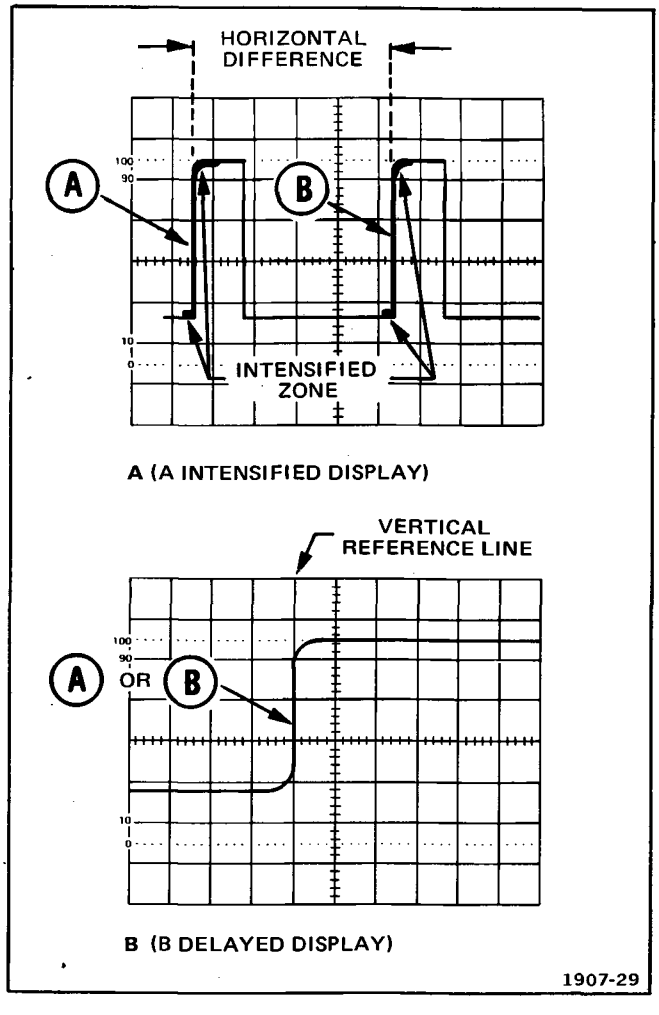


Fig. 2-13. Time difference between pulses.

5. Set the HORIZ DISPLAY switch to B DLY'D.

6. Slightly readjust the DTP control to move the first time measurement point to some vertical reference line (see Fig. 2-13, B). Note the DTP control setting.

7. Adjust the DTP control to move the second time measurement point to the same vertical reference line (see Fig. 2-13, B). Note the DTP control setting.

NOTE

If several signal repetitions exist between the time measurement points, switch to the A Intensified mode to locate the correct repetition, then back to the B Delayed mode to make the measurement. Do not move the horizontal POSITION control.

8. Use the following formula to find the time difference.

$$\text{Time Difference} = \left[\begin{array}{c}\text{second DTP setting} \\ - \\ \text{first DTP setting}\end{array}\right] \times \begin{array}{c}\text{A TIME/DIV} \\ \text{switch} \\ \text{setting}\end{array}$$

Example:

The A TIME/DIV switch was set to 0.2 ms/division and the B TIME/DIV to 10 μs/division. The first DTP control setting was 0.88 (at point A, Fig. 2-13, A) and the second was 5.57 (at point B, Fig. 2-13, A).

Substituting the given values:

$$\text{Time Difference} = (5.57 - 0.88) \times 0.2 \text{ ms}$$

Time Difference = 0.938 ms

Delayed-Sweep Magnification

The B Delayed mode can provide higher apparent sweep rate magnification than that provided by the X10 MAG switch. First try the Magnified-Sweep-Starts-After-Delay method. If this produces too much horizontal jitter, try the Magnified-Sweep-Triggered-After-Delay method.

MAGNIFIED SWEEP STARTS AFTER DELAY.

1. Set the HORIZ DISPLAY switch to A INTEN and the B SOURCE switch to STARTS AFTER DELAY.

2. With the DELAY TIME POS control, move the left edge of the intensified zone to the left side of the portion of the A sweep display to be magnified.

3. Set the B TIME/DIV switch so just the portion of the A sweep display to be magnified is intensified (see Fig. 2-14, A).

4. Set the HORIZ DISPLAY switch to B DLY'D. The portion of the A sweep display that was intensified in step 3 is not displayed in magnified form (see Fig. 2-14, B). The displayed sweep rate is determined by the B TIME/DIV switch. To calculate the apparent magnification factor, use the formula:

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

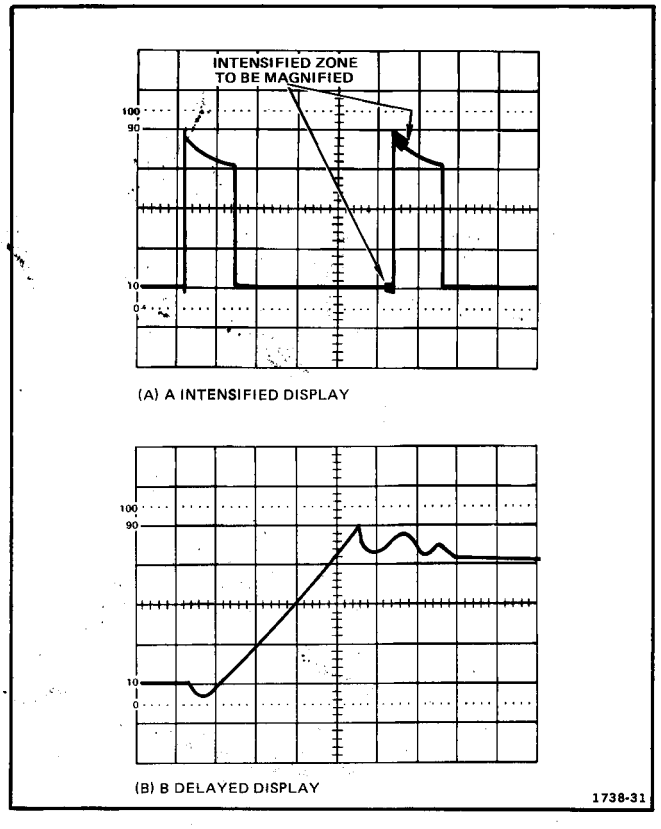


Fig. 2-14. Delayed Sweep magnification.

MAGNIFIED SWEEP TRIGGERED AFTER DELAY. At high apparent magnification, the magnified-sweep-starts-after-delay method may produce too much jitter. To eliminate the jitter, operate B sweep (in the triggered after delay mode) as follows:

1. Perform steps 1 through 3 of the magnified-sweep-starts-after-delay procedure.

2. Set the B SOURCE switch to the same position as the A SOURCE switch. Adjust the B LEVEL control for a stable intensified zone.

NOTE

Inability to intensify the desired portion of the A sweep display indicates the lack of a transition of sufficient amplitude, in that portion, on which to trigger. If this is the case, try reducing the VOLTS/DIV switch setting for more display amplitude or using external triggering.

3. Set the HORIZ DISPLAY switch to B DLY'D. To obtain a stable display it may be necessary to slightly readjust the B LEVEL control.

PERFORMANCE CHECK

This procedure allows the basic performance specifications to be checked without removing the instrument covers. It is intended for use in incoming inspection to determine acceptability of newly purchased or recently recalibrated instruments.

OPTIONS

Your instrument may contain options (such as Option 5 or Option 7) that can alter this procedure slightly. If this is the case, refer to the Options section(s) in this manual and perform the necessary performance checks.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 3-1, or equivalent, is required to perform a complete Performance Check of the 455/A2/B2. Specifications given for the equipment are the minimum necessary for accurate results.

TABLE 3-1
Test Equipment Required

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
1. Amplitude Calibrator	Amplitude accuracy, within 0.25%; signal amplitude, 5 millivolts to 50 volts; output signal, 1 kilohertz square wave.	Vertical-gain checks. X-gain check. Trigger level range. Trigger view gain and delay difference checks.	a. Tektronix PG506 Calibration Generator.[1] b. Tektronix 067-0502-01 Calibration Fixture.
2. Square-Wave Generator	Repetition rate, to above 100 kHz; risetime, 5 ns or less; output amplitude, 0.2 V.	Trigger view delay difference check.	a. Tektronix PG506 Calibration Generator.[1] b. Tektronix Type 106 Square-wave Generator.
3. *Sine-Wave Generator*	*Frequency, 350 kilohertz to above* 50 megahertz; output amplitude, variable from 0.5 to 4 volts peak-to-peak; output impedance, 50 ohms; reference frequency, 50 to 350 kilohertz; amplitude accuracy, constant within 3% of reference frequency as output frequency changes.	*Cascaded sensitivity and* bandwidth checks. Vertical Amplifier bandwidth checks. X bandwidth check. Triggering checks.	*a. Tektronix SG503 Leveled* Sine Wave Generator.[1] b. Tektronix Type 191 Constant Amplitude Signal Generator.
4. Time-Mark Generator	Marker outputs, 10 nanoseconds to 0.5 second; marker accuracy, within 0.1%; trigger output, 1 millisecond to 0.1 microsecond, time coincident with markers.	Timing checks.	a. Tektronix TG501 Time-Mark Generator.[1] b. Tektronix 2901 Time-Mark Generator.
5. Low-Frequency Generator	Frequency, 60 Hz to 5 kHz; output amplitude variable from 10 mV to 4 V p-p.	Low-frequency trigger checks.	
6. Test Oscilloscope	Bandwidth 500 kHz; Vertical deflection factor, 1 volt/div.	+ GATE output checks.	a. Any Tektronix oscilloscope is suitable.
7. Termination (2 required)	Impedance, 50 ohms; connectors, BNC.	Signal termination.	a. Tektronix Part 011-0049-01.
8. Cable (2 required)	Impedance, 50 ohms; Length, 42 inches; Connectors, BNC.	Signal interconnection.	a. Tektronix Part 012-0057-01.
9. Dual Input Coupler (2 required)	Connectors, BNC female to 2 BNC male.	Signal interconnection.	a. Tektronix Part 067-0525-01.
10. T Connector	Connectors, BNC.	Signal interconnection.	a. Tektronix Part 103-0030-00.

[1] **Requires a TM500 Series Power Module.**

PRELIMINARY PROCEDURE

Perform following steps to place 455/A2/B2 into a basic operating mode before continuing with the Performance Check.

1. Check that Line Voltage Selector switch (on rear panel) is set for correct line voltage. Unless otherwise specified, the instrument is shipped from factory with this switch set at 116 V. If Line Voltage Selector switch is changed to 232 V, fuse should be changed to 0.5 A, fast blow.

2. Connect the 455/A2/B2 to the correct line-voltage source and pull POWER switch on.

NOTE

Allow approximately 20 minutes warmup time before starting Performance Check procedure. For best overall accuracy, check performance in an ambient temperature range of +20°C to +30°C.

3. Set 455/A2/B2 controls as follows:

VERTICAL
(both channels if applicable)

POSITION	midrange
VOLTS/DIV	5 mV
VAR	detent
CH 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND
VERT MODE	CH 1
INVERT	button out (normal)

SWEEP

HORIZ DISPLAY	A
A and B TIME/DIV	.2 ms
VAR TIME/DIV	fully clockwise (detent)
DELAY TIME POS	fully counterclockwise

SWEEP (cont)

X10 MAG	out (off)
A TRIGGER HOLDOFF	NORM (detent)

TRIGGERING
(both A and B if applicable)

LEVEL	0
SLOPE	OUT: +
COUPLING	AC
SOURCE	NORM
TRIG MODE	AUTO

4. The scale-factor light above the CH 1 VOLTS/DIV knob should be lit, indicating that the instrument is on. A baseline trace should be displayed within graticule area. Adjust the INTENSITY, FOCUS and ASTIG controls for a low intensity, well defined trace.

5. Adjust the TRACE ROTATION control so that trace is parallel with the horizontal graticule lines.

This completes the Preliminary portion of the Performance Check procedure.

PERFORMANCE CHECK PROCEDURE

1. CH 1 AND CH 2 DEFLECTION ACCURACY

a. Connect amplitude calibrator as shown in Fig. 3-1.

b. CHECK—Deflection accuracy for CH 1 according to Table 3-2.

c. Set:

CH 1 AC-GND-DC	GND
CH 2 AC-GND-DC	DC
VERT MODE	CH 2

d. CHECK—Deflection accuracy for CH 2 according to Table 3-2. Adjust FOCUS and ASTIG as desired.

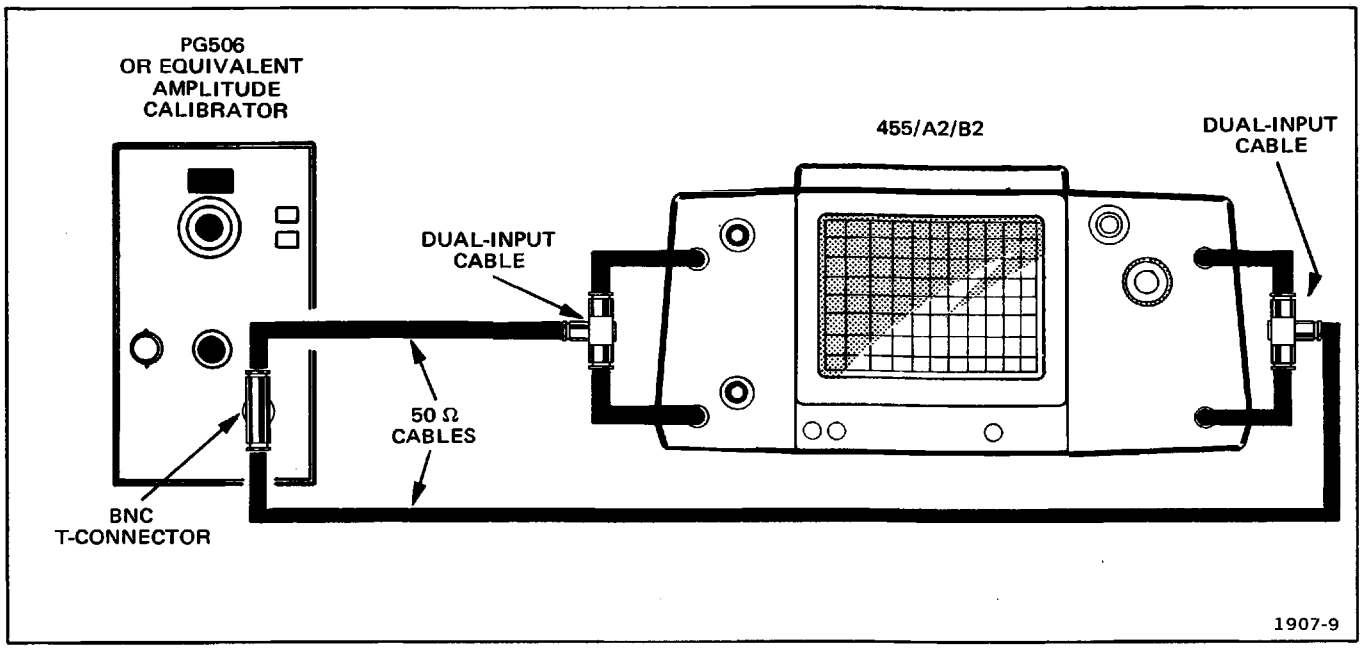


Fig. 3-1. Amplitude calibrator test setup.

TABLE 3-2
Vertical Deflection Accuracy

VOLTS/DIV Switch Setting	Calibration Generator Output	Vertical Deflection in Divisions	3% Tolerance in Divisions
5 mV	20 mV	4	3.88 to 4.12
10 mV	50 mV	5	4.85 to 5.15
20 mV	0.1 V	5	4.85 to 5.15
50 mV	0.2 V	4	3.88 to 4.12
0.1 V	0.5 V	5	4.85 to 5.15
0.2 V	1.0 V	5	4.85 to 5.15
0.5 V	2.0 V	4	3.88 to 4.12
1.0 V	5.0 V	5	4.85 to 5.15
2.0 V	10.0 V	5	4.85 to 5.15
5.0 V	20.0 V	4	3.88 to 4.12

2. CH 2 AND CH 1 VARIABLE VOLTS/DIV RANGE

a. Set CH 1 and CH 2 VOLTS/DIV to 5 mV and adjust calibration generator output to 20 mV.

b. CHECK—Display amplitude reduces from 4 divisions to less than 1.6 divisions with CH 2 VAR control fully counterclockwise.

c. Set: VERT MODE — CH 1

CH 1 AC-GND-DC — DC

d. CHECK—Display amplitude reduces from 4 divisions to less than 1.6 divisions with CH 1 VAR control fully counterclockwise.

e. Return both VAR controls to detent position.

3. X GAIN

a. Set: VERT MODE — CH 2

CH 2 AC-GND-DC — GND

A TIME/DIV — X-Y

INTENSITY — for visible display

b. Set calibration generator to 50 mV.

c. CHECK—Horizontal deflection is 10 divisions within 4% (9.6 to 10.4 div) for both AC and DC positions of CH 1 AC-GND-DC switch.

d. Set calibration generator to 20 mV.

e. CHECK—Horizontal deflection is 4 divisions, within 4% (3.84 to 4.16 div) for both AC and DC positions of CH 1 AC-GND-DC switch.

4. TRIGGER VIEW GAIN

a. Set:

VERT MODE	CH 1
A SOURCE	EXT ÷ 10
A SLOPE	OUT: +
A TIME/DIV	.2 ms

b. Set A LEVEL to 0.

c. Set calibration generator to 2 V.

d. CHECK—Display is 4 divisions within 20% (3.2 to 4.8) when TRIG VIEW is pressed and held in. Adjust A LEVEL control to vertically position display.

e. Set calibration generator to 0.2 V.

f. Set A SOURCE to EXT.

g. CHECK—Display is 4 divisions within 20% (3.2 to 4.8) when TRIG VIEW is pressed and held in.

h. Disconnect test equipment.

5. TRIGGER VIEW DELAY DIFFERENCE

a. Set:

A TIME/DIV	.05 μs
X10 MAG	in (on)

b. Connect fast-rise pulse generator as shown in Fig. 3-2.

c. Adjust the generator to display 4 divisions when the TRIG VIEW button is pressed and held in. Center display on crt using A LEVEL and horizontal POSITION controls. Release TRIG VIEW button.

d. Set CH 1 VOLTS/DIV switch and VAR control for 4 division display. Center display vertically with POSITION control.

e. CHECK—Time difference along graticule horizontal centerline between CH 1 display and TRIG VIEW display is 7.5 ns or less (1.5 div or less).

f. Return CH 1 VAR control to detent position.

g. Disconnect test equipment.

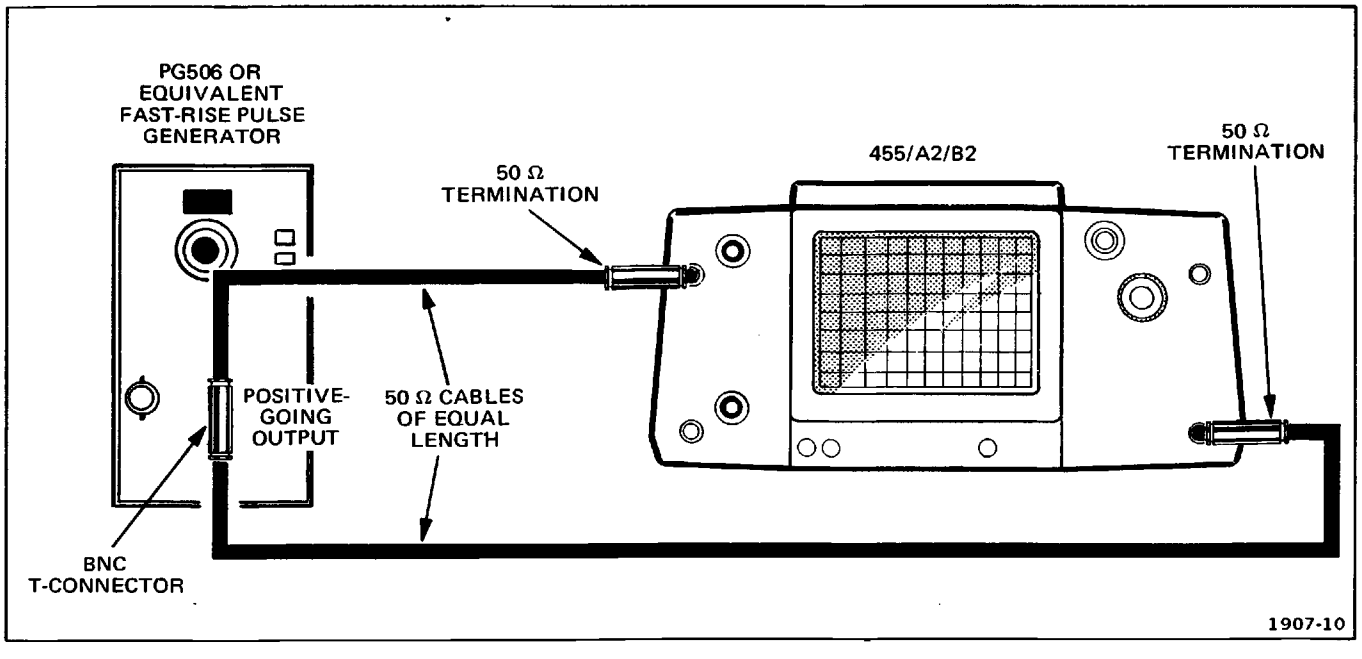


Fig. 3-2. Fast-rise pulse generator test setup.

6. CASCADED SENSITIVITY

a. Set:

VERT MODE	CH 2
CH 1 and CH 2 VOLTS/DIV	5 mV
CH 1 and CH 2 AC-GND-DC	DC
A TIME/DIV	.2 ms
X10 MAG	out (off)
A SOURCE	NORM

b. Connect sine-wave generator as shown in Fig. 3-3.

c. Set generator frequency for 50 kHz sine wave (reference) and adjust output for 1 division display.

d. Set VERT MODE to CH 1.

e. CHECK—Display is approximately 5 divisions.

7. CASCADED BANDWIDTH

a. Adjust generator output for 5 division (50 kHz) display.

b. Set generator frequency to 20 MHz.

c. CHECK—Display amplitude is at least 3.5 divisions.

8. CH 2 BANDWIDTH

a. Set VERT MODE to CH 2.

b. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 5 division display.

c. Set the generator frequency to 50 MHz.

d. CHECK—Display amplitude is at least 3.5 divisions.

9. CH 1 BANDWIDTH

a. Set VERT MODE to CH 1.

b. Remove 50 Ω cable and termination from CH 1 input and CH 2 OUT connector.

c. Move 50 Ω cable and termination from CH 2 input connector to CH 1 input connector.

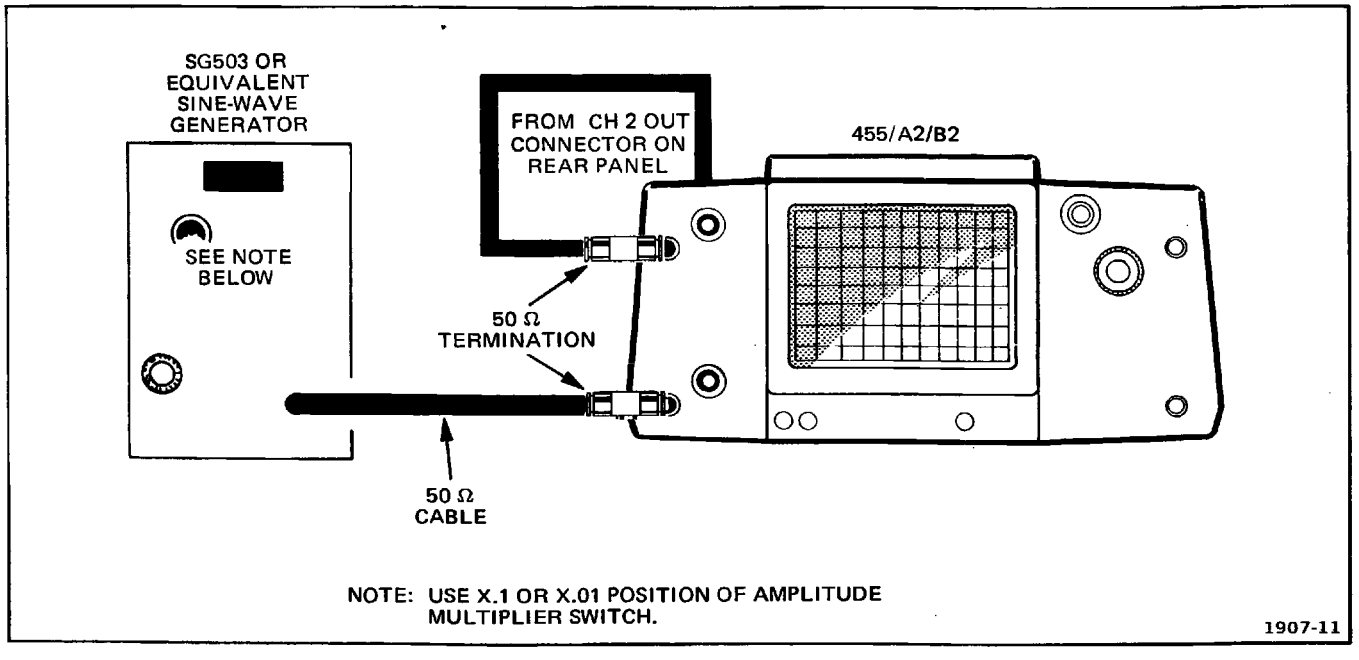


Fig. 3-3. Sine-wave generator test setup #1.

d. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 5 division display.

e. Set generator frequency to 50 MHz.

f. CHECK—Display amplitude is at least 3.5 divisions.

10. X BANDWIDTH

a. Set:

VERT MODE	CH 2
A TIME/DIV	X-Y
INTENSITY	for visible display

b. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 10 divisions of horizontal deflection. Center trace horizontally with horizontal POSITION control.

c. Set generator frequency to 3 MHz.

d. CHECK—Display amplitude is at least 7.0 divisions.

11. TRIGGER JITTER

a. Set:

VERT MODE	CH 1
A TIME/DIV	.05 μs
X10 MAG	in (on)

b. Set generator frequency to 50 MHz and adjust output amplitude for 1.5 division display.

c. Adjust A LEVEL for display with least horizontal displacement (jitter).

d. CHECK—Horizontal displacement (jitter) for 0.1 division or less.

e. Disconnect test equipment.

12. LOW FREQUENCY TRIGGERING

a. Set:

A TIME/DIV	10 ms
B TIME/DIV	10 ms
X10 MAG	out (off)
A and B COUPLING	AC
A and B SOURCE	NORM
VERT MODE	CH 1

b. Connect low-frequency generator as shown in Fig. 3-4.

c. Set generator frequency to 60 Hz and adjust output for 0.4 division display.

d. CHECK—Stable display can be obtained in both + and − positions of A SLOPE switch for these modes:

A SOURCE	A COUPLING
NORM	AC, HF REJ, DC
CH 1	DC
CH 2	DC

e. CHECK—No stable display can be obtained with A COUPLING switch in LF REJ position.

f. Set HORIZ DISPLAY to B DLY'D.

g. CHECK—Stable display can be obtained in both + and − positions of B SLOPE switch, for these modes:

B SOURCE	A COUPLING
NORM	AC, HF REJ, DC
CH 1	DC
CH 2	DC

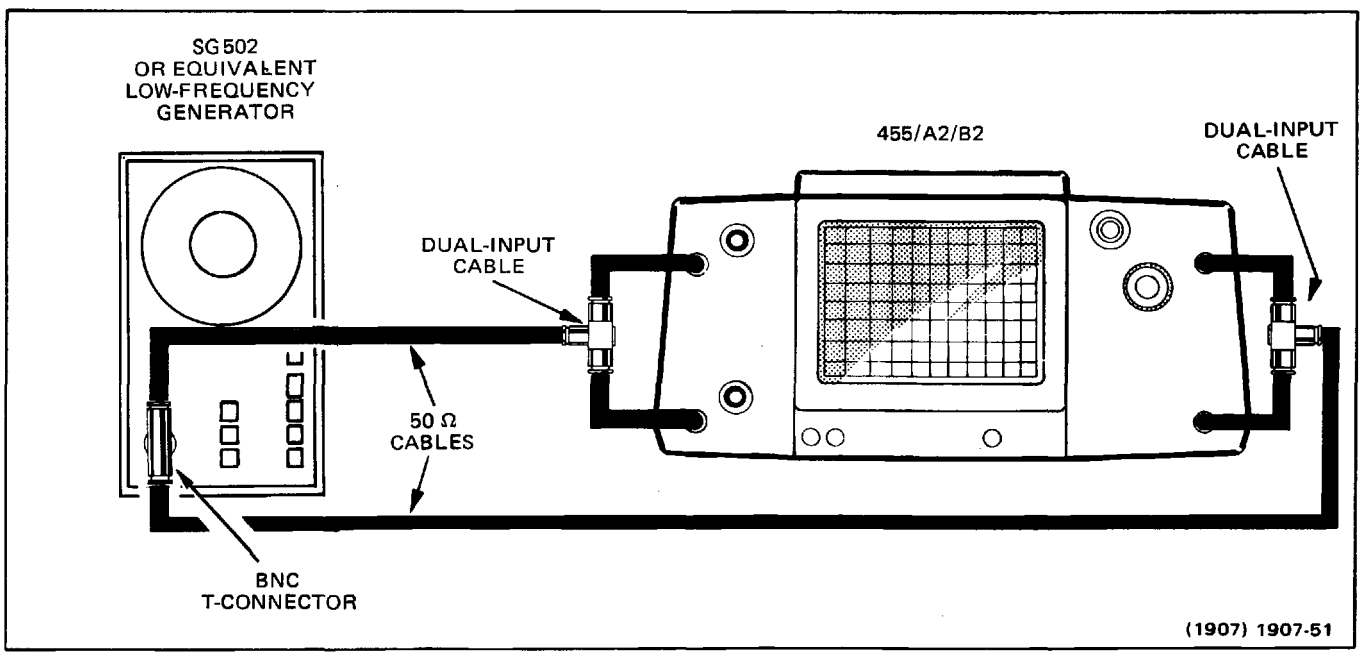


Fig. 3-4. Low-frequency generator test setup.

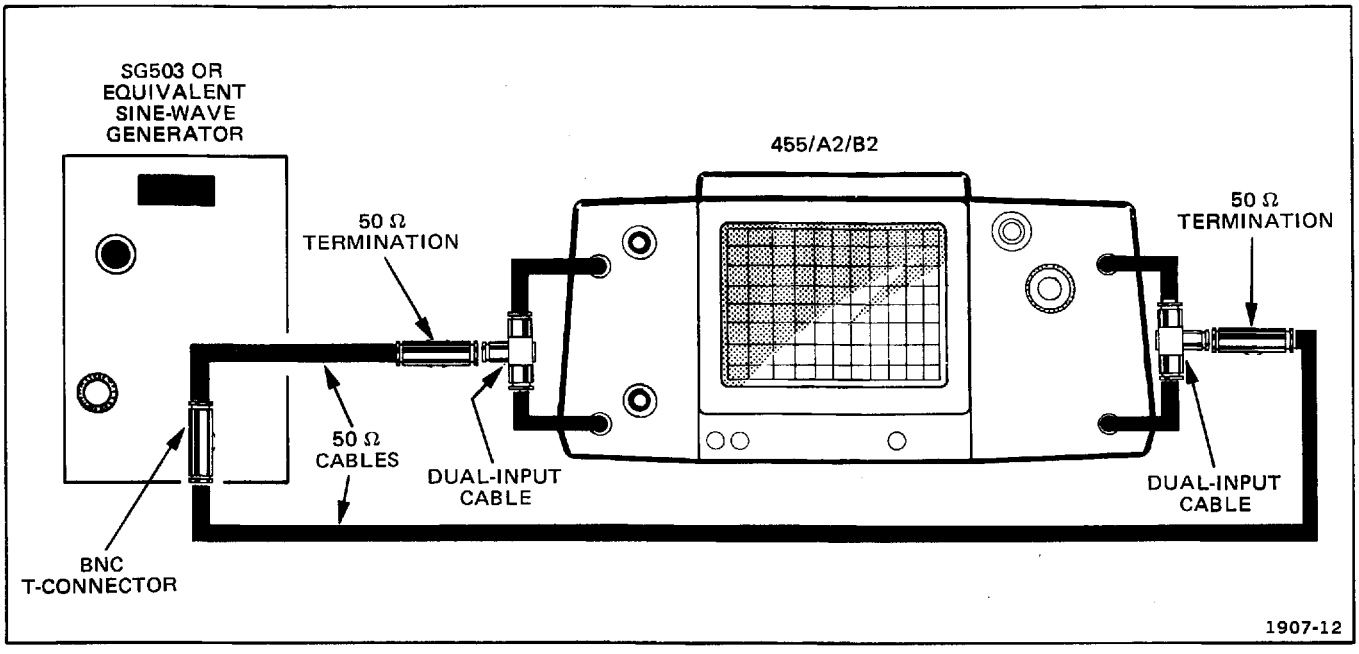


Fig. 3-5. Sine-wave generator test setup #2.

h. CHECK–No stable display can be obtained with B COUPLING switch in LF REJ position.

i. Disconnect test equipment.

13. 10 MHz INTERNAL TRIGGERING

a. Set:

A TIME/DIV	0.5 μs
B TIME/DIV	0.5 μs
CH 1 and CH 2 VOLTS/DIV	20 mV
HORIZ DISPLAY	A
A and B COUPLING	AC

b. Connect sine wave generator as shown in Fig. 3-5.

c. Set generator frequency to 10 MHz and adjust output amplitude for 0.4 division display.

d. CHECK–Stable display can be obtained in both + and – positions of A SLOPE switch for the following modes:

A SOURCE	A COUPLING
NORM	AC,LF REJ, DC
CH 1	DC
CH 2	DC

e. CHECK–No stable display can be obtained with A COUPLING switch in HF REJ position.

f. Set HORIZ DISPLAY to B DLY'D.

g. CHECK–Stable display can be obtained in both + and – positions of B SLOPE switch for these modes:

B SOURCE	B COUPLING
NORM	AC, LF REJ, DC
CH 1	DC
CH 2	DC

h. CHECK–No stable display can be obtained with B COUPLING switch in HF REJ position.

14. 50 kHz INTERNAL TRIGGERING

a. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 0.4 division display. Adjust B LEVEL as needed for a visible display. Set A TIME/DIV and B TIME/DIV to 10 μs.

b. CHECK–Stable display can be obtained in both + and – positions of B SLOPE switch for these modes:

B SOURCE	B COUPLING
NORM	AC, LF REJ, HF REJ, DC
CH 1	DC
CH 2	DC

c. Set HORIZ DISPLAY to A.

d. CHECK–Stable display can be obtained in both + and – positions of A SLOPE switch for these modes:

A SOURCE	A COUPLING
NORM	AC, LF REJ, HF REJ, DC
CH 1	DC
CH 2	DC

15. 50 kHz EXTERNAL TRIGGERING

a. Adjust generator output amplitude for 2.5 division display.

b. Set A SOURCE switch to EXT.

c. CHECK—Stable display can be obtained in both + and — positions of A SLOPE switch for AC and DC positions of A COUPLING switch.

d. Set: HORIZ DISPLAY B DLY'D

B SOURCE EXT

e. CHECK—Stable display can be obtained in both + and — positions of B SLOPE switch for AC and DC positions of B COUPLING switch.

f. Adjust generator output amplitude for 5 division display.

g. CHECK—Stable display can be obtained in both + and — positions of B SLOPE switch for LF REJ and HF REJ positions of B COUPLING switch.

h. Set HORIZ DISPLAY to A.

i. CHECK—Stable display can be obtained in both + and — positions of A SLOPE switch for LF REJ and HF REJ positions of A COUPLING switch.

16. 10 MHz EXTERNAL TRIGGERING

a. Set generator frequency to 10 MHz. Set A and B TIME/DIV to .05 μs.

b. CHECK—Stable display can be obtained in both + and — positions of A SLOPE switch for LF REJ position of A COUPLING switch.

c. CHECK—No stable display can be obtained in HF REJ position of A COUPLING switch.

d. Set HORIZ DISPLAY to B DLY'D.

e. CHECK—Stable display can be obtained in both + and — positions of B SLOPE switch for LF REJ position of B COUPLING switch.

f. CHECK—No stable display can be obtained in HF REJ position of B COUPLING.

g. Set HORIZ DISPLAY to A.

h. CHECK—Stable display can be obtained in both + and — positions of A SLOPE switch for AC and DC positions of A COUPLING switch.

i. Set HORIZ DISPLAY to B DLY'D.

j. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 2.5—division display. Return generator frequency to 10 MHz.

k. CHECK—Stable display can be obtained in both + and — positions of B SLOPE switch for AC and DC positions of B COUPLING switch.

17. 50 MHz EXTERNAL TRIGGERING

a. Set HORIZ DISPLAY to A and set CH 1 and CH 2 VOLTS/DIV switches to 50 mV.

b. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 5 division display.

c. Set generator frequency to 50 MHz.

d. CHECK—Stable display can be obtained in both + and — positions of A SLOPE switch for AC, LF REJ, and DC positions of A COUPLING switch.

e. CHECK—No stable display can be obtained in HF REJ position of A COUPLING switch.

f. Set HORIZ DISPLAY to B DLY'D.

g. CHECK—Stable display can be obtained in both + and — positions of B SLOPE switch for AC, LF REJ, and DC positions of B COUPLING switch.

h. CHECK—No stable display can be obtained in HF REJ position of B COUPLING switch.

18. 50 MHz INTERNAL TRIGGERING

a. Set:

HORIZ DISPLAY	A
A and B SOURCE	NORM

b. Set generator frequency to 50 MHz and adjust output amplitude for 1.5 division display.

c. CHECK—Stable display can be obtained in both + and — positions of A SLOPE switch for these modes:

A SOURCE	A COUPLING
NORM	AC, LF REJ, DC
CH 1	DC
CH 2	DC

d. CHECK—No stable display can be obtained with A COUPLING switch in HF REJ position.

e. Set HORIZ DISPLAY to B DLY'D.

f. CHECK—Stable display can be obtained in both + and — positions of B SLOPE switch for these modes:

B SOURCE	B COUPLING
NORM	AC, LF REJ, DC
CH 1	DC
CH 2	DC

g. CHECK—No stable display can be obtained with B COUPLING in HF REJ position.

19. Z AXIS INPUT

a. Set:

A and B TIME/DIV	10 μs
HORIZ DISPLAY	A
A and B COUPLING	AC
A SOURCE	EXT
CH 1 VOLTS/DIV	.1 V

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

c. Disconnect 50 Ω cable and termination from dual-input cable connected to CH 1 and CH 2 inputs and connect to EXT Z AXIS connector at rear of instrument.

d. CHECK—Trace modulation is noticeable at normal intensity. (Adjust A LEVEL control as required to obtain stable display).

20. TRIGGER LEVEL RANGES

a. Remove cable from Z AXIS INPUT connector and connect (without 50 Ω termination) to dual-input cable at vertical module.

b. Set:

A and B SLOPE	OUT: +
CH 1 VOLTS/DIV	1 V
A and B SOURCE	EXT

c. Set generator output to 50 kHz and adjust amplitude for 4 division display.

d. CHECK—Display is triggered along positive-going slope of waveform as A LEVEL control is rotated and is not triggered (free-runs) at either extreme of A LEVEL rotation.

e. Set A SLOPE to IN: —.

f. CHECK—Display is triggered along negative-going slope of waveform as A LEVEL control is rotated and is not triggered at either extreme of A LEVEL rotation.

g. Set HORIZ DISPLAY to B DLY'D.

h. CHECK—Display is triggered along positive-going slope of waveform as B LEVEL control is rotated and is not triggered (not visible) at either extreme of B LEVEL rotation.

i. Set B SLOPE to IN: —.

j. CHECK—Display is triggered along negative-going slope of waveform as **B LEVEL** control is rotated and is not triggered (not visible) at either extreme of B LEVEL rotation.

k. Disconnect test equipment.

21. A AND B SWEEP RATE ACCURACY

a. Set:

A SOURCE	NORM
B SOURCE	STARTS AFTER DELAY
A and B SLOPE	OUT: +
HORIZ DISPLAY	A

b. Connect test equipment as shown in Fig. 3-6.

c. CHECK—A TIME/DIV accuracy according to Table 3-3. Incremental accuracy should be 1 time mark/division within 2% (within 0.2 div at the 11th graticule line).

d. Set HORIZ DISPLAY to B DLY'D.

e. CHECK—B TIME/DIV accuracy according to Table 3-3 (adjust A **LEVEL** control as needed for a stable display).

NOTE

If the 11th time marker is not visible, set the A TIME/DIV switch one position counterclockwise from the B TIME/DIV switch. Example:

A TIME/DIV	*1 ms*
B TIME/DIV	*0.5 ms*

TABLE 3-3
A and B Timing Accuracy

A and B TIME/DIV Switch Setting	Time-Mark Generator Output
.05 μs	50 ns
.1 μs	0.1 μs
.2 μs	0.2 μs
.5 μs	0.5 μs
1 μs	1 μs
2 μs	2 μs
5 μs	5 μs
10 μs	10 μs
20 μs	20 μs
50 μs	50 μs
.1 ms	0.1 ms
.2 ms	0.2 ms

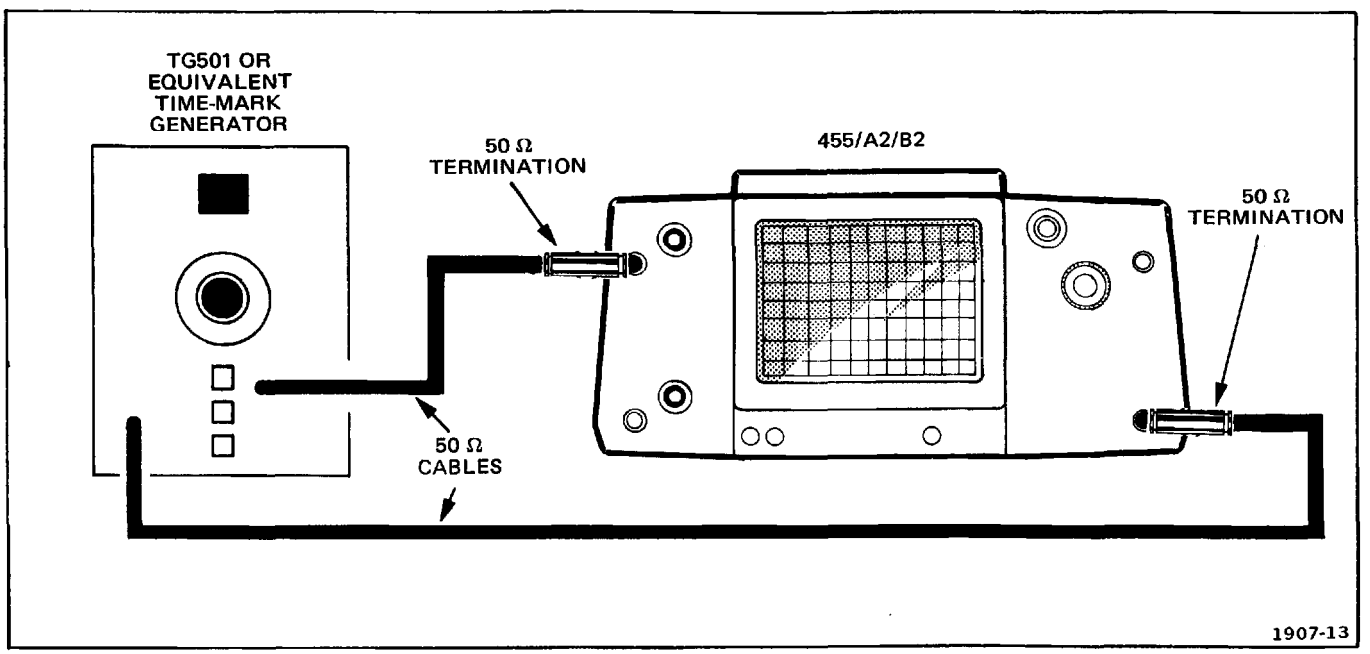


Fig. 3-6. Time-mark generator test setup.

TABLE 3-3 (continued)
A and B Timing Accuracy

A and B TIME/DIV Switch Setting	Time-Mark Generator Output
.5 ms	0.5 ms
1 ms	1 ms
2 ms	2 ms
5 ms	5 ms
*10 ms	10 ms
*20 ms	20 ms
*50 ms	50 ms
A SWEEP ONLY	
*.1 s	0.1 s
*.2 s	0.2 s
*.5 s	0.5 s

*** Set TRIG MODE switch to NORM.**

22. MAGNIFIED SWEEP ACCURACY

a. Set generator for 10 ns time marks.

b. Set:

A SOURCE	EXT
A TRIG MODE	AUTO
A and B TIME/DIV	0.5 μs
X10 MAG	in (on)

c. CHECK—B TIME/DIV magnified accuracy according to Table 3-4. One time mark/division within 3% (within 0.3 div at 11th graticule line) except at .05 μs B TIME/DIV setting which should be 1 time mark/2 div. Exclude portions of sweep as indicated in Table 3-4.

d. Set HORIZ DISPLAY to A.

e. CHECK—A TIME/DIV magnified accuracy according to Table 3-4. One time mark/division within 3% (within 0.3 div at 11th graticule line) except at .05 μs A TIME/DIV setting which should be 1 time mark/2 div. Exclude portions of sweep as indicated in Table 3-4.

23. DIFFERENTIAL TIME MEASUREMENT ACCURACY

a. Set generator for 0.1 μs time marks.

TABLE 3-4
A and B Magnified Accuracy

A and B TIME/DIV Switch Setting	Time-Mark Generator Output	Portions of Total Magnified Sweep Length to Exclude From Measurement
.05 μs	10 ns	First and last 8 divisions
.1 μs	10 ns	First and last 4 divisions
.2 μs	20 ns	First and last 2 divisions
.5 μs	50 ns	
1 μs	0.1 μs	
2 μs	0.2 μs	
5 μs	0.5 μs	
10 μs	1 μs	
20 μs	2 μs	
50 μs	5 μs	
.1 ms	10 μs	
.2 ms	20 μs	
.5 ms	50 μs	
1 ms	0.1 ms	
2 ms	0.2 ms	
5 ms	0.5 ms	
10 ms	1 ms	
20 ms	2 ms	
50 ms	5 ms	
A SWEEP ONLY		
*.1 s	10 ms	
*.2 s	20 ms	
*.5 s	50 ms	

*** Change TRIG MODE switch to NORM.**

b. Set:

HORIZ DISPLAY	B DLY'D
A SOURCE	NORM
B SOURCE	STARTS AFTER DELAY
A TIME/DIV	.2 μs
B TIME/DIV	.05 μs
DELAY TIME POS	1.00
X10 MAG	out (off)

c. Position 1st displayed marker to graticule vertical centerline with horizontal POSITION.

d. Set DELAY TIME POS (DTP) control to 9.00. Then move DTP to position 1st displayed marker to graticule vertical centerline.

e. CHECK—DTP reading is 9.00 within 0.07 (8.93 to 9.07).

f. Set generator for 0.5 μs time marks.

g. Set: DELAY TIME POS 1.50

A TIME/DIV .5 μs

h. Position displayed marker to graticule vertical centerline with horizontal POSITION.

i. Set DTP to 8.50. Then move DTP to position 1st displayed marker to graticule vertical centerline.

j. CHECK—DTP reading is 8.50 within 0.07 (8.43 to 8.57).

k. CHECK—Delayed sweep accuracy according to Table 3-5. Use 1.00 for 1st DTP setting and 9.00 for 2nd setting. If 1st time-mark start is not visible, use 2nd time mark.

TABLE 3-5
Differential Time Accuracy

Time-Mark Generator Output	A TIME/DIV Switch Setting	B TIME/DIV Switch Setting	DTP Setting
1 μs	1 μs	0.1 μs	
2 μs	2 μs	0.2 μs	
5 μs	5 μs	0.5 μs	
10 μs	10 μs	1 μs	
20 μs	20 μs	2 μs	
50 μs	50 μs	5 μs	
0.1 ms	0.1 ms	10 μs	
0.2 ms	0.2 ms	20 μs	
0.5 ms	0.5 ms	50 μs	8.925 to 9.075
1 ms	1 ms	.1 ms	
2 ms	2 ms	.2 ms	
5 ms	5 ms	.5 ms	
10 ms	10 ms	1 ms	
20 ms	20 ms	*2 ms	
50 ms	50 ms	*5 ms	
0.1 s	0.1 s	*10 ms	
0.2 s	0.2 s	*20 ms	
0.5 s	0.5 s	*50 ms	

*** Change TRIG MODE to NORM**

24. DELAY TIME JITTER

a. Set: A TRIG MODE AUTO

A TIME/DIV 1 ms

B TIME/DIV .5 μs

DELAY TIME POS 1.00

b. Set the Time-Mark Generator for 1 ms time marks, and set DTP to position a time mark to the graticule vertical center line.

c. CHECK—Horizontal jitter is 1 division or less.

d. Repeat part c with DTP set at 9.00.

e. Disconnect test equipment.

25. + GATE OUT

a. Set: A and B TIME/DIV 2 μs

HORIZ DISPLAY A

A TRIG MODE AUTO

A SOURCE NORM

b. Connect test oscilloscope to + GATE OUT connector at rear of instrument via an unterminated BNC cable.

c. CHECK—Output is a positive-going pulse of about 5.5 V amplitude.

NOTE

The + GATE OUT signal is internally set at factory for A gate output. It can be set for B gate by removing cabinet top and moving P2800 (on B2 module) to B gate position.

d. Disconnect test oscilloscope.

26. CHOPPED MODE REP RATE

a. Set VERT MODE to CHOP and set A LEVEL for stable display.

b. CHECK—About 1 complete square-wave cycle/2 divisions.

27. CALIBRATOR OUTPUT

a. Set: CH 1 VOLTS/DIV .1 V
A TIME/DIV .5 ms

b. Connect CALIBRATOR output to CH 1 input.

c. CHECK—For square-wave display of 300 mV (3 div) at approximately 1 kHz (1 full cycle/2 div).

NOTE

Calibrator signal peak-to-peak amplitude should be 300 mV within 1%. If necessary to check amplitude to this accuracy, refer to the Adjustments section.

CIRCUIT DESCRIPTION

CAUTION

SERVICING INFORMATION IN THE FOLLOWING SECTIONS IS INTENDED FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT REMOVE INSTRUMENT COVERS OR PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

This section describes the circuitry used in the 455/A2/B2 Oscilloscope. The description begins with a discussion of the basic circuit functions of each module, then expands into a detailed description of the individual circuits. Refer to the Block Diagrams and the schematic diagrams in the Diagrams section.

BASIC CIRCUIT FUNCTIONS

455 MAIN MODULE

Most of the 455 circuitry is contained on the main circuit board which is mounted on the lower part of the module.

The 455 Main Module contains the basic display functions of the oscilloscope. It houses the Calibrator, Sweep Gate Amplifier, Horizontal Output Amplifier, Z Axis Amplifier, CRT, and Power Supply circuits.

The Calibrator circuit produces a square-wave output with an accurate voltage amplitude for checking instrument calibration and compensating probes.

The Sweep Gate Amplifier amplifies the sweep gate signal, from the Horizontal Module, for output through the + GATE OUT connector at the rear of the instrument.

The Horizontal Module output connects to the Horizontal Output Amplifier through the interface connector. The Horizontal Output Amplifier amplifies the signal from the Horizontal Module to drive the crt horizontal deflection plates.

The Z Axis Amplifier circuit determines crt intensity and blanking. It sums the blanking signals from the Vertical Module, Horizontal Module and the EXT Z AXIS IN connector. The output level of the Z Axis Amplifier circuit controls the display intensity through the CRT circuit. The CRT circuit provides the voltages and controls to operate the crt.

The Power Supply circuit provides the low-voltage power (except +95 volt which is developed in the CRT circuit) necessary for operation of the entire oscilloscope. Voltages are distributed to the Vertical and Horizontal Modules through the interface connectors.

The crt vertical deflection plates are driven directly by the output signal from the Vertical Module.

A2 VERTICAL MODULE

The A2 circuitry is contained on a single circuit board. The Preamplifier and Switching circuits are contained within a single Hybrid Integrated circuit (HIC). The HIC is mounted in a special interface connector centered on the circuit board.

The A2 Vertical Module contains the Channel 1 and Channel 2 input, vertical Preamplifier, channel Switching Gates and Vertical Output Amplifier circuits.

Signals to be displayed on the crt are applied to the CH 1 OR X and/or CH 2 OR Y BNC connectors. The input signals are then amplified by the preamplifier circuitry. Each preamplifier circuit includes separate vertical-deflection factor, input coupling, balance, gain, and variable attenuation controls. The vertical deflection factor for each channel is indicated by two small lights located close to the skirt of each VOLTS/DIV knob. The right indicator lights up to show the correct deflection factor when a 10X probe with a scale-switching connector is used. The left indicator lights when a probe without the scale-switching connector (or no probe) is used.

A trigger pickoff stage in each Preamplifier circuit provides a sample of the Channel 1 and Channel 2 input signals to the Horizontal Module for sweep triggering purposes. A sample of the Channel 2 signal is also supplied to the Main Module for the output to the rear panel CH 2 OUT connector.

In the X-Y mode, the Channel 1 signal is connected to the input of the Horizontal Preamplifier in the Horizontal Module to provide the X-Axis deflection.

The Channel 2 Preamplifier circuit contains an invert feature to invert the channel 2 signal to the crt, CH 2 trigger, and to the CH 2 OUT connector when the INVERT button is pressed.

The outputs of both CH 1 and CH 2 Preamplifier circuits are connected within the HIC to the vertical switching circuit. The vertical switching circuit selects the channel(s) to be displayed, determined by the settings of the VERT MODE switch. In the ALT (alternate) mode, sync pulses from the Horizontal Module trigger the Channel Switching Multivibrator to alternately connect the outputs of the preamplifiers to the Delay-line Driver and Vertical Output Amplifier circuits.

When the VERT MODE switch is in the CHOP (chopped) mode, the Channel Switching Multivibrator free-runs at about 250 kHz, providing a dual-trace presentation of the signals on both channels. Chopped blanking pulses are sent to the CRT Z-Axis circuit to blank the crt during switching transitions.

The output of the vertical switching circuit is connected to the Vertical Output Amplifier through the Delay-Line Driver circuit and the Delay Line. The Vertical Output Amplifier circuit provides the final signal amplification needed for driving the vertical deflection plates. The BEAM FINDER switch, in the Main Module, connects to this circuit and, when pressed, limits vertical deflection to the viewing area as an aid in locating off-screen displays.

B2 HORIZONTAL MODULE

The B2 Horizontal Module contains the Sweep Generator, Trigger Generator, Sweep Control and Horizontal Preamplifier circuits. The A and B Triggering circuits produce a gate pulse that starts the A or B Sweep Generator circuits. The input signal to the A and B trigger circuits can be individual selected from the Channel 1 signal, the Channel 2 signal, th external trigger input connectors, or a sample of the line voltage powering the instrument. Each trigger circuit contains LEVEL, SLOPE, COUPLING and SOURCE controls.

The A Sweep Generator circuit, when initiated by the A Trigger circuitry, produces a linear sawtooth output signal, the slope of which is controlled by the A TIME/DIV switch. The TRIG MODE switch controls the operating mode of the A Trigger circuitry. In the AUTO position, the absence of an adequate trigger signal for about 100 ms after the end of sweep holdoff causes an A sweep start gate to be generated. In the NORM position, a sweep occurs only when correctly triggered by an adequate trigger signal. Pushing the SGL SWP pushbutton allows only one sweep to be initiated.

The B Sweep Generator is basically the same as the A Sweep Generator circuit. However, it only produces a sawtooth output signal after a delay time determined by the A TIME/DIV switch and the DELAY TIME POS dial. If the B Triggering SOURCE switch is set to the STARTS AFTER DELAY position, the B Sweep Generator begins to produce the sweep immediately following the selected delay time. If the switch is in one of the remaining positions, the B Sweep Generator circuit does not produce a sweep until it receives a trigger pulse from the B Trigger circuit which occurs after the selected delay time.

Both A and B Sweep Generators produce an unblanking gate signal to unblank the crt so that the display can be presented. These unblanking pulses are coincident with their respective sweep outputs.

The + gate signals, which are also coincident with the sweep outputs, are supplied to a rear panel connector. The A gate or B gate can be selected by moving plug P2800.

The Sweep Control circuit produces an alternate-trace sync pulse that is connected to the Channel Switching circuit in the Vertical Module. This pulse switches the display between channels at the end of each sweep when the alternate-trace mode is used.

The output of either the A or B Sweep Generator is amplified by the Horizontal Preamplifier and Horizontal Output Amplifier circuits (Main Module) to produce horizontal deflection for the crt, except in the fully counterclockwise position (X-Y) of the TIME/DIV switch. This circuit contains a X10 magnifier to increase the sweep rate 10 times in any A or B TIME/DIV switch position. Other horizontal deflection signals can be connected to the Horizontal Preamplifier by using the X-Y mode of operation. When the TIME/DIV switch is set to X-Y, the X signal is connected to the Horizontal Preamplifier circuit through the Channel 1 Vertical Preamplifier circuit in the Vertical Module.

DETAILED CIRCUIT OPERATION

The following detailed circuit description is subdivided according to the Block Diagram in the Diagrams section. Simplified diagrams are used where necessary for clarity. Complete schematic diagrams are located in the Diagrams section. Refer to the Diagrams section throughout the following discussion for circuit numbers, electrical values and circuit relationships. The waveforms and voltages shown on the diagrams are helpful for understanding circuit operation.

Diamond enclosed diagram numbers relate circuit descriptions to pull-out pages in the Diagrams section.

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

CALIBRATOR ◇1

The Calibrator circuit produces an accurate 300 mV square-wave output. The circuit consists of an astable multivibrator and an output amplifier. A 30 mA calibrator current output is also available when a current loop[1] is plugged into the CALIBRATOR output jacks.

Multivibrator

Transistors Q376, Q382 and associated circuitry compose an emitter-coupled astable multivibrator. The multivibrator runs as approximately 1 kHz. The frequency is determined by the RC time constant of C376-R377-R375. Transistors Q376 and Q382 conduct alternately, producing a square-wave output signal at the collector of Q382. Diodes CR372 and CR373 limit the charge of C376 to approximately 18 volts to prevent damage to Q376 or Q382 when either is removed or replaced while the instrument is operating.

Output Amplifier

The square-wave output signal from Q382 drives the output amplifier Q386 from cutoff to saturation, producing an accurate square wave at the output connector. Transistor Q386 is cut off when the square-wave signal rises to maximum and goes into saturation when the signal falls to minimum. Amplitude adjustment R386 adjusts the current through Q386, R387 and R388 to accurately set the calibrator output voltage.

HORIZONTAL OUTPUT AMPLIFIER ◇1

The Horizontal Output Amplifier provides the final signal amplification to drive the crt horizontal deflection plates. The negative-going and positive-going horizontal output signals from the Main Module drive two single-ended feedback amplifier stages. The amplifiers have a low input impedance and require very little voltage change at the input to produce the desired output change.

Transistor Q234 is a constant voltage source. Transistor Q234 and diodes CR235 – CR236 set the bases of Q232 and Q274 near the same quiescent dc level.

Transistors Q232 and Q274 are inverting amplifiers whose collector signals drive the emitters of complementary amplifiers Q244 – Q246 and Q284 – Q286 respectively.

The output signal from complementary amplifier Q244 – Q246 drives the right horizontal deflection plate. The output from complementary amplifier Q284 – Q286 drives the left horizontal deflection plate.

Capacitors C236, C244 and C284 provide a signal path for fast ac signal current from one side of the amplifier to the other. Resistors R233 – R232 and R272 – R273 are feedback elements in the amplifier. Capacitors C232 and C272 provide high frequency compensation.

SWEEP GATE AMPLIFIER ◇1

The Sweep Gate Amplifier amplifies the Sweep Gate Signal (A or B selected by moving P2800) from the Horizontal Module for output to the + GATE OUT connector at the rear of the main module.

The Sweep Gate Amplifier consists of amplifier Q356 and emitter follower Q358. Diode VR353 limits gate output to +5 volts. Diode CR352 sets the quiescent output level at about 0 volt.

[1] **To make a plug-in current loop, order Tektronix Part 012-0259-00 and modify it by replacing the 50 Ω resistor (inside) with a bare wire. A current loop also can be made from 5 turns of insulated wire.**

Diode CR358 protects the Sweep Gate Amplifier in the event that greater than +5 volts is applied to the + GATE OUT connector.

CRT CIRCUIT ②

The CRT circuit provides the voltage levels and control circuits to operate the crt. The circuitry consists of the z axis amplifier, high-voltage oscillator, high-voltage regulator, +95 volt low-voltage supply, high-voltage rectifier, high-voltage multiplier, and the crt controls.

High-Voltage Oscillator

Transistors Q552, Q556 comprise a high-voltage (HV) oscillator that produces drive for high-voltage transformer T550. Transistor Q556 and inductor L554 store additional energy from the +32 volt unregulated supply (at high power-line voltages) and supply that energy to the HV transformer. In this way, the additional energy is used, not lost in heat.

The following describes the sequence of events in the HV oscillator circuits. See Figure 4-1 for waveform relationships.

When the instrument is turned on, R542 provides start-up current to ensure that Q544 and Q548 turn on. Current from Q548 charges C548 to a level determined by the −2 kV feedback (through R563 A and B) to the base of Q544. As the voltage induced into the feedback windings swings positive, it adds to the voltage across C548, and Q552 is biased into conduction. Capacitor C548 provides the current for the base circuit, causing Q552 to turn on. Diodes CR554 and CR553 prevent Q552 from saturating, and provide temperature compensation for the base drive. The amount of voltage on C548 determines when Q552 turns on thereby controling the regulation. For example, Q552 turns on when the output voltage (−2 kV) attempts to go more negative.

Current then builds up through L554 and T550. Voltage is induced into the feedback windings keeping Q552 on until the rate of current change through L554 and T550 drops to zero, causing feedback current to drop and turn off Q552.

When Q552 turns off, the polarity of the voltage across L554 reverses, turning on Q556 by way of CR555. The turning on of Q556 places L554 in parallel with the T550 primary winding, which discharges the energy stored in L554 into T550. Transistor Q556 turns off when L554 has discharged to a point where its base drive is not sustained through CR555.

The feedback voltage again reaches a level which turns on Q552. Capacitor C548, which has been charging since Q552 turned off, discharges through the base circuit, saturates Q552 and the cycle repeats.

The oscillator frequency is determined by the resonant frequency of T550, which is about 45 kHz.

Capacitor C558 and inductor L558 provide decoupling to the +32 volt unregulated supply to prevent oscillator current from disturbing the +32 volt supply.

High-Voltage Regulator

The high-voltage regulator circuit consists of Q544, Q548, and their associated circuitry.

Regulation occurs as Q552 is turned on for more or less time. Feedback from the −2 kV output at pin 9 of U550 is applied to the base of Q544 through R563B. If the −2 kV starts to go more negative, Q544 collector goes more positive. This reduces the current in Q548 and allows C548 to maintain a

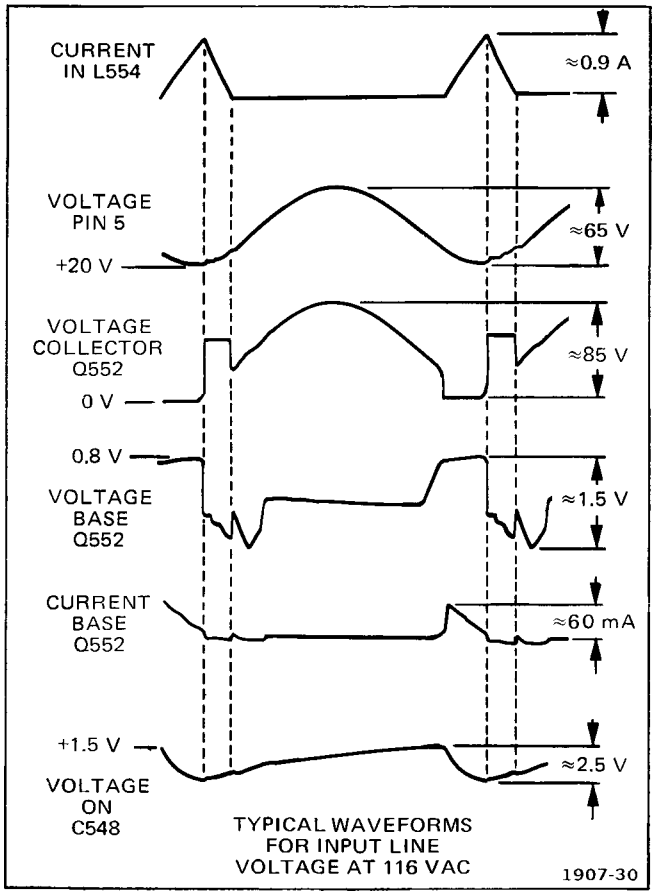


Fig. 4-1. HV-oscillator waveform relationships.

more negative charge. The more negative the voltage across C548, the later Q552 turns on. See Figure 4-1 showing voltage at C548. If the −2 kV starts to go less negative, C548 is allowed to maintain a more-positive charge, thus Q552 turns on sooner.

High-Voltage Circuitry

The secondary windings of the high-voltage transformer provide crt heater current, voltage for the +95 volt supply, and three 45 kHz sine-wave voltages (150 volt peak at terminal 8, 2 kV peak at terminal 9, and 3.3 kV at terminal 10) to the encapsulated module, U550. Encapsulated module U550 houses a high-voltage multiplier, a dc restorer circuit and high-voltage rectifiers and filters for the crt voltages; −2 kV (pin 9) and −2.1 kV (pin 4), adjustable from −2050 volts to −2090 volts by R532.

The CRT Bias adjustment R532, connected to pin 2 of U550, is adjusted to set the level at which the Z Axis Amplifier circuit extinguishes the crt display.

Crt Control Circuits

Crt-display focus is controlled by FOCUS control R564. ASTIG adjustment R576, which is used in conjunction with the FOCUS control to provide a well-defined display, varies the positive level on the astigmatism grid. Geometry adjustment R572 varies the positive level on the horizontal deflection plate shields to control the overall geometry of the display.

Two adjustments control the trace alignment by varying the magnetic field around the crt. Y Axis adjustment R573 controls the current through L573, which affects the crt beam after vertical deflection, but before horizontal deflection. Thus, it affects only the vertical (Y) components of the display. TRACE ROTATION adjustment R571 controls the current through L571 and affects both vertical and horizontal components of the display.

Z Axis Amplifier

The Z Axis Amplifier circuit controls the crt intensity level from several inputs. The effect of these input signals is either to increase or decrease the trace intensity, or to completely blank portions of the display. The input transistor Q514 is a current-driven, low-input-impedance amplifier. It provides termination for the input signals as well as isolation between the input signals and the following stages. The current signals from the various control sources are connected to the emitter of Q514 and the algebraic sum of the signals determines the collector conduction level.

Transistors Q518, Q526, and Q524 compose a feedback amplifier stage, with R515 and R516 as the feedback elements. Capacitors C515 and C516 provide high-frequency compensation. Q518 is an emitter follower providing drive to complementary amplifier Q526-Q524. Diodes CR525, CR518, and CR524 provide protection in the event of high-voltage arcing.

When the BEAM FINDER pushbutton is pressed, the output of the Z Axis Amplifier moves to a fixed level so that the crt is unblanked. Any incoming Z Axis signals are disconnected from the amplifier by the reverse bias on CR514.

With the BEAM FINDER pushbutton pressed, +32 volts is removed from R512 and +5 volts is applied to R504. This reduces the current in Q514, which turns off CR514 and disconnects the Z Axis input from Q518. Current through Q526 decreases and its collector voltage goes up due to feedback resistors R515 and R516. This action supplies additional current to the base junction of Q518, thus replacing current previously flowing through R503. The increased voltage on the collector of Q526 unblanks the crt which provides a visible display even though the crt might otherwise be blanked or unintensified.

LOW-VOLTAGE POWER SUPPLY ◈3

Description

The low-voltage Power Supply circuit provides three of the regulated low voltage sources (+5 volts, −5 volts, +32 volts) used to operate the main, vertical, and horizontal modules. A fourth low-voltage supply, +95 volts, is produced in the CRT circuit.

The +32 volts is zener referenced and adjustable with the +32 volt internal calibration adjustment (R736). All other regulated supplies in the instrument, including the +95 volt and crt high-voltage supplies, depend on the +32 volts for their accuracy.

Setting the +32 volt supply accurately, with the +32 volt adjustment (R736), sets all other regulated-supply voltages within specifications, providing the supplies are functioning correctly.

Power Input

Ac power is applied to the primary of T700 through line fuse F700, POWER switch S700, and the line voltage selector switch S701. The line voltage selector switch S701 connects the split primary windings of T700 in parallel for 116 volts ac operation and in series for 232 volts ac. When

changing from one line voltage to the other, the line fuse should be changed as follows: 1 amp fast blow for 116 volts or 0.5 amp fast blow for 232 volts.

The unused windings (pins 5, 6, 18, 19, 20, 21, and 22) of T700 are provided for use with instrument options.

Secondary Circuit

Integrated circuits U722A, U722B and U762 are high-gain amplifier cells with differential inputs. These amplifiers monitor voltage variations in the output voltages and provide correction signals to the series-regulating transistors.

Current limiting circuits provide short-circuit protection for each of the regulated supplies. The following text discusses the +32 volt current-limiting circuit. The other current-limiting circuits operate similarly.

In the +32 volt supply, Q734 is normally biased off. Under normal conditions the base of Q734 sets at about +32 volts. As the supply current increases, the voltage drop across R734 increases. This increasing voltage is coupled through Q736 to voltage divider, R732 and R733, causing the base of Q734 to go more positive. When the supply current increases sufficiently beyond the normal operating current, Q734 turns on. The collector of Q734 moves in the negative direction, which begins turning off Q732 and Q736, and creates a fold-back condition. See Figure 4-2. Transistor Q736 continues to conduct some current when the supply is limited, which drops enough voltage across R734 to keep Q734 biased on. Resistor R731 acts to keep the minimum fold-back current constant as the input line voltage changes.

The series regulating element in the −5 volt supply is a type of Darlington configuration, consisting of Q766, Q768 and R777. Transistor Q768 is the current carrying element and Q766 is the controlling element. The five diodes CR762, CR763, CR764, CR765 and CR766 provide a level shift with little attenuation of the error signal.

Fuses F736, F746 and F768 provide short-circuit protection for each of the unregulated supplies.

Disconnect-Jumper wires are located in series with the regulated voltage lines for use in troubleshooting.

Line triggering signal is taken from pin 17 of T700 through resistive divider R772-R773. Capacitor C773 is provided to reject unwanted high-frequency signals.

The SCALE ILLUM control, through Q784, varies the voltage across the graticule lights DS784 and DS786 from 0 to 6.6 volts.

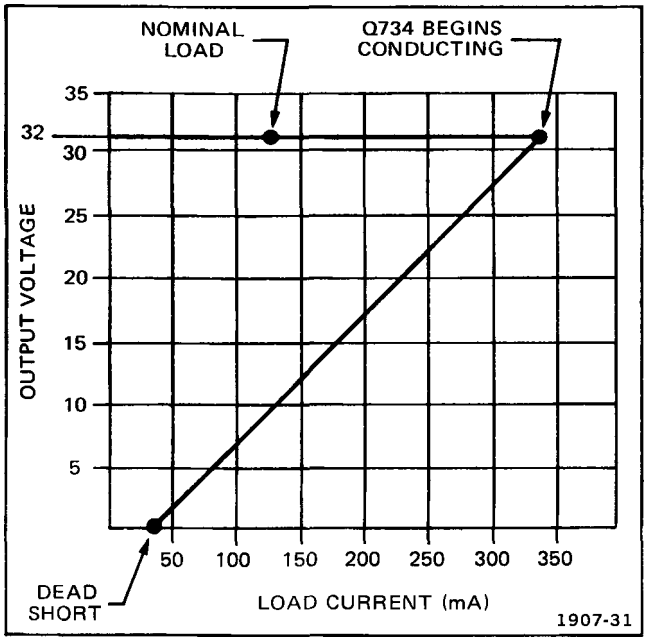


Fig. 4-2. Foldback circuit action.

CHANNEL 1 AND CHANNEL 2 INPUT CIRCUITS ④

The Input circuits are composed of the Scale Factor Control, Input Coupling and Attenuators, and the FET Input Source Follower. The Channel 1 and Channel 2 input circuits are identical, therefore, only the channel 1 circuit is discussed in detail.

Scale Factor Control

Scale factor indicators light when +5 volts is applied to the emitters of Q4114-Q4116 and/or Q4214-Q4216 by the VERT MODE switch.

When CH 1 pushbutton is pushed, +5 volts is disconnected from the channel 2 circuit and when CH 2 pushbutton is pushed, +5 volts is disconnected from the channel 1 circuit. Both circuits are connected to +5 volts when the VERT MODE switch is in any of the other modes.

When the CH 2 pushbutton is out, +5 volts is applied to the emitters of Q4114 and Q4116. If no probe or a 1X probe is connected to the CH 1 input connector, Q4116 conducts and turns on the 1X scale factor light-emitting diode (LED) CR4117. If a 10X probe with a scale-switching connector is connected to the CH 1 input connector, R4112 is grounded (through 11 kΩ resistor in probe) and Q4114 is biased into conduction. This turns on the 10X LED CR4115, biases off Q4116, and turns off CR4117.

Input Coupling and Volts/Division Switching

The Channel 1 and Channel 2 Input Coupling, Attenuator, and Gain Switching circuits A4100 (CH 1), A4200 (CH 2), A4162 (CH 1), and A4262 (CH 2) are made up of thick-film resistors on ceramic substrate.

Signals applied to the input connector can be ac-coupled, dc-coupled, or internally disconnected from the input to the Preamplifier circuit. When the Input Switch S4100A is set to DC, the input signal is coupled directly to the attenuator. When set to AC, the input signal passes through C4100A on its way to the attenuator. The capacitor blocks the dc component of the signal. In the GND position, the signal path to the attenuator is open and the input to the attenuator is grounded. This provides a ground reference without disconnecting the input signal from the input connector. Resistor R4100A allows C4100A to precharge in the GND position so that the trace remains on screen when switched to the AC position.

The effective overall deflection factor of each channel is determined by the VOLTS/DIV switch setting. The basic deflection factor of the vertical deflection system is 5 mV/div. At this setting, no attenuators are switched in and the Preamplifier gain is set to maximum by the Gain Switching circuit. To achieve the complete range of deflection factors indicated on the front panel, precision attenuators are switched in and out of the Attenuator and Gain Switching circuits.

The VOLTS/DIV control operates the attenuator switch (S4100B) contacts and the vertical gain switch (S4162) contacts from a single switch cam.

The Attenuator circuit consists of a 10X and a 100X attenuator. An attenuation factor of 1000X is obtained when the 10X and 100X attenuators are cascaded.

The Gain Switching circuit consists of two 2X gain-reduction networks. A gain reduction of 4X is obtained when both 2X networks are switched in simultaneously.

Figure 4-3 illustrates attenuator and gain switching sequences.

FET Input Source Follower

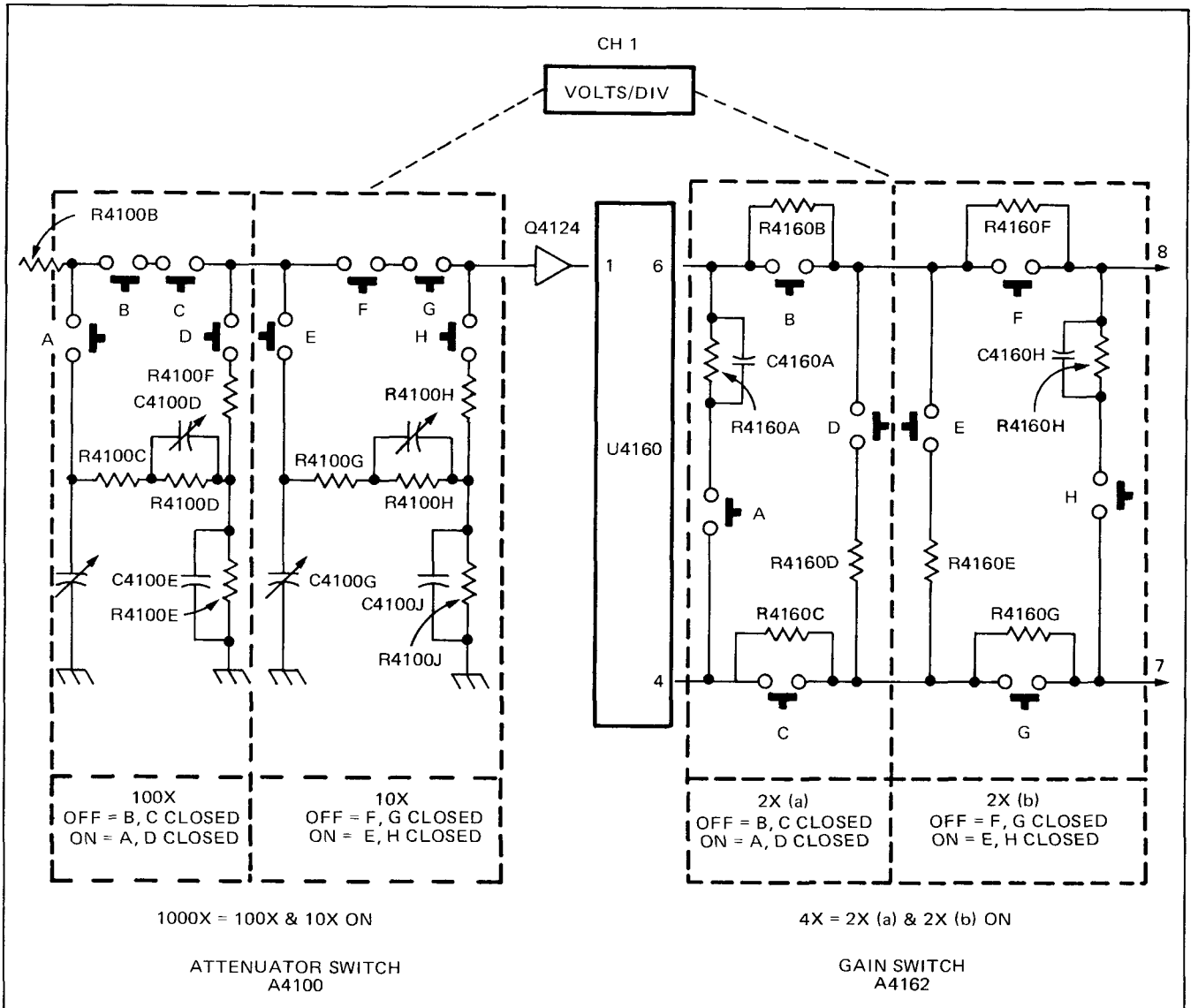
The Channel 1 signal from the Input Attenuator is connected to the source follower Q4124A through R4123 and C4123. Resistor R4122 provides the 1 MΩ input resistance for this channel. Resistor R4123 limits the current drive to the gate of Q4124A when a high-amplitude negative-going signal is applied to the CH 1 OR X input connector. Transistor Q4124B provides a constant current source for Q4124A.

VERTICAL PREAMPLIFIER AND SWITCHING ⑤

The Preamplifier circuit provides the initial stages of signal amplification. The Channel Switching circuit determines whether the Channel 1 and/or Channel 2 signals are connected to the Vertical Output Amplifier. In the alternate and chopped modes of operation, both channels are displayed alternately on a time-sharing basis.

Preamplifier and Channel Switching Gates

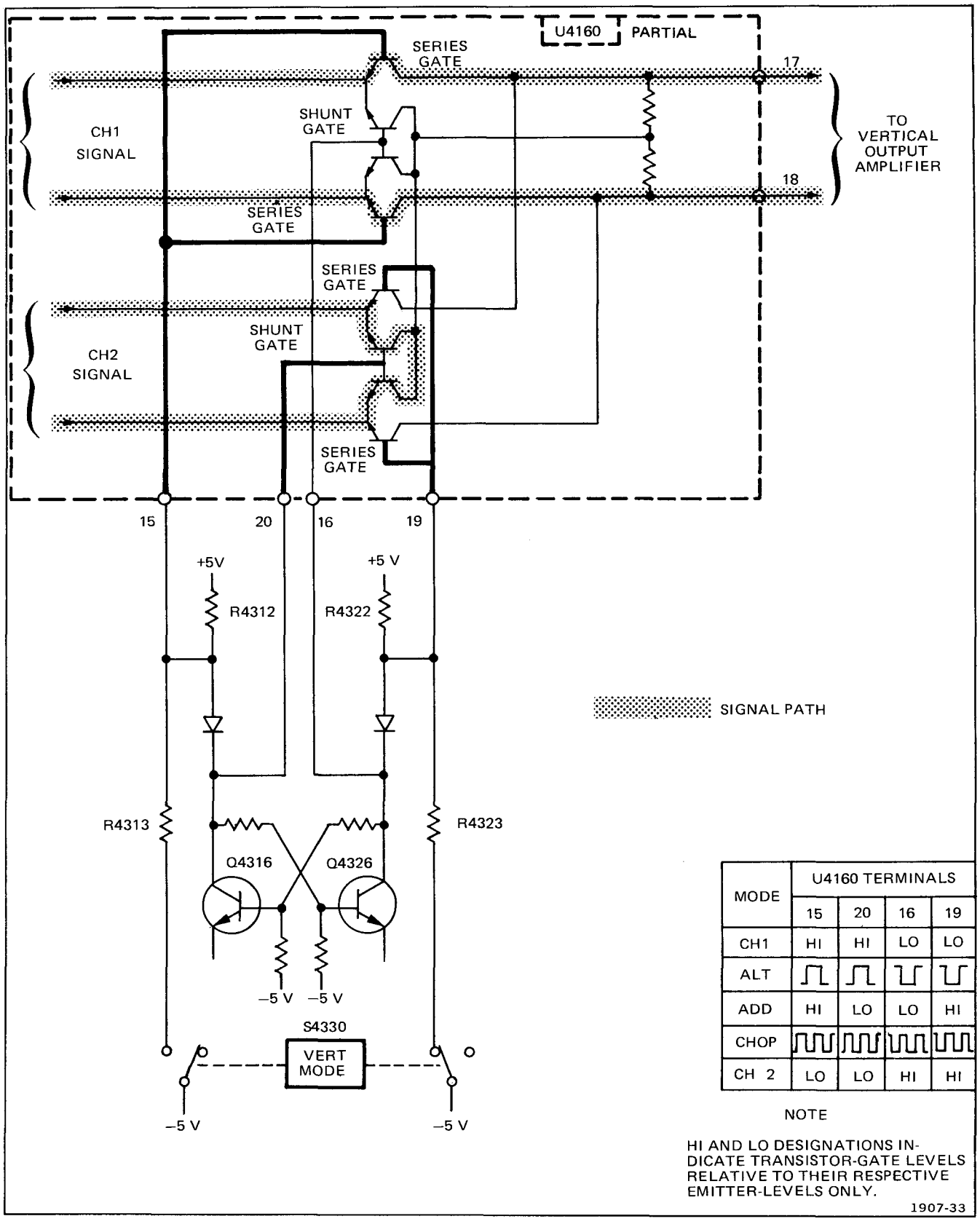
Channel 1 and Channel 2 Preamplifiers and switching gates are contained within a single hybrid integrated circuit (HIC), U4160. Outputs from U4160 provide triggering signals to the Horizontal Module and the CH 2 OUT signal to the Main Module.



VOLTS/DIV SETTING	ATTENUATION	GAIN REDUCTION
5 mV	1X	1X
10 mV	1X	2X
20 mV	1X	4X
50 mV	10X	1X
100 mV	10X	2X
200 mV	10X	4X
500 mV	100X	1X
1 V	100X	2X
2 V	100X	4X
5 V	1000X	1X

1907-32

Fig. 4-3. Attenuator and gain switching sequences.



MODE	U4160 TERMINALS			
	15	20	16	19
CH1	HI	HI	LO	LO
ALT	⎍	⎍	⎎	⎎
ADD	HI	LO	LO	HI
CHOP	⎍⎍	⎍⎍	⎎⎎	⎎⎎
CH 2	LO	LO	HI	HI

NOTE

HI AND LO DESIGNATIONS INDICATE TRANSISTOR-GATE LEVELS RELATIVE TO THEIR RESPECTIVE EMITTER-LEVELS ONLY.

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Fig. 4-4. Channel switching gates.

PREAMPLIFIERS. The Channel 1 input signal from the FET Input Source Follower enters terminal 1 of the HIC; Channel 2 signal enters at terminal 32. Channel 2 Preamplifier contains an INVERT switch that interchanges the + and − signal lines within the HIC.

Gain of the Preamplifiers is controlled by the Gain-Switching circuits. These circuits are discussed along with the descriptions of the VOLTS/DIV switching circuits.

SWITCHING GATES. Transistor gates inside the HIC allow either the Channel 1 or Channel 2 Preamplifier signals to be coupled to the Vertical Output Amplifier. These gates are controlled by the Channel Switching Multivibrator and the VERT MODE switch to provide the various vertical modes.

As shown in Fig. 4-4, there are series and shunt gates for each channel. The series gates, when on, pass the signal to Vertical Output Amplifier. The shunt gates short the + and − signal lines together when the series gates are off.

Channel 1 is on when terminal 15 is HI with respect to terminal 16. Likewise, Channel 2 is on when terminal 19 is HI with respect to terminal 20.

CHANNEL 1 DISPLAY ONLY. When the CH 1 pushbutton is pressed, −5 volts is applied to R4323. Resistors R4323 and R4322 form a divider which sets a LO at terminals 19 and 16. This turns off the Channel 2 series gates and shorts the + and − signal lines together through the shunt gate. See Fig. 4-4.

CHANNEL 2 DISPLAY ONLY. Operation of this mode is identical to that of Channel 1 except that terminals 15 and 20 are switched LO through R4313.

ADDED MODE OPERATION. In the ADD mode, both Channel 1 and Channel 2 signals are displayed simultaneously. Terminal 16 is LO with respect to terminal 15 and terminal 20 is LO with respect to terminal 19. This keeps the shunt gates off and the series gates on. The signal output to the Delay-Line Driver is thus the algebraic sum of the Channel 1 and Channel 2 signals.

Channel Switching Multivibrator

The Channel Switching Multivibrator consists of Q4316, Q4326 and associated circuitry. The VERT MODE switch turns on the multivibrator in the ALT or CHOP modes.

In the ALT mode, the Alternate Trace Sync Pulse Amplifier is turned on, allowing the pulses to switch the multivibrator. In the CHOP mode, the multivibrator is turned on and free runs at about 250 kHz.

As the multivibrator switches states, Channel 1 and Channel 2 switching gates are turned on and off.

ALTERNATE TRACE DISPLAY. In this mode, the Channel Switching Multivibrator operates as a bistable multivibrator. When the ALT pushbutton is pressed, −5 volts is applied to the emitter of alternate amplifier Q4334, turning on either Q4316 or Q4326. For example, when Q4316 is turned on, terminals 15 and 20 go LO, turning off the Channel 1 series gates and allowing only the Channel 2 signal to pass.

The alternate trace sync pulse, from the Horizontal Module, is differentiated by C4334 and applied to the base of Q4334. At the end of each sweep, the alternate trace sync pulse steps negative. The negative pulse momentarily turns off Q4334, which turns off Q4316. When Q4334 turns on again, the charge on C4316 (negative at CR4318 and positive at CR4328) causes Q4326 to turn on. This causes terminals 16 and 19 to go LO, turning off the Channel 2 series gates and allowing only the Channel 1 signal to pass.

CHOPPED MODE OPERATION. In the CHOP mode, the Channel Switching Multivibrator operates as an astable multivibrator, running at about 250 kHz. When the CHOP pushbutton is pressed, −5 volts is applied to the emitters of Q4316 and Q4326 through R4336, T4335, R4318 and R4328. Transistors Q4316 and Q4326 conduct alternately switching Channel 1 and Channel 2 off and on similar to the alternate mode of operation.

The frequency determining components in the CHOP mode are C4316, R4318 and R4328.

The Chopped Blanking Amplifier Q4338 provides an output pulse to the Z Axis Amplifier circuit in the Main Module that blanks out the transition between the Channel 1 and Channel 2 traces. When the Channel Switching Multivibrator changes states, the voltage across T4335 momentarily increases. A negative pulse is applied to the base of Q4338 to turn it off. The width of the pulse at the base of Q4338 is determined by R4335 and C4335. Transistor Q4338 is quickly driven into cutoff and the positive-going output pulse, which is coincident with the trace switching, is connected to the Z Axis Amplifier circuit through R4338.

VERTICAL OUTPUT AMPLIFIER ⑥

The Vertical Output Amplifier circuit provides the final amplification for the vertical deflection signal. This circuit includes the Delay Line, the Delay-Line Driver, the Normal Trigger Pickoff, the Vertical Output Amplifier, and part of the Beam Finder circuitry. Pushing the BEAM FINDER pushbutton compresses an overscanned display to within the viewing area.

Delay-Line Driver

The output from the Channel switching gates, at pin 17 and 18 of U4160, is applied to the Delay-Line-Driver transistors Q4362 and Q4372. Transistors Q4362 and Q4372 are connected as feedback amplifiers with R4362 and R4372 providing the feedback. A sample of the signal at the collector of Q4372 is picked off for the normal trigger signal supplied to the Horizontal Module.

Resistors R4365 and R4375 provide reverse termination for the Delay Line. The TRIG VIEW switch S4380 connects the output of the Trigger view circuit, in the Horizontal Module, to the input of the Delay Line in place of the signal from the Delay-Line Driver. This allows viewing of the trigger signal that is present in the A Trigger circuit in the Horizontal Module.

Delay-line impedance is 75 Ω and provides a 120 ns delay.

Normal Trigger Pickoff

Normal trigger signals are picked off from the collector of Q4372 and sent through emitter-follower transistor Q4394 and on to the Horizontal Module.

Resistors R4386, and 75 Ω line termination (Horizontal Module) divide the signal at the emitter of Q4384 to the appropriate signal level for the trigger.

Vertical Output Amplifier

Transistors Q4434, Q4444, Q4462, Q4464, Q4466, Q4472, Q4474 and Q4476 compose a common-emitter shunt-feedback amplifier. Shunt-feedback transistors Q4462, Q4464, Q4466 and Q4472, Q4474, Q4476 are stacked to eliminate the need for a heat sink and a high-voltage transistor. Feedback is provided through R4473, R4474, R4475 and R4463, R4464, R4465. Feedback compensation capacitors C4464 and C4474 are an integral part of the circuit board.

The sensitivity at the delay-line input to each amplifier half is 50 mV/division and at the input to the crt is about 1.35 volts/division. Thus, the gain of the Vertical Output Amplifier is about 27. The gain is adjustable with calibration adjustment R4436.

Thermal resistor RT4437 provides gain temperature compensation. Variable-capacitance diode CR4437 and capacitor C4437 are used for temperature compensation of the step response; thermal resistor RT4448 varies the bias on CR4437 as the temperature changes. Capacitor C4417 and R4417 provide crt rolloff compensation. Capacitor-resistor combinations C4411, R4411, C4410, C4412, R4412, and C4414, R4414 are provided for Delay-Line compensation.

When the BEAM FINDER pushbutton in the Main Module is pressed, +5 volts is applied to the common-emitter stage through R4435 and R4445. This limits the vertical deflection to within the crt-screen area.

TRIGGER INPUT ⑦

This circuit determines triggering source and coupling and, through source follower stages, presents trigger signals to the Trigger Generator circuit.

SOURCE switches, S2100 (B Trigger), and S2150 (A Trigger), select trigger signals from the following sources:

NORM—Signals displayed on the crt.

CH 1—Signals entering Channel 1 vertical input via emitter follower Q2104.

CH 2—Signals entering Channel 2 vertical input via emitter follower Q2108.

EXT—Signals entering external trigger input connectors.

EXT ÷ 10 (A trigger only)—Signals entering A external trigger input connector attenuated by 10 times through divider network R2154-C2154 and R2155-C2155.

LINE (A trigger only)—A sample of the line voltage is obtained from the power transformer.

STARTS AFTER DELAY (B trigger only)—Allows the B sweep to be gated on by the Delayed Gate pulse only.

Trigger Coupling

The Trigger COUPLING switches provide a means of accepting or rejecting certain components of the trigger signal. Coupling capacitors C2113 and C2115 (A trigger circuit) or C2163 and C2165 (B trigger circuit) block the dc component of the trigger signal, in the AC, LF REJ, and HF REJ positions. In these positions, frequency components below about 60 Hz are attenuated.

In the LF REJ position, frequency components of the trigger signal below about 50 kHz are attenuated, while in the HF REJ position, frequency components above about 50 kHz are attenuated. The DC position passes signals from dc to 50 MHz.

Input Source Follower

Field effect transistors Q2120A and Q2170A are source followers. They provide high input impedance for the trigger signals and also provide isolation between the trigger generator circuit and the trigger signal source. Diodes CR2123 and CR2173 protect Q2120A and Q2170A Transistors Q2120B and Q2170B are high-impedance, relatively constant, current sources for Q2120A and Q2170A. They also provide temperature compensation for Q2120A and Q2170A.

TRIGGER, SWEEP AND HORIZONTAL PREAMPLIFIER ⑧ ⑨

This circuitry contains the Trigger generators, Sweep Generators, Sweep Control, and Horizontal Preamplifier circuits. Trigger signals, selected by the Trigger Input circuit, start the sweep. Control of the sweep, in the various modes, is provided by the Sweep Control IC (integrated circuit) and logic circuits contained within the Sweep Generator IC's.

A and B Trigger Generators

The A and B Trigger Generators are contained within two identical IC's U2600 and U2700. Fig. 4-5 shows a block diagram of the circuitry in these IC's.

The following is a brief description of the function associated with each pin of the IC used for U2600 and U2700.

Pin 1. Ground pin.

Pin 2. Trigger signal in. Input for the trigger signal selected by the Trigger Input circuit.

Pin 3. Trigger level in. Connects to the LEVEL control to determine the level at which the trigger signal at pin 2 produces a sweep-gate output.

Pin 4, 5, 6 and 7. Pins 4 and 7 provide a negative-going and positive-going sample of the trigger input signal when power is applied to pins 4, 5, 6 and 7 through the TRIG VIEW switch in the Vertical Module.

Pin 8. −5 volt supply.

Pin 9. Free run in. (Used on B sweep only.) Controls the state of the Sweep Gate output at pin 10. When pin 9 is HI (STARTS AFTER DELAY mode) pin 10 is LO. When pin 9 is LO, the state of pin 10 is controlled by the state of pin 12 and/or the Trigger Input signal.

Pin 10. Sweep Gate out. Provides a Sweep Gate output to trigger the sweep. When pin 10 goes LO the sweep runs; when it goes HI the sweep is terminated.

Pin 11. Logic Gate out. (Used on A sweep only.) Produces the same output as pin 10, except when pin 9 is HI (STARTS AFTER DELAY mode). The output at pin 10 is not affected by the state of pin 9. This logic gate output is used to initiate the Sweep Control IC functions.

Pin 12. Reset in. The trigger is enabled through this pin. When pin 12 is LO, pin 10 can be switched from HI to LO by an adequate trigger signal which starts the sweep. When pin 12 goes HI, pins 10 and 11 go HI, the sweep is ended, and the trigger is reset.

Pin 13. Ground pin.

Pin 14. Not connected internally.

Pin 15. +5 volt supply.

Pin 16. Slope in. Connects to the SLOPE switch to determine the slope (positive-going or negative-going) from which the trigger signal at pin 2 produces a sweep gate output.

+5 volts on pin 16 produces a + slope trigger output.

0 volts on pin 16 produces a — slope trigger output.

A TRIGGER GENERATOR. Basically, the A Trigger IC, U2700, accepts a selected trigger signal from the Trigger Input circuit and produces a negative sweep gating pulse.

The + position of the SLOPE switch allows triggering on positive-going trigger signals and the — position allows triggering on negative-going trigger signals. The LEVEL control R2712 sets the voltage level, on the trigger signal, at which triggering occurs. Trigger Level Centering adjustment R2715 centers the adjustment range of the LEVEL control.

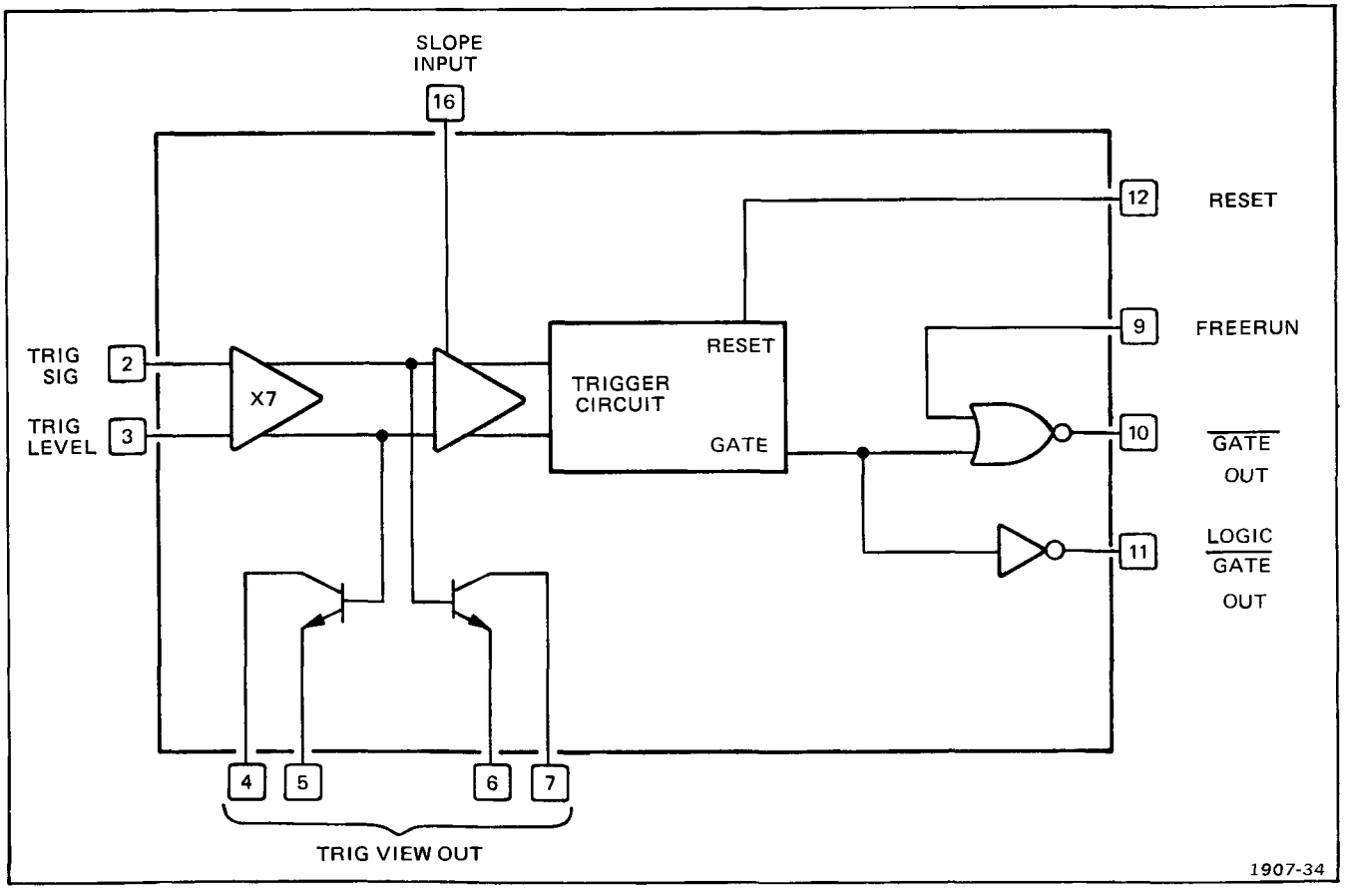


Fig. 4-5. Trigger IC block functional block diagram.

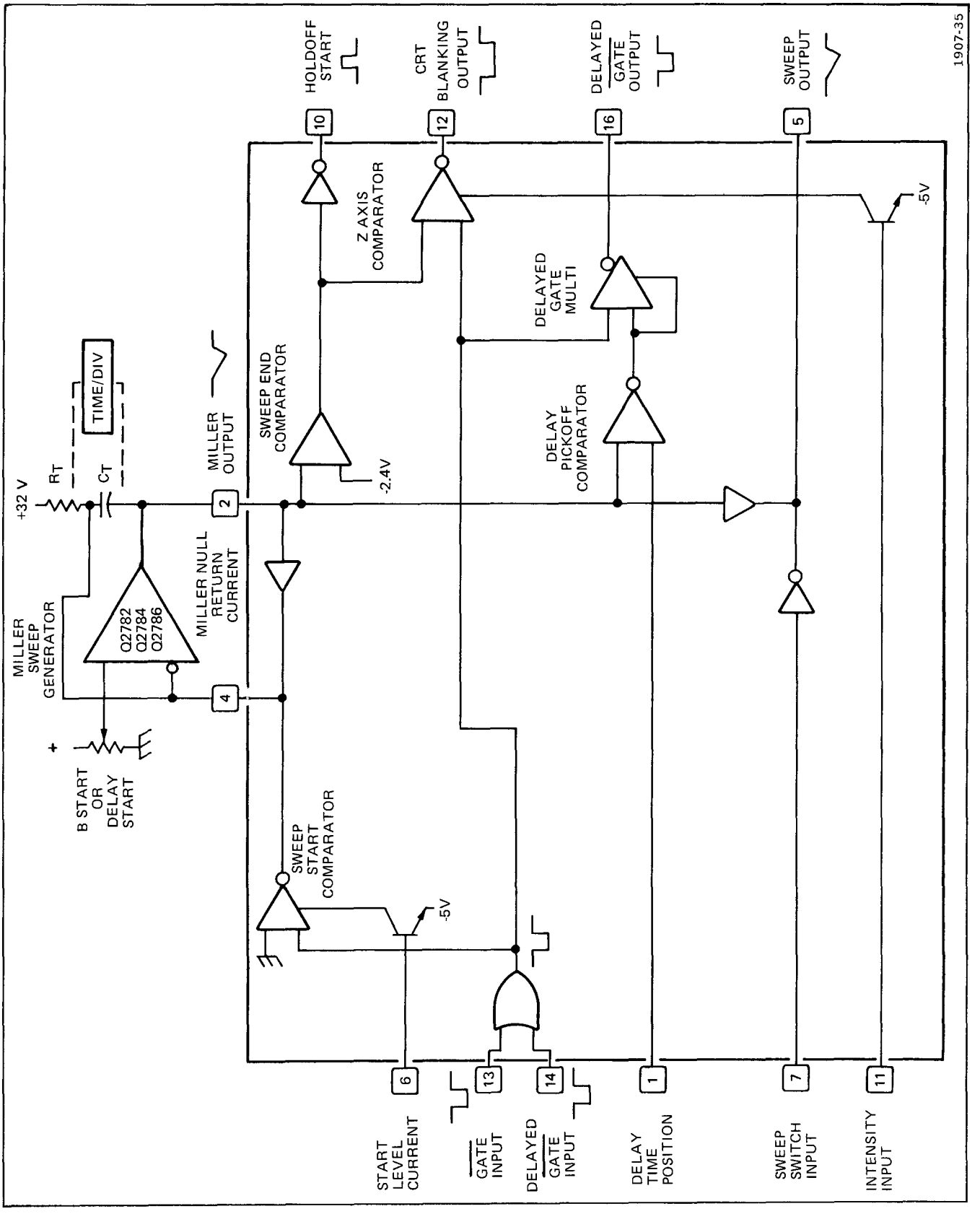


Fig. 4-6. Sweep generator IC Function block diagram.

The Sweep Gate output at pin 10 steps LO to trigger the sweep. The Logic Gate output at pin 11 is identical to pin 10 and is used to trigger Sweep Control circuit functions.

When pin 12 (Reset in) is HI, both pins 10 and 11 are HI and remain HI disabling the sweep until pin 12 goes LO and a triggerable signal occurs.

The trigger view output, pins 4, 5, 6, and 7 provide a sample of the trigger input signal to the Vertical Module for display on the crt.

B TRIGGER GENERATOR. The operation of the B Trigger IC U2600 is similar to that of the A Trigger IC with several exceptions. The pin 11 (Logic Gate output) is not used. Although pin 9 (Freerun) is not used in the A Trigger, it is used in the B trigger. When pin 9 is switched HI by the SOURCE and HORIZ DISPLAY switches, pin 10 (Sweep Gate Out) goes LO to enable triggering of the B Sweep by the A delayed gate pulse at U2690. As long as pin 9 is HI a reset pulse on pin 12 cannot reset pin 10 HI. The trigger view terminals are not used in the B trigger.

Sweep Generator IC's

The A and B Sweep Generators are contained within two identical integrated circuits U2690 and U2790. Fig. 4-6 shows a block diagram of circuitry in these IC's.

The following is a brief description of the function associated with each pin of the IC used for U2690 and U2790.

Pin 1. Delay-time multiplier in. (Used in A sweep only.) Connects to the DELAY TIME POS control to vary the time between the start of the A sweep and the start of the Delayed Gate output at pin 16.

Pin 2. Miller output. The output of the Miller sweep circuit appears on this pin.

Pin 3. Current Source. Sets internal current levels.

Pin 4. Miller Null Return Current. Supplies retrace current and feedback to set the sweep start voltage on the Miller circuit.

Pin 5. Sweep Output. This is the sweep output which is applied to the Horizontal Preamplifier. This output is switched off and on by Pin 7.

Pin 6. Start Level Current Input. Sets current levels in the diodes which determine the sweep start voltage.

Pin 7. Sweep Switch Input. Enables the sweep output at pin 5. When pin 7 is LO, a sweep output at pin 5 can occur; when HI, the sweep output is disabled by the sweep output being pulled to −5 volts.

Pin 8. −5 volt supply.

Pin 9. Ground.

Pin 10. Holdoff Start out. Produces an output to start the holdoff ramp when the sweep ramp has reached its maximum negative level.

Pin 11. Intensity Input. The intensity circuit varies the current into this pin, to change the blanking current at pin 12, which changes the crt intensity level.

Pin 12. Crt Blanking Output. Provides a crt blanking signal to the Z axis circuit to increase, decrease or extinguish the crt intensity.

Pins 13 and 14. $\overline{\text{Gate}}$ Input and Delayed $\overline{\text{Gate}}$ Input. These pins are used together to start and stop the sweep. A negative-going gate pulse applied to pin 13 starts the sweep when pin 14 is LO or a negative-going gate pulse applied to pin 14 starts the sweep when pin 13 is LO. In the A sweep IC, pin 14 is switched HI in the X-Y mode to prevent A sweep operation. In the B sweep IC the delayed gate pulse is applied to pin 14 to start and stop the B sweep.

Pin 15. +5 volt supply.

Pin 16. Delayed Gate Output. (Used in A sweep only.) Provides a delayed gate pulse to start the B sweep. The delayed gate pulse is delayed from the start of the A sweep by a time determined by the DELAY TIME POS control.

Miller Sweep Generator

Transistors Q2782, Q2784, and Q2786 make up the A Miller Sweep Generator. A simplified block diagram of this circuit is shown in Fig. 4-6. Since both A and B sweep circuits operate nearly identically, only the A sweep is discussed. Any exceptions to the operation of the B sweep are also discussed.

When both pins 13 and 14 of U2790 are LO, the Sweep Start Comparator (inside U2790) minus input is pulled LO. This causes pin 4 of the IC to become a high impedance, allowing C_t to begin charging through R_t. As C_t begins to charge toward the voltage applied to R_t, the gate of Q2784 (connected to the junction of C_t - R_t), goes positive by the same amount. This increases the current through Q2784 and decreases the current through Q2782.

The decrease in the Q2782 drain current through R2787 produces a positive-going voltage at the base of Q2786. The voltage at the collector of Q2786 and the negative side of C_t is pulled down. This results in a negative-going voltage applied across C_t, maintaining a constant charging current and giving a linear rate of fall to the sawtooth output signal.

The sawtooth output continues to fall in this manner until it reaches −2.4 volts and initiates a Holdoff Start pulse at pin 10. The Holdoff Start pulse starts the holdoff ramp in U2750 and resets the sweep by causing pin 13 of U2790 to go HI.

The B sweep is dependent on the signal at the delayed gate input (pin 14) and resets only when the A sweep ends.

The Delay Start and B Start controls, R2782, and R2682, adjust the quiescent level of the A and B sweeps, thus determining the correct starting points for the sweep outputs.

Sweep Control IC

The Sweep Control circuit is contained within a single IC U2750. Fig. 4-7 shows a block diagram of the circuitry in this IC.

The following is a brief description of the function associated with each pin of U2750.

Pin 1. Single sweep mode. When this pin is LO (ground) and pin 4 is HI, the sweep is in the single sweep triggering mode.

Pin 2. Single sweep reset. Pushing the SGL SWP pushbutton resets the sweep triggering circuit, making it ready for another single sweep to be triggered. The READY indicator lights when the single sweep circuit is reset and any sweep in progress is terminated.

Pin 3. Automatic timing. In the automatic triggering mode, when no trigger pulse occurs within about 100 ms following holdoff, C2757 charges sufficiently to allow pin 3 to be HI. This causes pin 6 to produce a sweep gating pulse to trigger the sweep and produce a baseline trace even when no trigger is available.

Pin 4. Automatic mode. Grounding the pin enables automatic sweep operation when pin 1 is HI.

Pin 5. Logic $\overline{\text{Gate}}$. This is the gate input from the A Trigger Generator that is used to initiate several sweep control functions.

Pin 6. Automatic $\overline{\text{Gate}}$. Provides a gate output, in the automatic mode, to trigger the sweep when no trigger signal occurs within about 100 ms following the end of the holdoff.

Pin 7. A Gate. Provides a gate pulse to trigger the alternate trace circuitry in the Vertical Module.

Pin 8. Ground.

Pin 9. Holdoff output. This pin switches from LO to HI to reset the sweep and trigger circuits.

Pin 10. Holdoff Timing. RC networks are connected between this pin and pin 11 to vary the holdoff time, depending on the setting of the A TRIGGER HOLDOFF control and the A TIME/DIV switch.

Pin 11. Holdoff Ramp. A negative-going ramp is present here that determines the holdoff time.

Pin 12. Hold Off Start. A positive-going pulse, which occurs at the end of the sweep, is applied to this pin to terminate any automatic gate present, start the holdoff ramp, and initiate the reset pulse to the A trigger circuit.

Pin 13. Triggered light. Voltage at this pin lights the TRIG light when a triggered gate has occurred.

Pin 14. Light ground. Provides a ground point for the READY and TRIG lights.

Pin 15. Ready Light. Voltage at this pin lights the READY light when the sweep is reset in the single sweep mode.

Pin 16. +5 volt supply.

Sweep Control Operation

The Sweep Control circuit provides control for the TRIG light, the READY light, the holdoff function, the sweep resetting function and the various sweep trigger modes.

A Sweep Mode

Assuming a triggerable signal is applied to pin 2 of U2700, gate pulses are produced at pin 10 and 11 (see Fig. 4-8 and 4-9). The sweep gate into pin 13 of U2790 starts the negative-going A sweep ramp at pin 5 of U2790. When the A sweep ramp reaches a predetermined level (within U2790), a holdoff start signal is produced at pin 10 of U2790. The holdoff start signal produces a Reset output signal at pin 9 of U2750 and pin 12 of U2700 that causes the sweep gate out at pin 10 of U2700 and pin 13 of U2790 to go HI and reset the A sweep. At this point the holdoff start goes LO, but the Reset pulse stays high until the holdoff ramp at pin 11 of U2750 reaches approximately −2 volts. The holdoff ramp at pin 11 of U2750 stays LO until a trigger occurs and the A sweep gate on pin 13 of U2790 goes LO again and returns pin 11 of U2750 to its HI state.

In the A and A INTEN positions of the HORIZ DISPLAY switch, pin 7 of U2790 is held LO, enabling the A sweep output signal at pin 5 of U2790. Pin 7 of U2690 is held HI disabling the B sweep output at pin 5 of U2690.

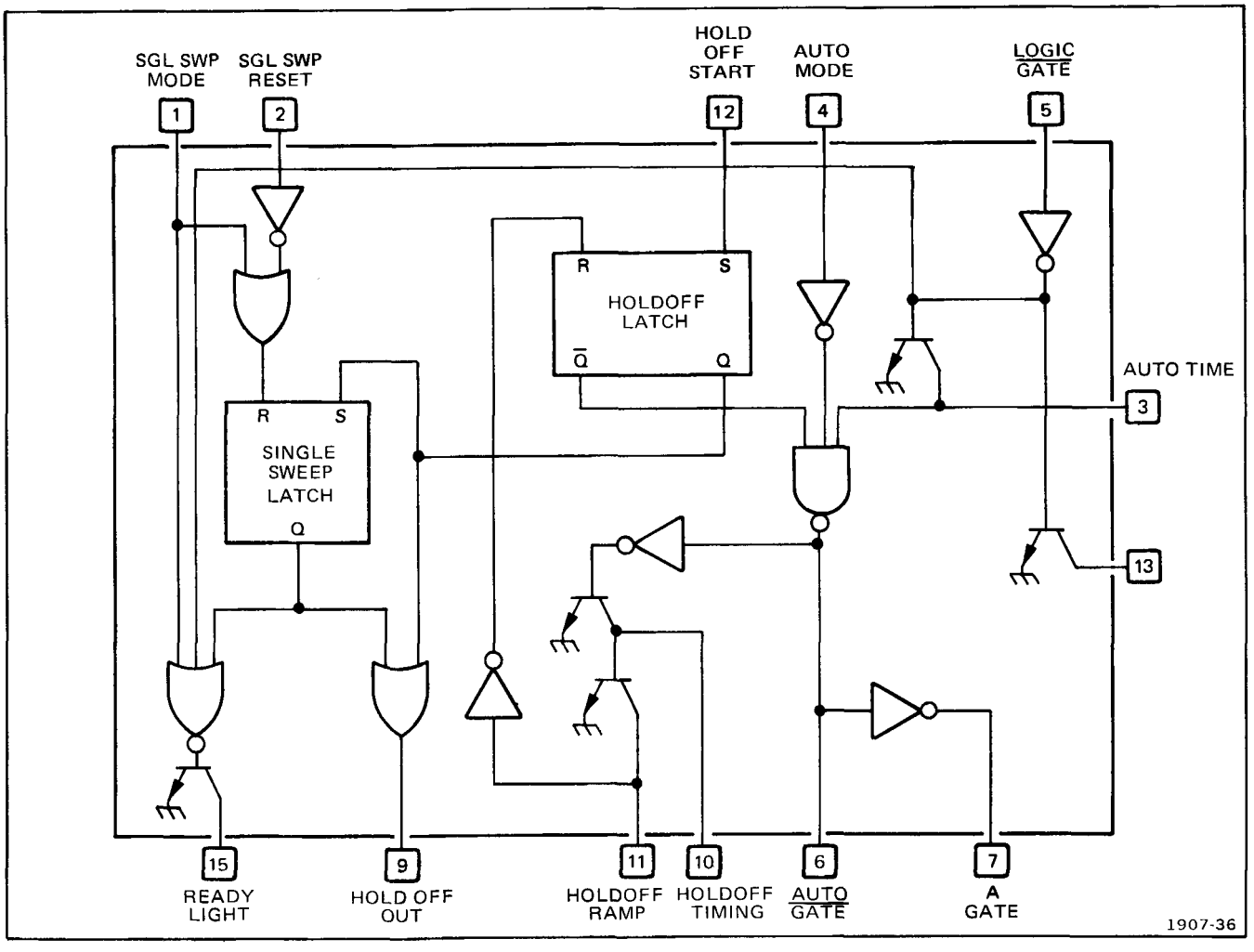


Fig. 4-7. Sweep-control IC functional block diagram.

B Dly'd Sweep Mode

In the B DLY'D mode, Fig. 4-10, the A sweep operates similarly to the A mode, but the A sweep output at pin 5 of U2790 and the unblanking output at pin 12 of U2790 are disabled.

When the A sweep ramp within U2790 reaches the level set by the DELAY TIME POS control, pin 14 of U2690 goes LO to start the B sweep. In the STARTS AFTER DELAY mode, pin 9 of U2600 is held HI and pin 10 of U2600 is held LO, allowing the B sweep to start as soon as pin 14 of U2690 goes LO. The time A sweep takes to reach the level set by the DELAY TIME POS control represents the time from the start of A sweep to the start of B sweep. The delayed time is determined by multiplying the A TIME/DIV setting by the DELAY TIME POS setting. In all other positions of the B SOURCE switch the B sweep does not start until a trigger signal occurs at pin 2 of U2600. When the B sweep starts, a crt unblanking signal is produced at pin 12 of U2690 to unblank the crt. When the B sweep reaches a predetermined level within U2690, output current at pin 12 drops, unblanking the crt. The B sweep stops running down and remains negative until reset by the delayed gate pulse going HI, which occurs when the A sweep terminates.

U2740A and B provide a voltage source for the DELAY TIME POS circuit.

A Inten Sweep Mode

In the A INTEN mode, both A and B sweeps operate. The B sweep output at pin 5 of U2690 is disabled as in the A mode. The B sweep unblanking signal at pin 12 of U2690 adds to the A sweep unblanking signal to intensify the B sweep time segment of the A sweep display.

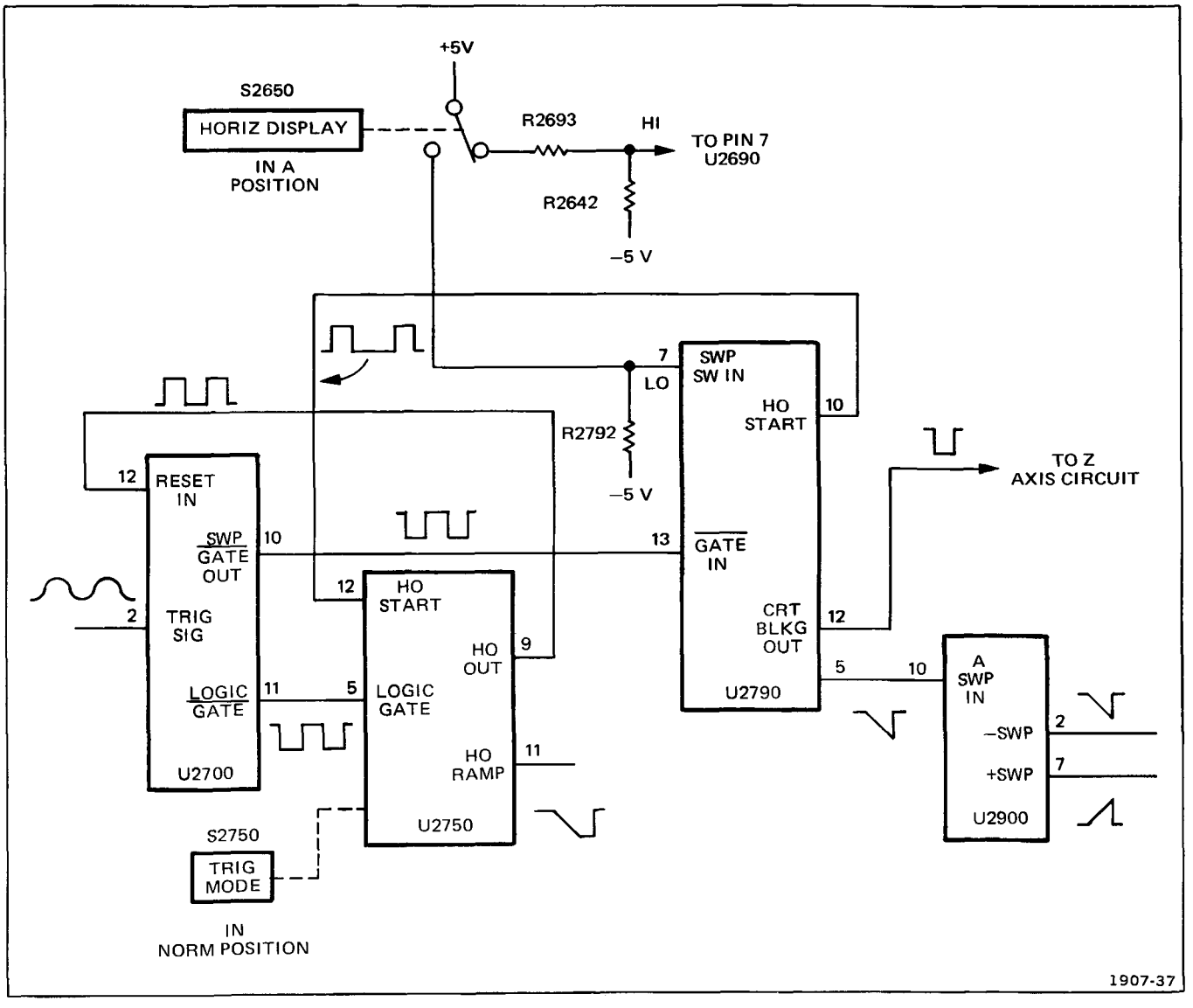


Fig. 4-8. Sweep operation in A mode.

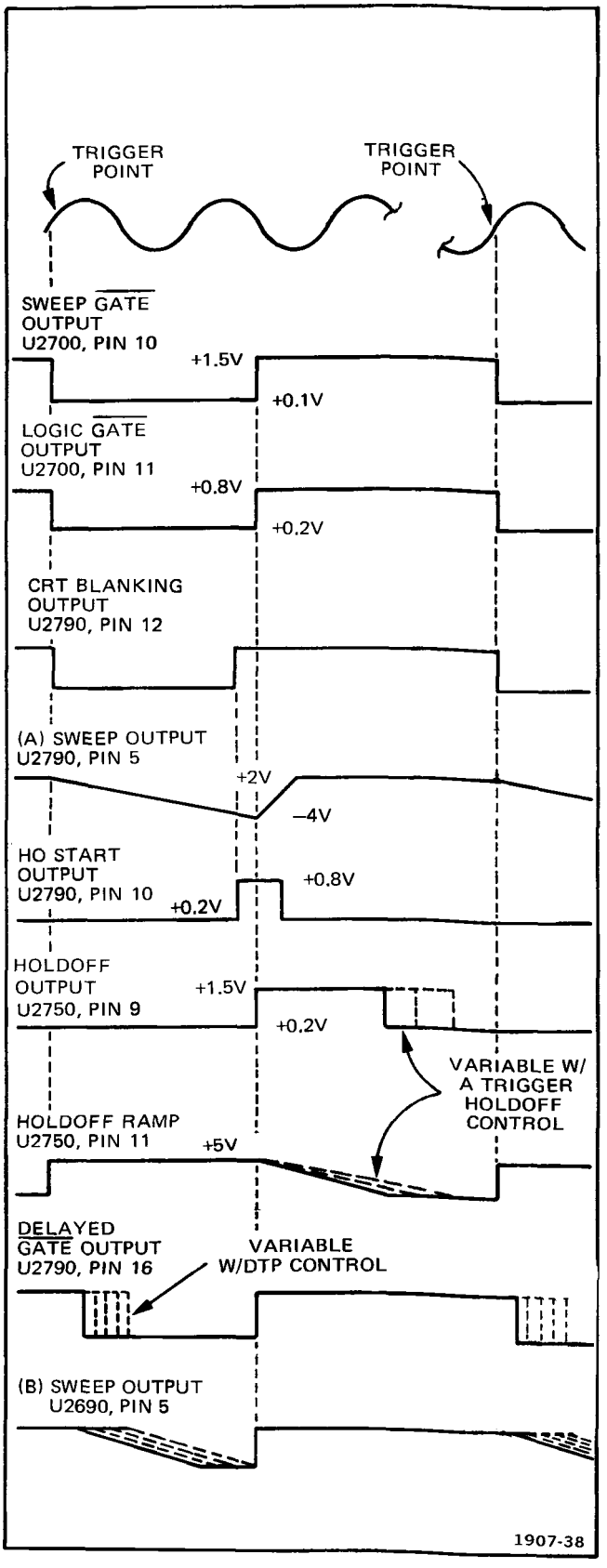


Fig. 4-9. Sweep-circuit waveform relationships.

Horizontal Preamplifier IC

The Horizontal Preamplifier circuit is contained within a single IC, U2900.

The following is a brief description of the function associated with each pin of U2900.

Pin 1. Magnifier registration. This pin is used in conjunction with pin 8 to provide registration between the normal and magnified sweeps.

Pin 2. Sweep. This pin provides the negative-going sweep output to the Horizontal Output Amplifier. This output represents the inputs to pin 9 or 10, except in the X-Y mode when pin 12 is HI, and it represents the input to pin 11.

Pin 3. Gain. This pin, in conjunction with pin 6, is connected to the gain setting circuitry. The X10 Magnifier switch is connected to this pin.

Pin 4. −5 volt supply.

Pin 5. Current source. Sets internal current levels.

Pin 6. Gain. See pin 3.

Pin 7. + Sweep. This pin provides the positive-going sweep output to the Horizontal Output Amplifier.

Pin 8. Magnifier registration. See pin 1.

Pin 9. B Sweep In. Input connection for the B sweep signal.

Pin 10. A Sweep In. Input connection for the A sweep signal.

Pin 11. X Signal. Input connection for the X signal from CH 1 when the A TIME/DIV switch is in the X-Y position.

Pin 12. X-Y Mode. When this pin is LO (normal sweep mode), the outputs at pins 2 and 7 represent the inputs to pin 9 or pin 10.

Pin 13. Frequency compensation. Connects to frequency compensating capacitor.

Pin 14. Horizontal position. Connects to the horizontal POSITION control.

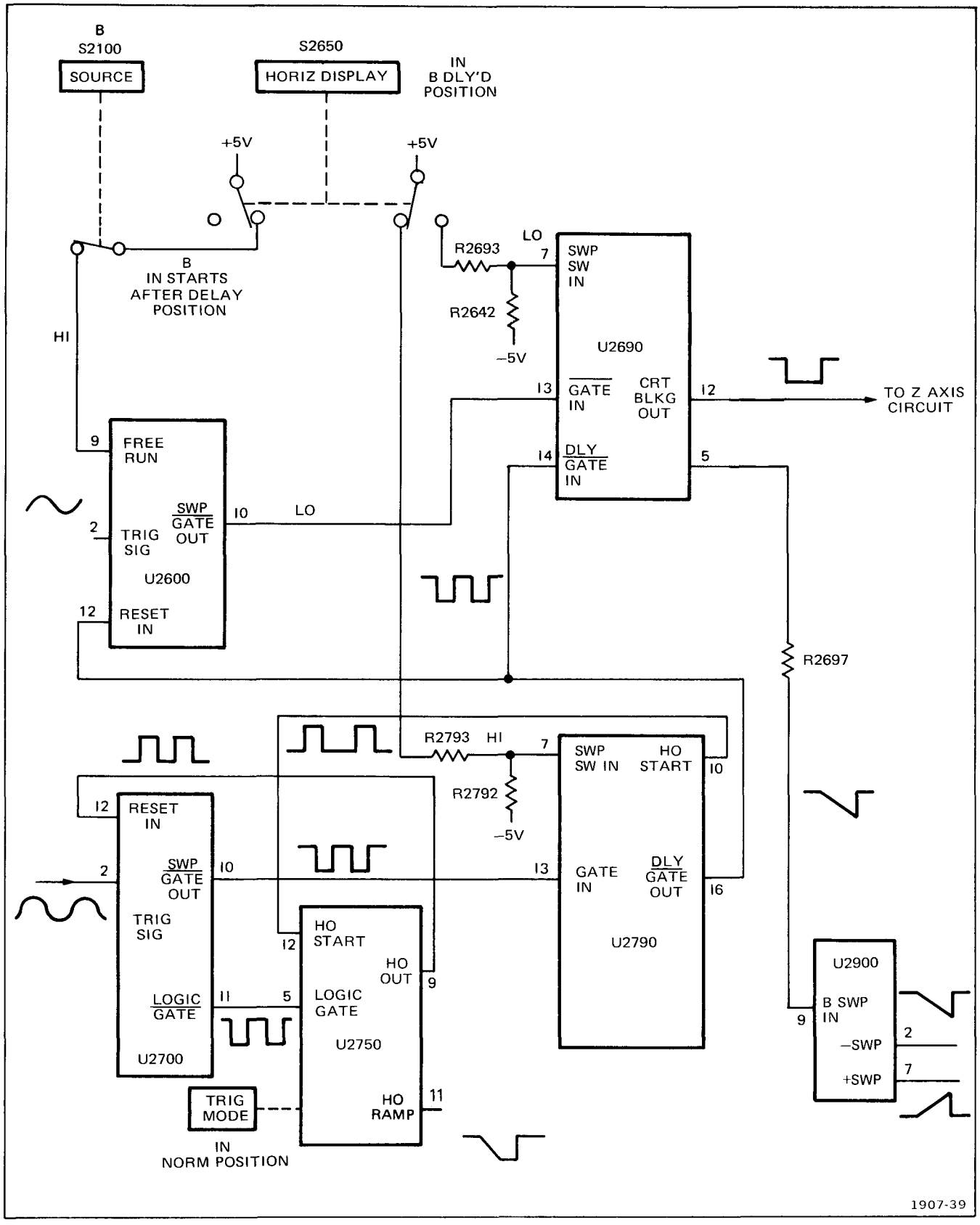


Fig. 4-10. Sweep operation in B DLY'D mode.

MAINTENANCE

This section contains information for use in preventive or corrective maintenance. The corrective maintenance portion includes information on component removal and replacement.

CABINET REMOVAL

WARNING

Dangerous potentials exist at several points inside this instrument. To prevent electrical shock, do not touch exposed connections or components when the instrument is operated with the cabinet removed. Disconnect power before cleaning the instrument or replacing components.

The cabinet top can be removed easily for servicing or recalibration. Using a large coin, rotate the three circular locks clockwise on each side of the instrument until the slot is vertical, and lift the cabinet top straight up.

PREVENTIVE MAINTENANCE

Preventive maintenance consists primarily of cleaning and visual inspection. When performed on a regular basis, preventive maintenance will reduce instrument failure and improve reliability. The frequency of maintenance depends on the severity of the instrument environment. The most convenient time to perform preventive maintenance is usually just prior to recalibration. The following information in general, applies to all three modules in this oscilloscope.

CLEANING

The cabinet helps keep dust out of the instrument interior. More frequent cleaning is necessary when the instrument is operated with the cabinet removed. The front cover helps keep dust away from the front panel and the crt face. The front cover should be installed when storing or transporting the instrument.

Interior

Remove accumulated dust and dirt as often as operating conditions require. Dirt acts as an insulating blanket on components, preventing efficient heat dissipation, which can cause overheating and possible component breakdown. It also provides an electrical conduction path that can cause instrument failure, especially under high humidity conditions.

The best way to clean the interior is to blow off the accumulated dust with dry, low-pressure air (approximately 9 lb/in^2). Remove any remaining dirt with a soft brush or cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning circuit boards.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Do not use chemicals which contain acetone, benzene, toluene, xylene, petroleum ether, white kerosene, carbon tetrachloride, methylene chloride, trichloroethane, trichlorotrifluoroethane (freon 113, —TF, —TA, —TE, —TMC) and trichloroethylene. Recommended cleaning agents are isopropyl alcohol, kelite (1 part kelite, 20 parts water), or a solution of 1% mild detergent and 99% water. If these cleaners are not readily available, it is safe to use ethyl alcohol (methanol). Most spray circuit coolants contain freon 12 as a propellant. Because many freons adversely affect switch contacts, check the contents and brand name before using a spray. Use the following brand names for an acceptable coolant: Artic Freeze, Quik-Freeze, and Can-O-Gas. Do not use Zero Mist brand of circuit coolant. The only recommended circuit coolants are dry ice (CO_2) or isopropyl alcohol.

Switch Contacts

Cam actuated switch contacts provide some of the switching functions in the vertical module. Contact cleaning is seldom necessary, but if it is, observe the following precautions to prevent damage to the contacts.

Clean the switch contacts with isopropyl alcohol only. Apply the alcohol with a camel-hair brush. Do not use cotton swabs; they tend to snag on contacts, which can cause damage or intermittent switch contact.

Exterior

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

Crt

Clean the light filter and the crt face with a soft lint-free cloth dampened with denatured alcohol or a mild detergent and water solution. The optional crt mesh filter can be cleaned in the following manner:

1. Hold filter in vertical position and brush lightly with small soft brush to remove light coatings of dust and lint.

2. Greasy residues or dried-on dirt can be removed with solution of warm water and neutral pH liquid detergent. Use brush to lightly scrub filter.

3. Rinse filter thoroughly in clean water and allow to air dry.

4. Remove any remaining lint or dirt, using low-pressure air (approximately 9 lb/in^2). Do not use tweezers or other hard cleaning tools that can damage special finish of filter.

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

VISUAL INSPECTION

Occasionally inspect for such defects as broken connections, improperly seated semiconductors, damaged or improperly installed circuit boards, and heat-damaged components. An overheated component usually indicates other trouble in the instrument. Be sure to correct the cause of overheating to prevent recurrence of the damage.

LUBRICATION

Most potentiometers used in this instrument are permanently sealed and generally do not require lubrication. Switch mechanisms are lubricated at the factory and rarely require lubrication. A regular, periodic lubrication program is not recommended.

SEMICONDUCTOR CHECKS

Periodically checking transistors and other semiconductors is not recommended. The ideal method to check semiconductor performance is by actual operation in the instrument.

RECALIBRATION

To ensure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or every six months if used infrequently. Also, it may be necessary to recalibrate certain portions of the instrument after replacing components.

CORRECTIVE MAINTENANCE

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

OBTAINING REPLACEMENT PARTS

Standard Parts

All electrical and mechanical part replacements for this instrument can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components may be available locally in less time. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating and description.

NOTE

Physical size and shape of a component may affect Instrument performance, particularly at high frequencies. Always use direct-replacement components, unless you know that a substitute will not degrade instrument performance.

Special Parts

In addition to the standard electronic components, some special components are used in this instrument. Some components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements. Others are manufactured for Tektronix, Inc. according to our specifications (see Cross Index Manufacturers Code Number to Manufacturer in Electrical Parts List for code numbers). Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., include all of the following information to insure receiving the proper parts.

1. Instrument type (include modification or option numbers).

2. Instrument serial number.

3. A description of the part (if electrical, include the circuit number).

4. Tektronix part number.

SOLDERING TECHNIQUES

WARNING

To prevent electrical shock or damage to the instrument, always disconnect the instrument from the power source before soldering.

Use ordinary 60/40 solder and a 15 watt pencil-type soldering iron for most soldering. Using a soldering iron with higher wattage-rating on etched circuit boards can cause the etched circuit wiring to separate from the board base material.

The following technique should be used to replace a component on the circuit board. Most components can be replaced without removing the boards from the instrument.

1. Grip component lead with long-nose pliers. Touch soldering iron to lead at solder connection. Do not lay iron directly on board.

2. When solder begins to melt, pull lead out gently. This should leave clean hole in board. If not, hole can be cleaned by reheating solder and placing sharp object (e.g. toothpick) into the hole to clean it out. A vacuum-type desoldering tool also can be used for this purpose.

3. Bend leads of new component to fit holes in board. If component is replaced while board is mounted in instrument, cut leads so they just protrude through board. Insert leads into holes in board with component firmly seated against board (or as positioned originally). If it does not seat properly, heat solder and gently press component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clip excess lead that protrudes through board (if not clipped in step 3).

6. Clean area around solder connection with flux-remover solvent.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

To prevent electrical shock or damage to instrument, always disconnect the instrument from the power source before replacing components.

Rear Panel Assembly Removal

The rear panel assembly can easily be removed for troubleshooting or component replacement (such as power supply fuses). The instrument can be operated with the rear panel assembly removed. See Fig. 5-1.

To remove the rear panel assembly, remove the four screws located at the four inside corners of the rear subpanel. Then carefully pull the top of the rear panel away from the mounting brackets while lifting the bottom of the subpanel out of the groove in the cabinet bottom.

To install the rear panel assembly, set the bottom of the subpanel into the groove in the cabinet bottom and install the four screws. Be sure to reconnect all interconnecting cables.

Cabinet Bottom Removal

NOTE

The instrument can be operated with the cabinet bottom removed if necessary for troubleshooting.

Remove 13 screws holding cabinet bottom to instrument. See Fig. 5-2.

Interconnecting Cable and Pin Connector Replacement

The interconnecting cable assemblies are factory assembled. They consist of machine installed pin connectors mounted in plastic holders. The plastic holders are easily replaced as

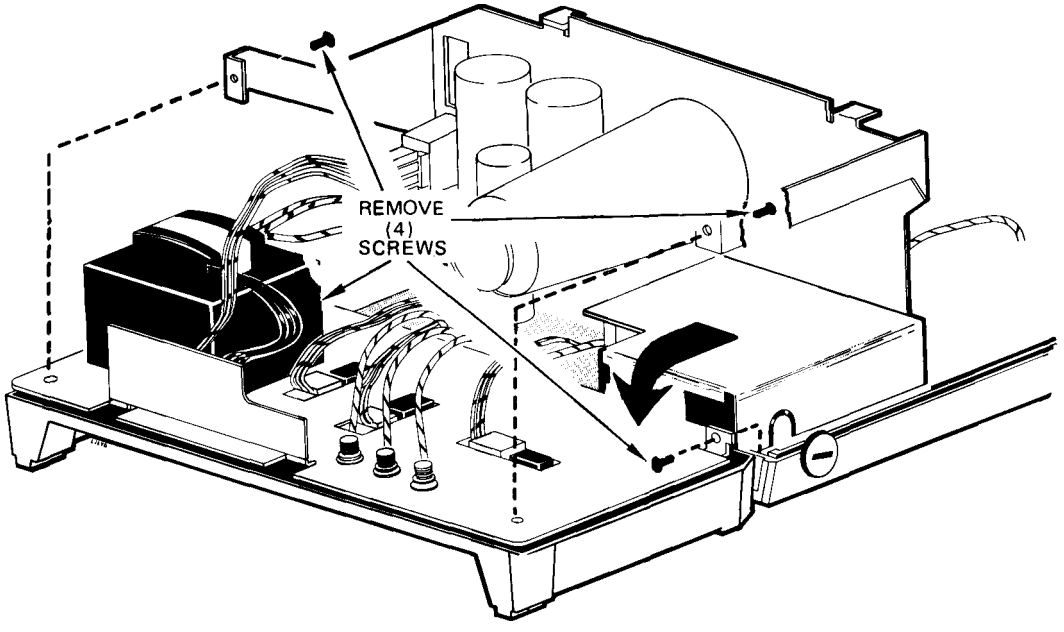


Fig. 5-1. Rear-panel assembly removal.

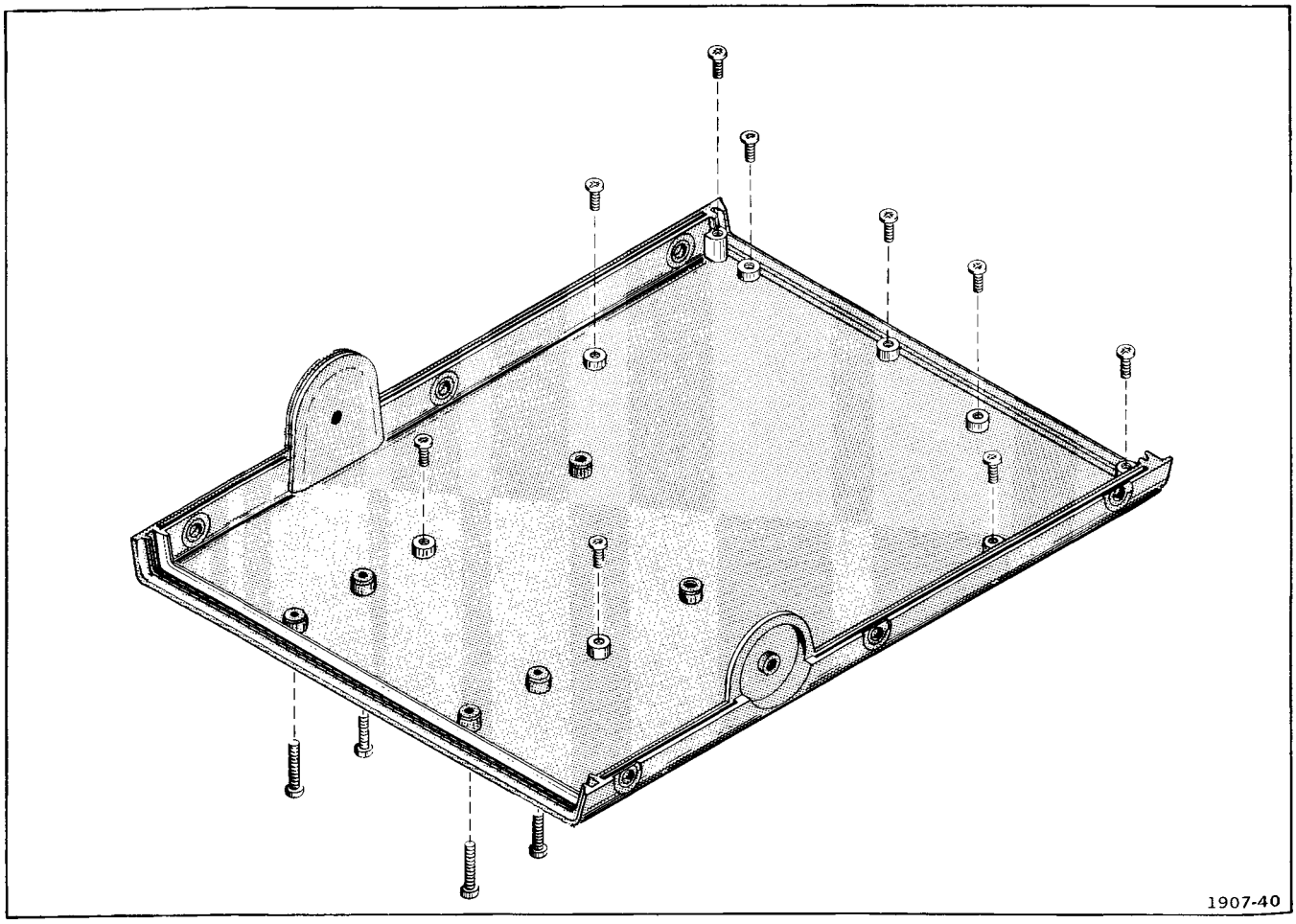


Fig. 5-2. Cabinet bottom removal.

individual items, but if the connectors are faulty, the entire cable should be replaced.

It is possible for the pin connectors to become dislodged from the plastic holders. If this happens, the connector can be reinstalled as follows (see Fig. 5-3):

1. Bend grooved portion of holder away from cable as shown.

2. Re-insert connector into its hole in the plug-in portion of holder. Wires are positioned in holder according to color-code system (see note below).

NOTE

Holder positions are numbered (number one is identified with a triangle). The wires are EIA color coded to match the numbers on the holder. For example, brown stripe for position 1 (triangle), red stripe for position 2, yellow stripe for position 4, etc.

3. Bend grooved part of holder so that connector is inserted into groove.

When plugging connector holders on to board pins, be sure to match triangle mark on holder with triangle mark on circuit board.

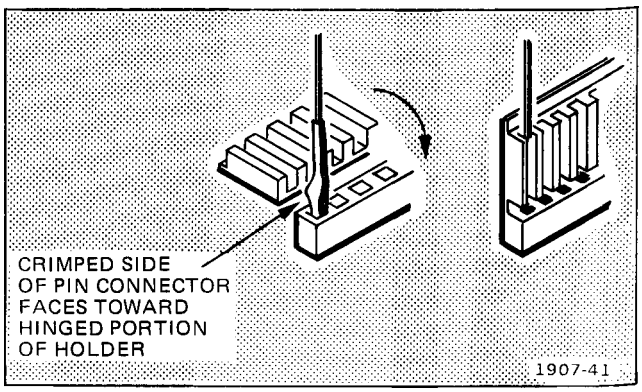


Fig. 5-3. Pin connector replacement.

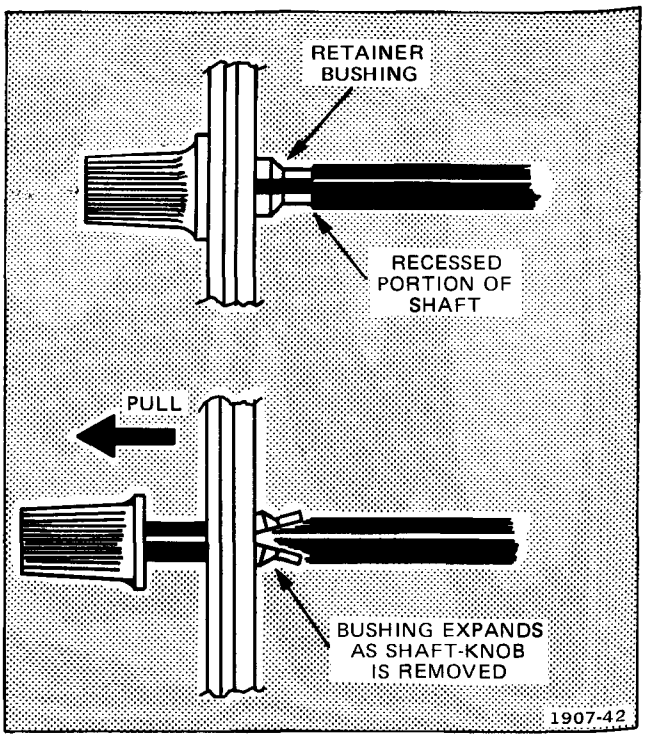


Fig. 5-4. Shaft-knot removal.

Shaft-Knob Removal

1. Grip knob end with one hand and shaft end with other hand.

2. Pull on knob, while pushing on shaft, to free recessed portion of shaft from retainer bushing (see Fig. 5-4). Some shaft-knobs may require considerable force to remove.

Cathode Ray Tube (Crt) Removal

WARNING

Handle crt carefully. Rough handling or scratching can cause crt to implode.

TO REMOVE CRT:

1. Remove Vertical Module (see instructions in Vertical Module Maintenance section).

2. Remove plastic bezel and filter from front of crt (held with 4 screws).

3. Unplug crt anode lead and discharge to chassis.

4. Unplug crt base socket.

5. Disconnect 2 vertical deflection plate leads from left side of crt neck.

6. Disconnect 2 horizontal deflection plate leads from bottom of crt neck.

7. Hold crt face in one hand and slowly push crt base with other hand.

8. Carefully pull crt out of shield.

TO INSTALL CRT:

1. Remove horizontal deflection plate leads from Interface board and plug them onto crt horizontal deflection plate pins.

2. Carefully insert crt into shield. Before pushing crt completely in place, pull horizontal deflection plate leads through hole in bottom of shield with tweezers or long-nose pliers.

3. Connect horizontal deflection plate leads to Interface board.

4. Connect vertical deflection plate leads.

5. Connect crt base socket and anode lead.

6. Install filter and bezel.

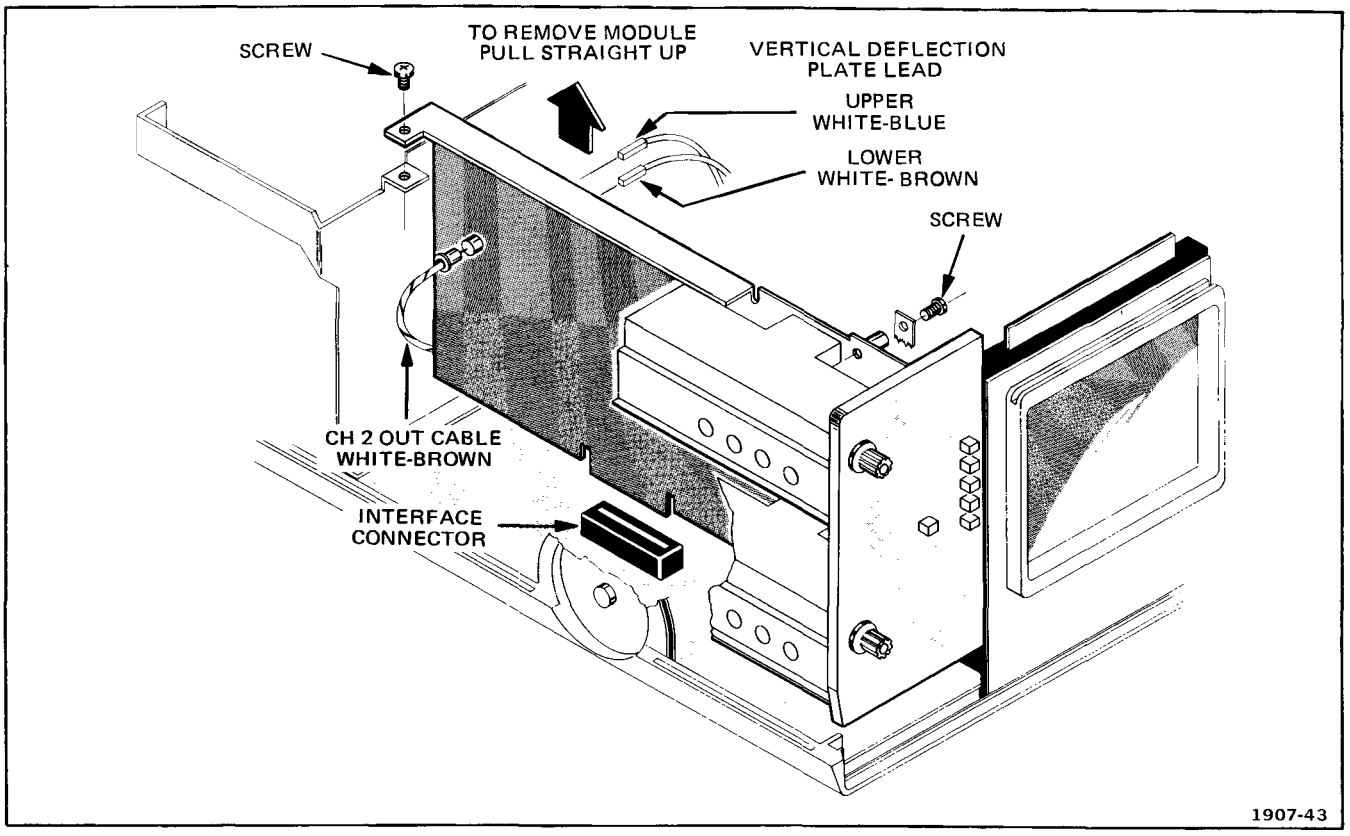


Fig. 5-5. Vertical Module removal.

Vertical Module Removal (Fig. 5-5)

To remove module:

1. Remove two screws holding module.

2. Disconnect white-brown CH 2 OUT cable and vertical deflection plate leads.

3. Pull plug-in module straight away from main module interface connector.

To install module:

1. Place module interface plug over main module interface connector and press firmly in place.

2. Connect vertical deflection leads to the two pins on the inward side of vertical circuit board.

3. Connect CH 2 cable.

4. Secure module with two screws.

Scale-Factor LED Replacement

VOLTS/DIV scale-factor LED's (light-emitting diodes) are pressed into plastic retainer sleeves in front subpanel. LED's can be removed by pressing them out with a small diameter blunt instrument.

Refer to Fig. 5-6 when replacing the LED's. Use a low-wattage soldering iron and apply only enough heat to solder the LED leads to the etched circuit cable.

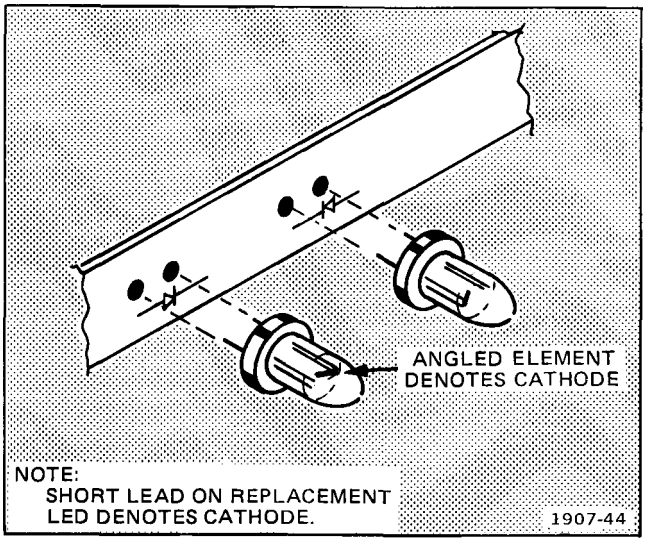


Fig. 5-6. LED replacement.

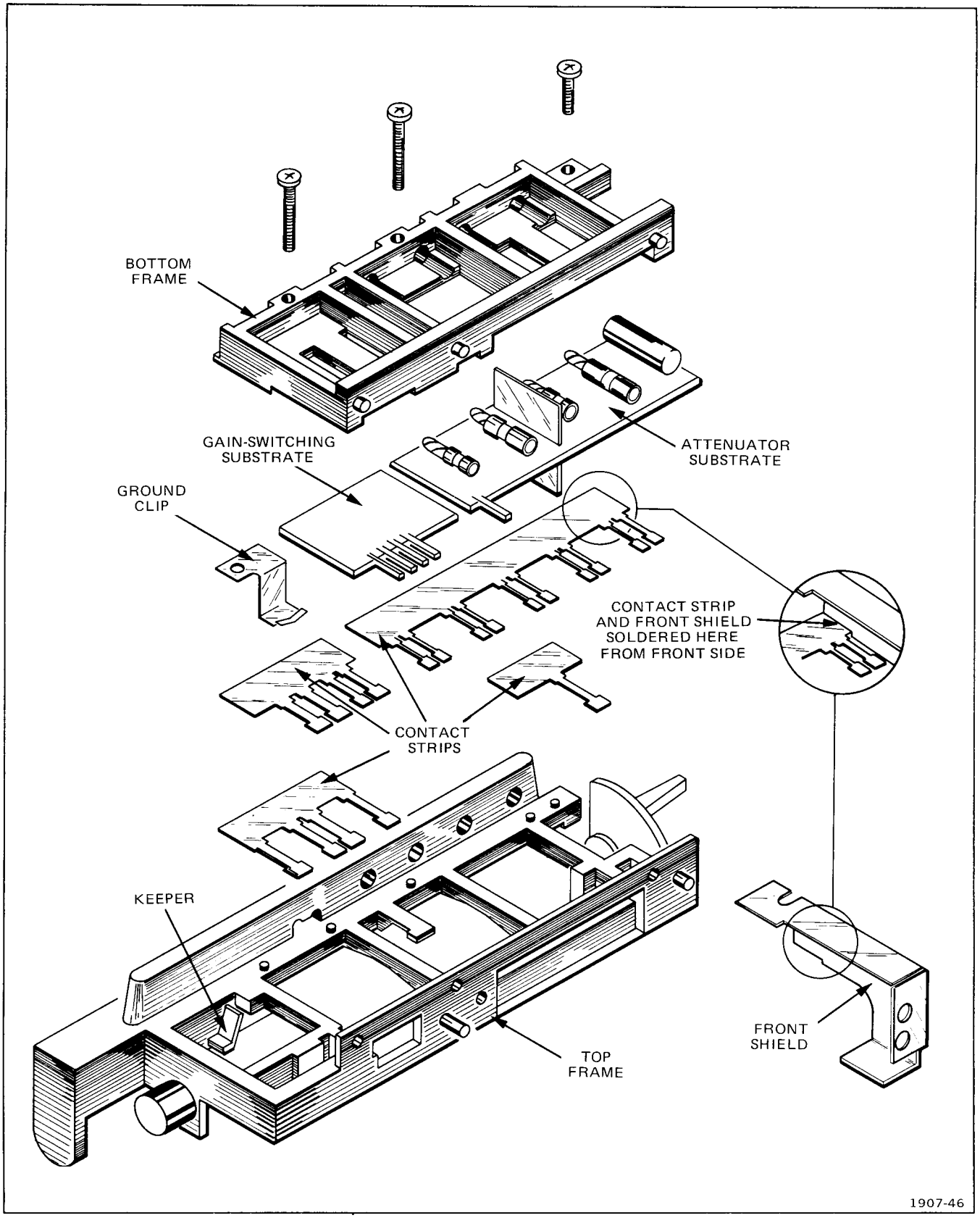


Fig. 5-7. VOLTS/DIV switch disassembly.

VOLTS/DIV Switch Assembly Removal

To remove switch assembly:

1. Remove VAR knob using hex wrench.

2. Pull off VOLTS/DIV knob.

3. Remove POSITION shaft-knob.

4. Unplug J4140 or J4240 from Vertical board.

5. Remove switch shield, held with 4 screws.

6. Remove long-narrow shield from back of Vertical board; held with 3 screws.

7. Unsolder components from terminal projecting through Vertical board.

8. Unsolder 43 Ω resistor and ground connection from input connector.

9. Remove two remaining screws holding switch assembly.

10. Pull rear of switch assembly away from Vertical board far enough to unplug pin connectors and release indexing keys from module frame. Remove switch assembly.

To re-install switch assembly:

Reverse order of above procedure. Make sure that pins on gain substrate align with sockets on Vertical board.

To replace VOLTS/DIV switch components:

Do not disassemble VOLTS/DIV switch unless absolutely necessary to replace components.

If disassembly is necessary, read the following list of special considerations before beginning disassembly (see Fig. 5-7).

Substrate or Contact Replacement Considerations

1. Front shield is soldered to front edge of contact strip and must be removed before bottom frame can be removed.

2. Substrates and contacts can be removed without removing actuator assembly.

3. Do not touch contact or substrate surfaces. Contamination can occur, causing intermittent or noisy contacts.

4. When installing contact strips, observe guide pin alignment.

5. Ground clip is sandwiched between top gain-contact strips and bottom frame. A relieved portion is provided in bottom frame for accepting lip of ground clip.

Actuator Assembly Replacement Considerations

1. Actuator assembly is held by two keepers that are molded into top frame. These keepers can be easily broken if the following is not considered.

Insert a narrow-blade screwdriver between rear actuator bearing and one keeper. Carefully rotate screwdriver to pry keeper away from bearing lip and release one side of bearing. Release other side of bearing in same manner.

CAUTION

Be extremely careful not to force keeper beyond point where bearing is released. It can easily be broken. If keeper breaks, top frame must be replaced.

2. After actuator bearing is released, remove actuator assembly by pushing bearing completely free of its mounting and pulling front of actuator off front bearing.

Hybrid IC Removal

CAUTION

Handle hybrid IC carefully. Ceramic material may break if dropped.

To remove hybrid IC:

1. Insert narrow-blade screwdriver between socket and one lip of mounting clamp as shown in Fig. 5-8. Rotate screwdriver to release clamp from socket.

2. Carefully lift clamp and hybrid IC from socket. Be careful not to damage socket contacts.

To install hybrid IC:

1. Place hybrid IC on socket so that cutoff corner of ceramic substrate matches indexing key on socket.

2. Snap mounting clamp onto socket projections to hold hybrid IC in place.

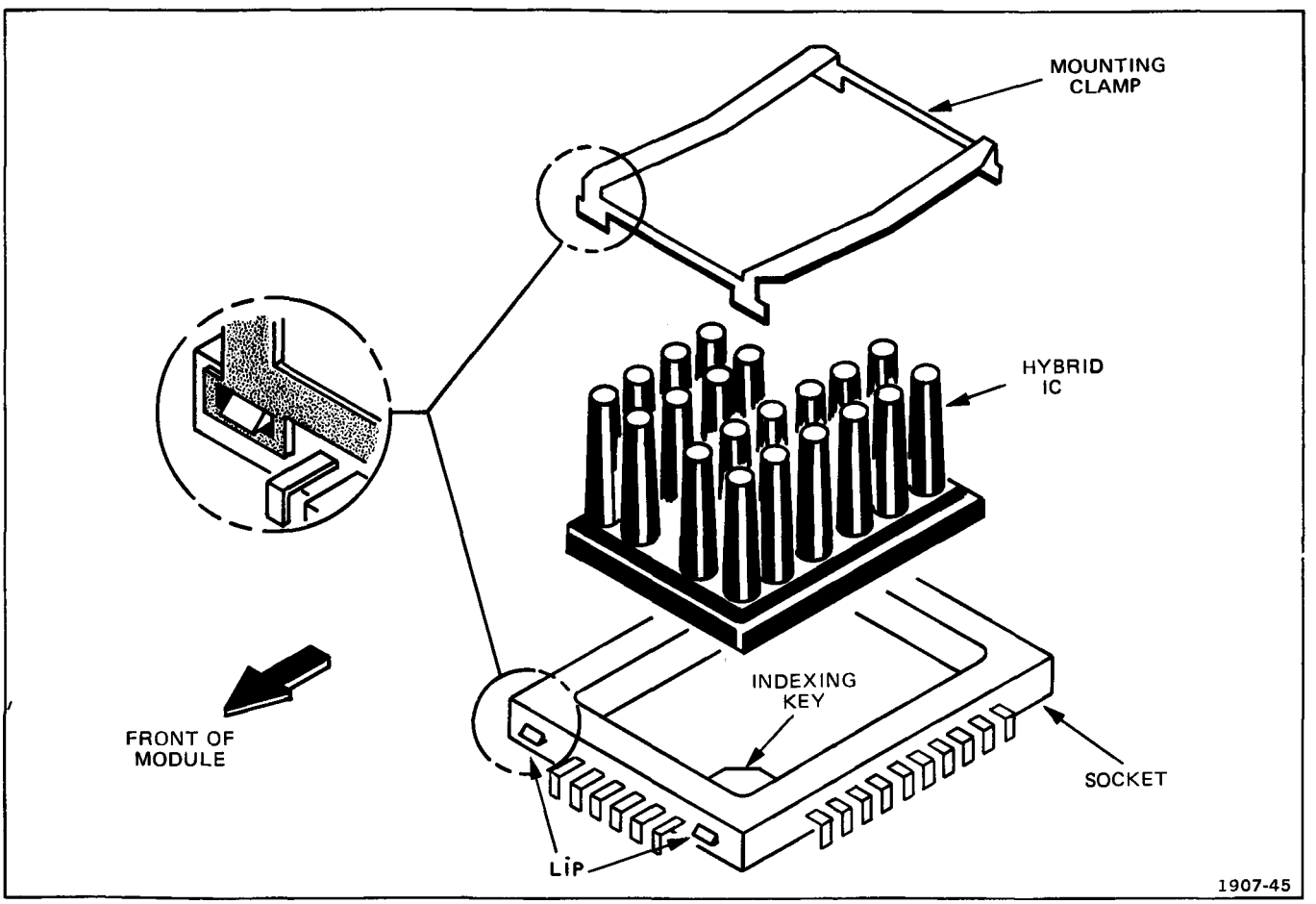


Fig. 5-8. Hybrid IC replacement.

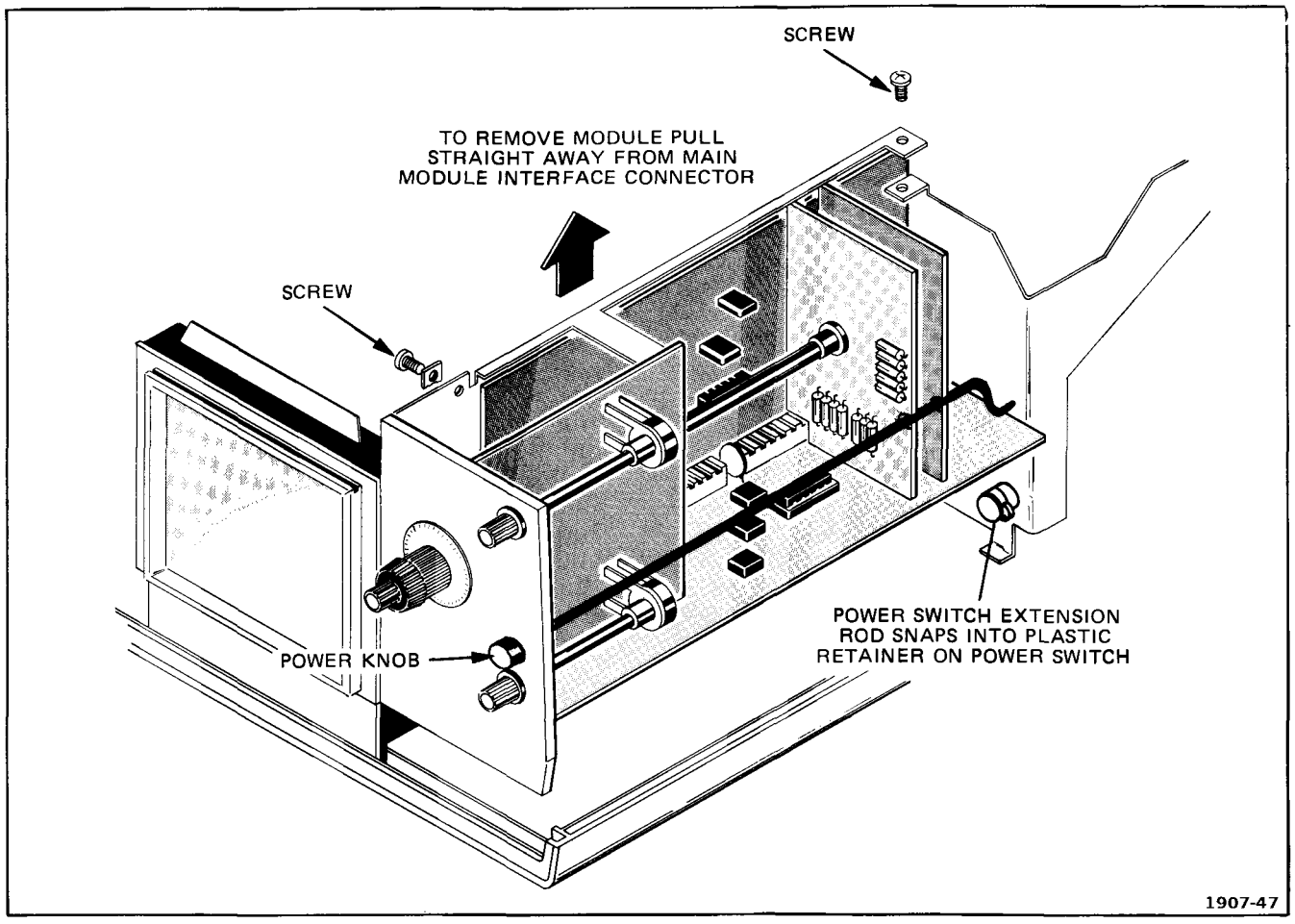


Fig. 5-9. Horizontal Module removal.

Horizontal Module Removal (Fig. 5-9)

To remove module:

1. Remove two screws holding module.
2. Unsnap the POWER switch extension from clip on Power switch shaft.
3. Pull plug-in module straight away from main module interface connector.

To install module:

1. Place module interface plug over main module interface connector and press firmly into place.
2. Snap POWER switch extension into clip on POWER switch shaft. (Yokes on plastic clips must be aligned before extension can be snapped into place).
3. Secure module with two screws.

Board Locations

Figure 5-10 shows the general location of the circuit boards in the B2 Module to facilitate board replacement.

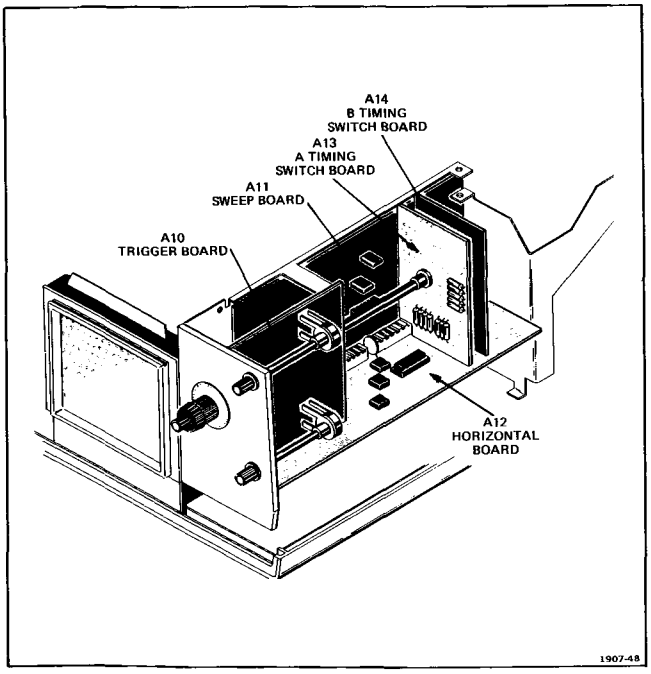


Fig. 5-10. Circuit board locations.

A and B Timing Switch Board Removal

To remove switch assembly:

1. Set A and B TIME/DIV knobs to .2 μs.

2. Remove VAR and A and B TIME/DIV knobs using hex wrench.

3. Remove the two screws and hex nuts holding switch board assembly to Horizontal board, see Fig. 5-11.

4. Unplug switch board assembly from Sweep board.

To separate A and B timing boards (Fig. 5-11).

1. Remove VAR control shaft at coupling using hex wrench.

2. Remove four screws holding A and B Timing Switch boards together. Separate boards, being careful not to lose plastic mounting clip.

CAUTION

Do not touch switch contacts; they can be easily damaged or contaminated. If cleaning is necessary, use a soft camel-hair brush and isopropyl alcohol. A cloth with alcohol may be used on board contacts.

To reassemble Timing Switch board:

1. Sandwich the switch mechanism between A and B Timing boards as shown; A board at front (shaft end) and B board at rear. Install plastic mounting clip in place between boards.

2. Secure the boards with four screws as shown. Make sure locator keys are seated in boards before tightening screws.

3. Install VAR control shaft.

4. Plug Timing board assembly onto Sweep board. Be careful not to bend pins.

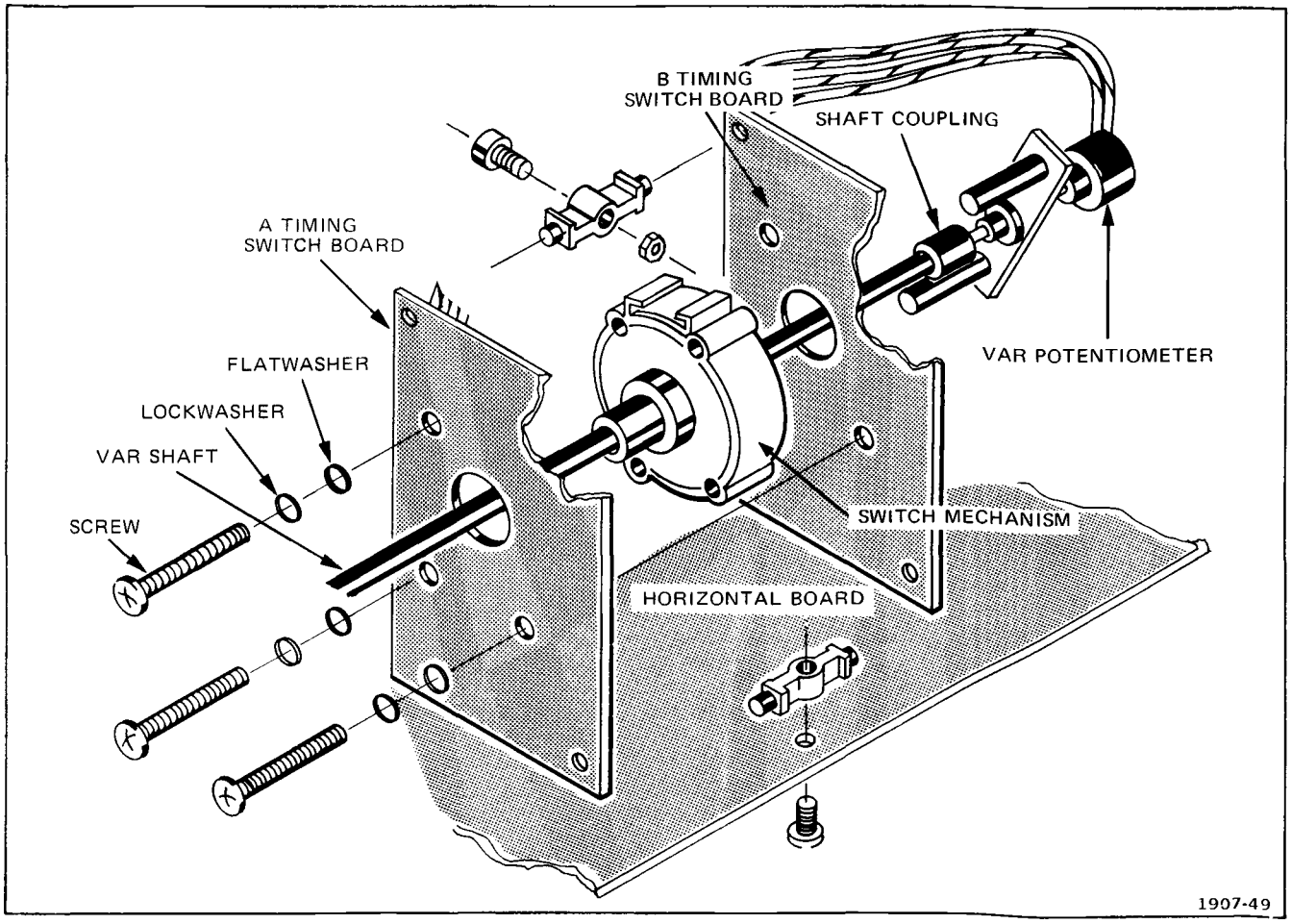


Fig. 5-11. A and B timing switch disassembly.

5. Rotate both outer (A) and inner (B) shafts to .2 μs position (third position from fully clockwise).

6. Install A and B TIME/DIV knobs in .2 μs position.

7. With A and B knobs locked, check knobs can be set to both X-Y and .2 μs positions.

8. Install VAR TIME/DIV knob. VAR marking should be right-side up when rotated fully clockwise to detent position.

Trigger Board Removal

To remove board:

1. Remove shaft-knobs using procedure in this section.

2. Remove one screw securing upper rear corner of board to module frame.

3. Unsolder, 47 Ω resistor at B Ext Trigger input connector, and three wires from rear of Trigger board.

To install board, reverse order of above procedure. Be careful not to bend pins when plugging on boards.

Horizontal Board Removal

To remove board:

1. Remove Trigger board.

2. Remove POSITION, LEVEL, and A TRIGGER HOLDOFF knobs. See shaft-knob removal procedure in this section.

3. Remove screw and nut holding A and B Timing board assembly to Horizontal board.

4. Remove screw holding rear of Horizontal board to module frame.

5. Remove screw holding front of Horizontal board to front subpanel.

6. Unsolder 47 Ω resistor from Ext A Trigger input connector.

7. Lay module on left side.

8. Unplug A and B Timing board assembly from Sweep board and move it away from Horizontal board.

9. Unplug Horizontal board from Sweep board.

To install board, reverse the above procedure. Be careful not to bend pins when plugging on board.

TROUBLESHOOTING

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

TROUBLESHOOTING AIDS

Troubleshooting Chart

A troubleshooting chart (Fig. 5-13) is provided to aid in locating problem areas.

Diagrams

Complete circuit diagrams are given on foldout pages in the Diagrams sections. The portions of the circuit mounted on circuit boards are enclosed with heavy lines. The component number and electrical value of each component in this instrument are shown on the diagrams (see the first page of the Diagrams section for definition of the reference designators used to identify components). Each main circuit is assigned a series of component numbers to assist in identifying their circuit location. Important voltages and waveforms are also shown on the diagrams. The physical locations of the waveform test points are shown on the circuit-board illustrations.

Circuit Board Illustrations

In conjunction with each circuit diagram is a circuit board illustration. These are located on the back of the pullout page opposite the associated circuit diagram. Each circuit component shown on the circuit diagram is identified on the circuit board illustration by its circuit number. Circuit number locations are identified with a grid-index system.

Component Value Identification

Values of capacitors, diodes and resistors used in this instrument are identified by direct numerical values or by a color-code scheme. Fig. 5-12 shows the color-code and numerical-value schemes used.

Semiconductor Lead Configurations

Typical semiconductor lead configurations are shown at the beginning of the diagrams section.

TROUBLESHOOTING EQUIPMENT

The following equipment is useful for troubleshooting.

1. Semiconductor Tester

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

Purpose: To test semiconductors.

Example: Tektronix 576 Curve Tracer or Tektronix 577 (D1 or D2) Curve Tracer with 177 Test Fixture.

2. Test Oscilloscope

Description: Frequency response, dc to at least 50 megahertz; deflection factor, 5 millivolts to 5 volts/division; Input impedance, 1 megohm, 20 picofarads; sweep rate, 0.5 second/division to 0.05 microsecond/division. A 10X, 10 megohm voltage probe should be used to reduce circuit loading for voltage measurements.

Purpose: To check operating waveforms.

3. Multimeter

Description: Non-loading digital multimeter. Voltmeter, 10 megohm input impedance and 0 to 150 volts range; dc voltage accuracy, within 0.15%; display, 4½ digits. Ohmmeter, 0 to 20 megohms.

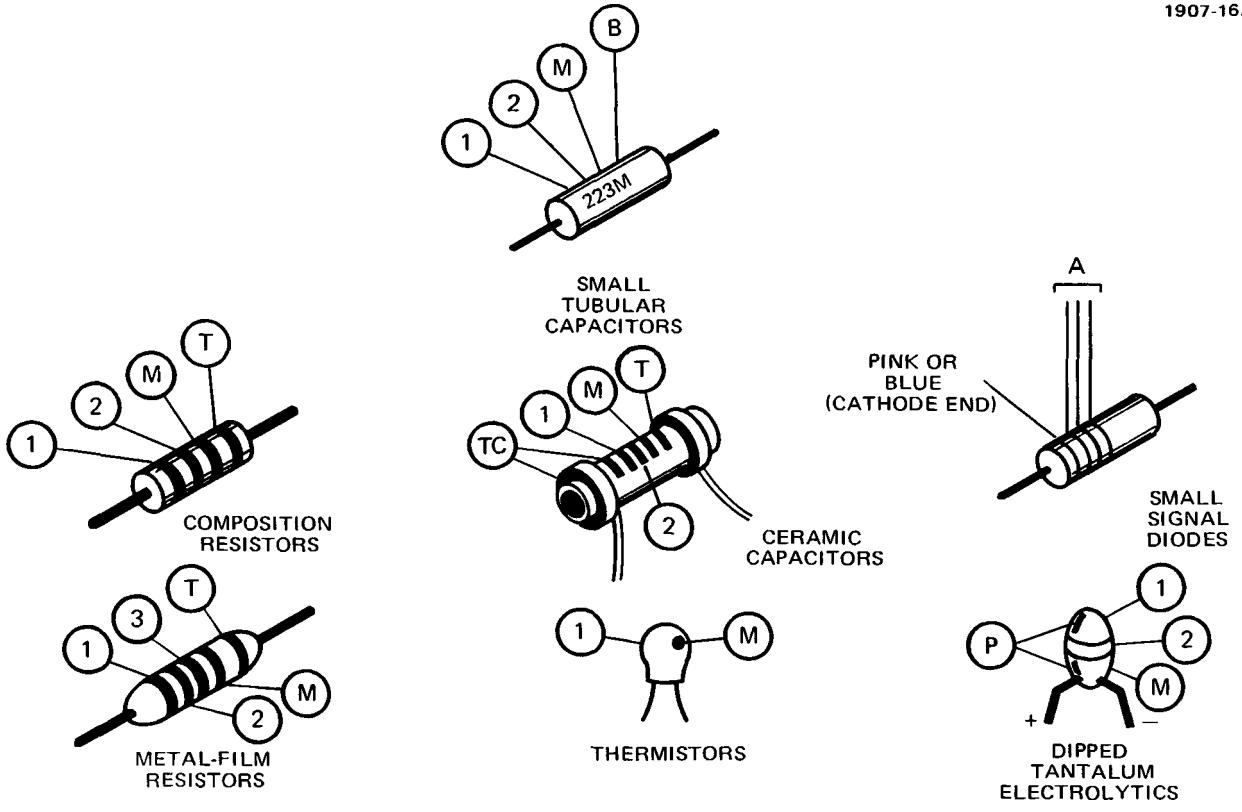
Purpose: To check voltages and for general troubleshooting.

4. Variable Autotransformer

Description: Output variable from 0 to 140 volts, 1.2 amperes minimum rating. Must have a 3-wire power cord, plug and receptacle.

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

1907-16A



(A) COLORS IDENTIFY SIGNIFICANT DIGITS IN TEKTRONIX PART NUMBER (E.G. BROWN, GRAY, GREEN STRIPES INDICATE PART NUMBER 152-0185-00)

(B) TOLERANCE; F=±1%, J=5%, K=10%, M=20%

(1) (2) and (3) 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.

(T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;

(M) MULTIPLIER (T) TOLERANCE;

(TC) TEMPERATURE COEFFICIENT.

(P) POLARITY AND VOLTAGE RATING

COLOR	SIGNIFICANT FIGURES	RESISTORS (Ω)		CAPACITORS (pF)			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE		
					over 10 pF	under 10 pF	
BLACK	0	1	———	1	±20%	±2 pF	4 VDC
BROWN	1	10	±1%	10	±1%	±0.1 pF	6 VDC
RED	2	10^2 or 100	±2%	10^2 or 100	±2%	———	10 VDC
ORANGE	3	10^3 or 1 K	±3%	10^3 or 1000	±3%	———	15 VDC
YELLOW	4	10^4 or 10 K	±4%	10^4 or 10,000	+100% –9%	———	20 VDC
GREEN	5	10^5 or 100 K	±½%	10^5 or 100,000	±5%	±0.5 pF	25 VDC
BLUE	6	10^6 or 1 M	±¼%	10^6 or 1,000,000	———	———	35 VDC
VIOLET	7	———	±1/10%	———	———	———	50 VDC
GRAY	8	———	———	10^{-2} or 0.01	+80% –20%	±0.25 pF	———
WHITE	9	———	———	10^{-1} or 0.1	±10%	±1 pF	3 VDC
GOLD	–	10^{-1} or 0.1	±5%	———	———	———	———
SILVER	–	10^{-2} or 0.01	±10%	———	———	———	———
NONE	–	———	±20%	———	±10%	±1 pF	———

Fig. 5-12. Component value identification.

Example: General Radio W 8 MT 3 VM or W10 MT 3 W Metered Variac Autotransformer.

5. Module Extender Troubleshooting fixture

Description: 18 inch ribbon cable with a module interface connector at each end (Tektronix part 067-0757-00).

Purpose: To operate Vertical and Horizontal modules outside of Main module. Useful for troubleshooting circuits which are inaccessible with modules installed.

TROUBLESHOOTING TECHNIQUES

This troubleshooting procedure is arranged in an order that checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation and calibration. If the trouble is not located by these checks, the remaining steps should aid in locating the defective component. Replace defective components using the replacement instructions under Corrective Maintenance.

Check Control Settings

Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Information sections.

Check Associated Equipment

Before proceeding with troubleshooting, check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the interconnecting cables are not defective. Also, check the power source.

Check Instrument Calibration

Check the calibration of this instrument, or the affected circuit if the trouble exists in one circuit. The apparent trouble may only be misadjustment that can be corrected by calibration. Complete calibration instructions are given in the Adjustments sections of this manual.

Visual Check

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

Isolate Trouble to a Circuit

Using the troubleshooting chart (Fig. 5-13), isolate trouble to a particular circuit. The symptom often identifies the defective circuit. Trouble appearing in more than one circuit can indicate possible power supply problems. Power-supply tolerance and ripple limits can be checked using Table 5-1.

TABLE 5-1
Power Supply Tolerance and Ripple

Supply	Tolerance	Maximum Ripple (peak-to-peak)
−5 V	± 1.1% (5.5 mV)	1 mV
+5 V	± 1.1% (5.5 mV)	1 mV
+32 V	± 0.6% (192 mV)	1 mV
+95 V	± 2.0 V	1 V
−2 kV	± 1.2% (24 V)	200 mV

Power supply disconnect jumpers are provided for each of the supplies. Refer to the schematics and circuit board illustrations for their location. These jumpers can be unsoldered to disconnect the circuit load from most of the supplies. Each unregulated supply contains a fuse for circuit protection.

Check Circuit Board Interconnections

After the trouble has been isolated to a particular circuit, check for loose or broken connections, improperly seated transistors and heat damaged components.

Check Voltages and Waveforms

Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages are given on the diagrams. Waveforms are shown at the left of the circuit diagram.

NOTE

Voltages and waveforms given on the diagrams are not absolute and therefore may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the voltage and waveform setup procedures in the Diagrams sections. Individual deviations should be noted on the schematics for future reference.

Check Individual Components

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

WARNING

The Power switch must be turned off before removing or replacing components to prevent electrical shock or circuit damage.

SEMICONDUCTORS. A good check of transistor operation is actual performance under operating conditions. A transistor can be most effectively checked by substituting a new component for it (or one which has been checked previously). 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.

When troubleshooting transistors in the circuit with a voltmeter, measure the emitter-to-base and emitter-to-collector voltages to determine if the voltages are consistent with normal circuit voltage. Voltages across a transistor vary with the type of device and its circuit function. Some of these voltages are predictable. The emitter-to-base voltage of a conducting silicon transistor will normally be 0.6 to 0.8 volts. The emitter-to-collector voltage of saturated transistors is approximately 0.2 volts. Because these values are small, the best way to check them is by connecting the voltmeter across the junction and using a sensitive voltmeter setting, rather than by comparing 2 voltages taken with respect to ground (both leads of the voltmeter must be isolated from ground if this method is used). If values less than these are obtained, either the device is short-circuited or no current is flowing in the circuit. If values are in excess of the base-emitter values given, the junction is back-biased or the device is defective. Values in excess of those given for emitter-collector could indicate either a non-saturated device operating normally, or a defective (open-circuited) transistor. If the device is conducting, voltage will be developed across resistances in series with it; if it is open, no voltage will be developed across resistances in series with it unless current is being supplied by a parallel path.

When troubleshooting field-effect transistors, the voltage across its elements can be checked in the same manner as transistors. However, it should be remembered that normal depletion mode operation has the gate-to-source junction reverse biased, while the enhanced mode has the junction forward biased.

IC's (integrated circuits) can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of circuit operation is essential to troubleshooting circuits using IC's. Use care when checking voltages and waveforms around the IC's so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin IC's is with an IC test clip. This device also doubles as an extraction tool. Typical semiconductor lead configurations are shown at the beginning of the Diagrams section.

DIODES. A diode can be checked for an open or for a short circuit by measuring the resistance between terminals with an ohmmeter set to the R X 1 k scale. The diode resistance should be very high in one direction and very low when the meter leads are reversed.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents can damage diodes. Check diodes in the same manner as transistor emitter-to-base junctions. Silicon diodes should have 0.6 to 0.8 volts across the junction when conducting. Higher readings indicate that they are either back biased or defective, depending on polarity.

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

INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit.

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 be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

ATTENUATORS. The thick film attenuators are best checked by substitution. If only one channel of the 455 is not operating properly, and there is reason to believe an attenuator is defective, replace the suspected attenuator with the same attenuator from the other channel and check instrument operation. If proper operation results, order a new attenuator.

Repair and Readjust the Circuit

If any defective parts are located, follow the replacement procedures given in the Maintenance section. Be sure to check the performance of any circuit that has been repaired or that has any electrical components replaced. Recalibration of the affected circuit may be necessary.

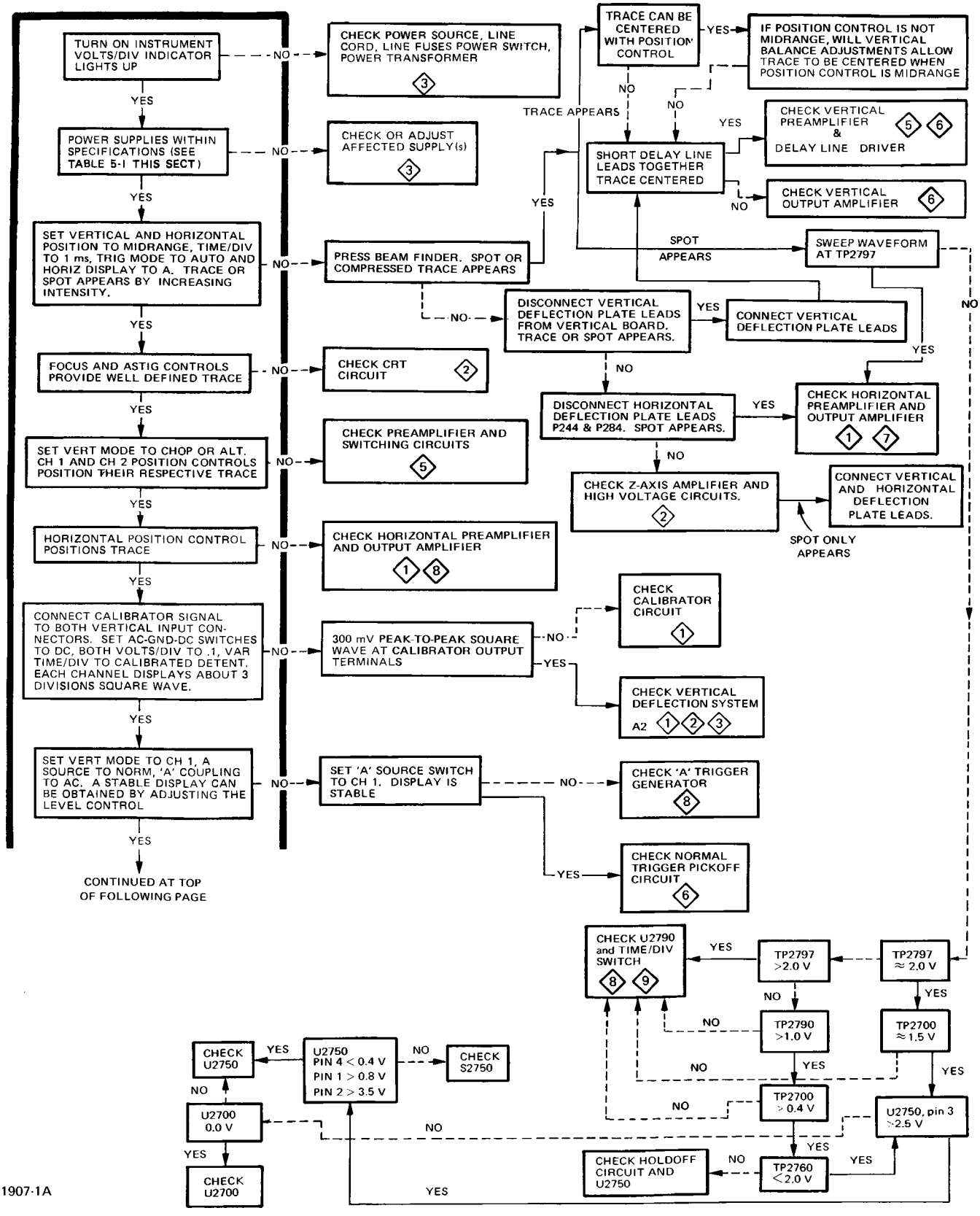
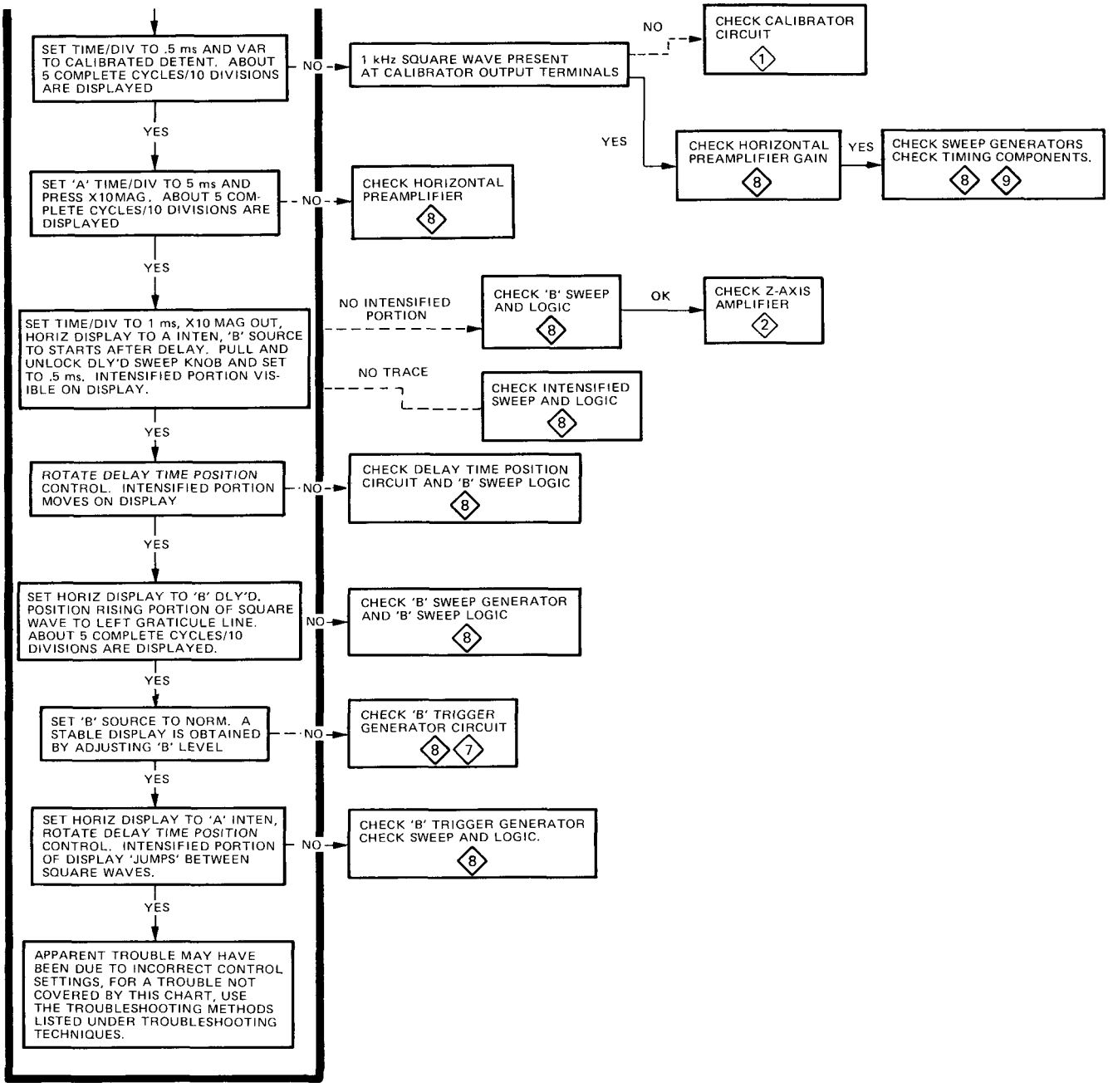


Fig. 5-13. Troubleshooting chart.



1907-1A

Fig. 5-13. Troubleshooting chart (cont).

REPACKAGING FOR SHIPMENT

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

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

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to the following table for carton test strength requirements.
2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.
3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.
4. Seal carton with shipping tape or industrial stapler.

SHIPPING CARTON TEST STRENGTH

Gross Weight (lb)	Carton Test Strength (lb)
0-10	200
10-30	275
30-120	375
120-140	500
140-160	600

@

ADJUSTMENTS

IMPORTANT–PLEASE READ BEFORE USING THIS PROCEDURE

The purpose of this procedure is to provide an adjustment sequence that will allow an operating instrument to be adjusted to meet its original performance requirements; it is not intended as a troubleshooting guide. Any trouble which becomes apparent during the adjustment sequence should be corrected before proceeding. Refer to the Troubleshooting portion of the Maintenance section.

TOLERANCES

Limits and tolerances are instrument specifications only if they are called out as performance requirements in the Specification sections.

Tolerances given are for the oscilloscope under test and do not include test equipment error.

ADJUSTMENT INTERACTION

Some adjustments interact with others, these are identified with an INTERACTION step.

PARTIAL PROCEDURES

Partial adjustment is sometimes desirable after replacing components or to touch up adjustments between major recalibrations. Adjustments can be made to individual circuits without having to perform the complete adjustment procedure. However, do not change the setting of the +32 V adjustment unless you intend to readjust the entire instrument.

To prevent unnecessary readjustment of other parts of the instrument, reset an adjustment only if the tolerance given for that step is not met. If it is necessary to reset an adjustment, also check any steps listed in the INTERACTION-part of the step.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 6-1, or equivalent is required for complete calibration of the oscilloscope. Specifications given for the equipment are the minimum necessary for accurate calibration.

TABLE 6-1
Test Equipment Required for Adjustment Procedure

Description	Minimum Specifications	Usage	Example of Applicable Test Equipment
1. Digital Voltmeter	Range, 0 to 32 V dc; dc voltage accuracy, 0.1%; display, 4 ½ digits.	Power supply adjustments. Calibrator amplitude adjustment. Crt grid bias adjustment.	a. Tektronix DM501 Digital Multimeter.[1]
2. Time-Mark Generator	Marker outputs, 10 ns to 0.5s; marker accuracy, within 0.1%; trigger output, 1 ms to 0.1 μs, time coincident with markers.	Y-Axis alignment. Geometry adjustment. A & B timing adjustments.	a. Tektronix TG501 Time-Mark Generator.[1] b. Tektronix 2901 Time-Mark Generator.
3. Amplitude Calibrator	Amplitude accuracy, within 0.25%; signal amplitude, 20 mV to 2 V square wave; frequency, 1 kHz.	Vertical gain adjustment. X gain adjustment. Trigger view gain adjustment.	a. Tektronix PG506 Calibration Generator.[1] b. Tektronix 067-0502-01 Calibration Fixture.

[1] Requires TM500 Series Power Module.

TABLE 6-1 (CONT.)
Test Equipment Required for Adjustment Procedure

Description	Minimum Specifications	Usage	Example of Applicable Test Equipment
4. Square-Wave Generator	Repetition rate, to above 100 kHz; risetime, 1 ns or less from the fast-rise output; output amplitude, 60 V from high-amplitude output; aberrations, within 2% from fast-rise output.	Low and high frequency compensation adjustments.	a. Tektronix PG506 Calibration Generator[1]. b. Tektronix Type 106 Square-Wave Generator.
5. Sine-Wave Generator	Frequency, 50 kHz to above 50 MHz; output amplitude, 0.5 to 5 V peak-to-peak; amplitude accuracy, within 3% of reference frequency as output frequency is varied.	Vertical bandwidth check. Triggering adjustments.	a. Tektronix SG503 Sine-Wave Generator.[1] b. Tektronix Type 191 Constant-Amplitude Signal Generator.
6. Test Oscilloscope	Bandwidth, dc to 100 MHz; vertical deflection factor, 5 mV.	Z axis compensation adjustment and calibration check.	a. Tektronix 465 Oscilloscope with P6065A Probe.
7. Cable	Length, 42 inches; impedance, 50 Ω; connectors, BNC.	Signal interconnection.	a. Tektronix part 012-0057-01.
8. Termination	Impedance, 50 Ω; connectors, BNC.	Signal termination.	a. Tektronix part 011-0049-01.
9. Input RC Normalizer	RC time constant, 1 MΩ times 20 pF; connectors, BNC.	Vertical input attenuator compensation adjustments.	a. Tektronix Input RC Normalizer Calibration fixture, part 067-0538-00.
10. Alignment Tool		Vertical attenuator low-frequency compensation adjustments.	a. Tektronix parts 003-0307-00 (handle) and 003-0334-00 (insert).
11. Low Capacitance Screwdriver		Variable capacitor adjustments.	a. JFD Electronics Corp. Adjustment Tool 5284.
12. Screwdriver	Length, three-inch shaft; bit size, 3/32 inch.	Variable resistor adjustments.	a. Xcelite R-3323.

[1] Requires TM500 Series Power Module.

A. MAIN MODULE

Equipment Required

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

PRELIMINARY PROCEDURE

WARNING

Dangerous potentials exist at several points inside this instrument. To prevent electrical shock, do not touch exposed connections or components when the instrument is operated with the cover removed.

1. Remove the cabinet from the instrument. Using a large coin, rotate the three circular locks on each side of the instrument, counterclockwise, until the slots are vertical. Lift the cabinet top straight up.

2. Turn the instrument on and allow at least 5 minutes warm-up time before starting the adjustment procedure.

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

3. Preset front panel controls as follows:

NOTE

Do not preset internal controls.

Crt

INTENSITY	Midrange

Vertical

CH 1 POSITION	Midrange
CH 1 AC-GND-AC	DC
VERT MODE	CH 1

Horizontal

HORIZ DISPLAY	A
TRIG MODE	AUTO
X10 MAG	out (off)
A COUPLING	AC
A SLOPE	OUT: +
A SOURCE	NORM
A TIME/DIV	.5 μs
POWER	out (on)

Set all other controls as desired. The oscilloscope should produce a baseline trace with the controls set as above. If not, locate and cure the problem before proceeding.

4. Adjust INTENSITY, FOCUS, and ASTIG controls as needed to maintain a well-defined display.

PROCEDURE

A1. +32 VOLT POWER SUPPLY

NOTE

Do not change the setting of the +32 V adjustment unless you intend to readjust the entire instrument.

a. Connect digital voltmeter between +32 V test point and the ground test point (see Fig. 6-1). If meter reads between +31.94 and +32.06 V, skip step b.

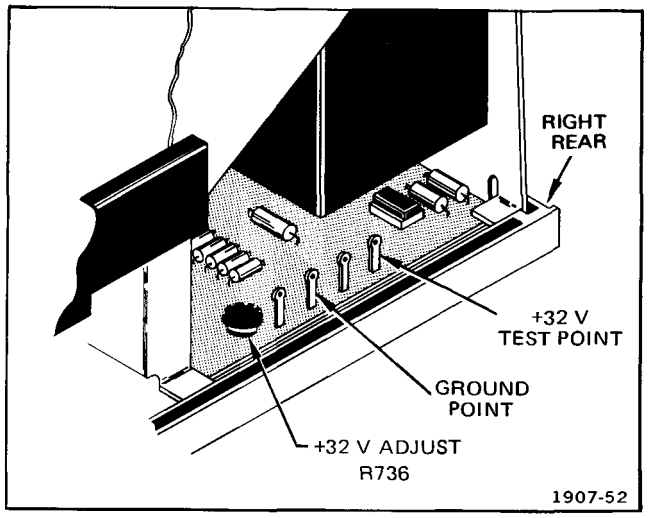


Fig. 6-1. +32 volt adjustment location.

b. ADJUST—+32 V Adjust, R736, for +32 V. Refer to Fig. 6-1.

A2. CRT BIAS

a. Set A TIME/DIV switch to X-Y.

b. Connect digital voltmeter between TP526 (see Fig. 6-2) and ground.

c. Set INTENSITY control for a +20 V reading.

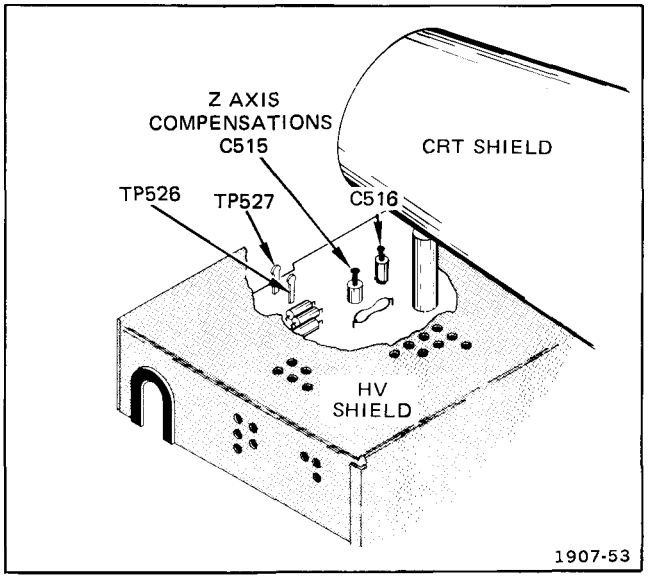


Fig. 6-2. Z axis compensation adjustment locations.

d. Set FOCUS and ASTIG controls for well-defined spot. If spot is not displayed, adjust Crt Bias adjustment, R532, (see Fig. 6-3) for a visible spot. Then, adjust FOCUS and ASTIG controls.

e. ADJUST—Crt Bias, R532, counterclockwise until spot is just barely visible.

f. Disconnect digital voltmeter.

A3. Z AXIS COMPENSATION

a. Set A TIME/DIV switch to 0.5 μs.

b. Set INTENSITY for a low-level display.

c. Connect test oscilloscope, through 10X probe to TP527 (near TP526, see Fig. 6-2). Set test oscilloscope to display about 4 division positive-going pulse. High-voltage oscillator signal will be visible but should be ignored when making following adjustments.

d. ADJUST—Z Axis Compensations, C515 (see Fig. 6-2) and C516, for optimum square corner of pulse on test oscilloscope.

e. Disconnect test oscilloscope.

A4. TRACE ROTATION

a. Set A TIME/DIV switch to 1 ms.

b. Position the trace vertically to center horizontal graticule line.

c. ADJUST—TRACE ROTATION (front panel adjustment) to align trace with center horizontal graticule line.

A.5 Y AXIS ALIGNMENT

a. Connect 1 ms time marks from time-mark generator to CH 1 input via 50 Ω BNC cable and 50 Ω BNC termination.

b. Set CH 1 VOLTS/DIV control to obtain slightly more than 8 divisions of vertical deflection. Position display baseline below bottom graticule line (off screen).

c. Set A TIME/DIV and VAR TIME/DIV controls to obtain exactly one time mark/division (may be necessary to set A TIME/DIV to .5 ms).

d. ADJUST—Y AXIS, R573 (see Fig. 6-3), to align center time mark with center vertical graticule line.

e. INTERACTION—Position display baseline to center horizontal graticule line and readjust TRACE ROTATION control. Then recheck Y Axis alignment.

A6. GEOMETRY

a. Adjust VAR timing and horizontal POSITION controls to align time markers with vertical graticule lines.

b. ADJUST—Geometry, R572 (see Fig. 6-3), for minimum bowing of time marks.

c. INTERACTION—Between Geometry and Y Axis Adjustments. Repeat both adjustments for best geometry and Y Axis alignment.

d. Disconnect time-mark generator.

A7. CALIBRATOR

a. Connect digital voltmeter leads to CALIBRATOR output terminals.

b. Connect shorting jumper between TP376 and TP386 (see Fig. 6-3). If output voltage does not read between +297 mV and +303 mV, continue with step c.

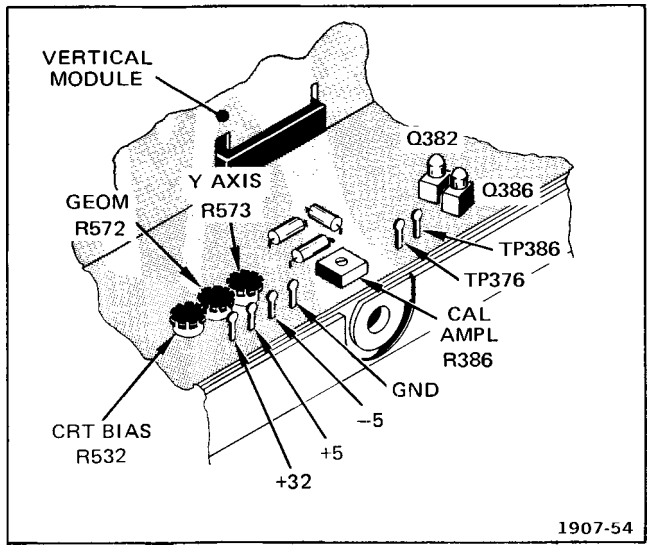


Fig. 6-3. Crt and calibrator adjustment locations.

c. ADJUST—Calibrator Amplitude, R386 (see Fig. 6-3) for +300 mV.

d. Remove shorting jumper between TP376 and TP386.

e. Connect test oscilloscope to CALIBRATOR output jacks and check for 300 mV square wave, approximately 1 kHz.

f. Disconnect test oscilloscope.

B. VERTICAL MODULE

Equipment Required

1. Amplitude Calibrator
2. Square-Wave Generator
3. Sine-Wave Generator
4. 50 Ω BNC Cable
5. 50 Ω Termination
6. 10X Attenuator
7. 20 pF BNC Normalizer
8. Alignment Tool
9. Low-Capacitance Screwdriver
10. Screwdriver

Preset front panel controls as follows:

NOTE

Do not preset internal controls.

Crt

INTENSITY	Midrange

Vertical
(both channels where applicable)

VAR VOLTS/DIV	fully cw (detent)
VOLTS/DIV	20 mV
POSITION	midrange
AC-GND-DC	DC
VERT MODE	CH 1

Horizontal

HORIZ DISPLAY	A
TRIG MODE	AUTO
X10 MAG	out (off)
A COUPLING	AC
A SOURCE	NORM
A TIME/DIV	.2 ms
VAR (VOLTS/DIV)	detent

Set all other controls as desired.

The oscilloscope should produce a baseline trace with the controls set as above. Adjust INTENSITY and FOCUS controls as needed to maintain a well-defined display while making adjustments.

Refer to Fig. 6-4 for vertical adjustment locations.

B1. CH 1 BALANCE

a. Center trace on crt screen with CH 1 POSITION control.

b. ADJUST—CH 1 Bal, R4134, for no trace shift when switching CH 1 VOLTS/DIV switch from 20 mV to 50 mV.

B2. CH 2 BALANCE

a. Set VERT MODE switch to CH 2.

b. Center trace on crt screen with CH 2 POSITION control.

c. ADJUST—CH 2 Bal, R4234, for no trace shift when switching CH 2 VOLTS/DIV switch from 20 mV to 50 mV.

B3. VERTICAL GAIN

a. Set: VOLTS/DIV (both channels) 5 mV
VERT MODE CH 1

b. Connect 20 mV amplitude-calibrator signal to CH 1 input connector via unterminated BNC cable.

c. ADJUST—Gain R4436 for exactly 4 divisions of display.

d. Set VERT MODE to CH 2.

e. Move 20 mV amplitude-calibrator signal to CH 2 input connector.

f. ADJUST—CH 2 Gain R4273 for exactly 4 divisions of display.

g. Disconnect test setup.

B4. LOW-FREQUENCY INPUT COMPENSATIONS

a. Connect 1 kHz square-wave-generator signal from high amplitude output to CH 1 input connector via 50 Ω cable, 10X attenuator, 50 Ω termination, and 20 pF input RC Normalizer.

b. Set generator output for 6 division display. Maintain 6 division display throughout this step, adding or removing attenuators as required.

c. ADJUST—C4124, C4100C, C4100D, C4100G and C4100H (see Fig. 6-4) according to Table 6-2. Use alignment tool listed in Test Equipment Required.

d. Move test setup to CH 2 input connector.

e. Set VERT MODE to CH 2.

f. ADJUST—C4224, C4200C, C4200D, C4200G and C4200H according to Table 6-2. Also see note below.

NOTE

To adjust C4200C it is necessary to remove the front left cabinet latch as follows: loosen set screw holding collar to latch shaft. Remove latch and collar.

g. Disconnect test setup.

B5. HIGH-FREQUENCY COMPENSATIONS

a. Connect 100 kHz positive-going fast-rise signal from square-wave generator to CH 2 input connector via 50 Ω cable, 10X attenuator and 50 Ω termination.

b. Set: CH 2 VOLTS/DIV 5 mV
A TIME/DIV .05 μs
A SLOPE OUT: +

c. Set the generator for a 5 division display.

d. ADJUST—C4417, R4417, C4447, R4412 and C4412 (see Fig. 6-4) for best transient response (also R4414, SN B030000-up). See note below. Total aberrations should not exceed 0.75 minor divisions (3%).

NOTE

C4417 and R4417 affect the first 15 ns, C4447 affects the front corner and R4412 and C4412 affect first 100 ns.

e. Move square-wave-generator setup to CH 1 input.

TABLE 6-2

Low-Frequency Input Compensation

VOLTS/DIV Setting		Adjust for Optimum Over All	Front Corner	Flat Top
CH 1	5 mV	C4124		
	50 mV		C4100H	C4100G
	.5 V		C4100D	C4100C
CH 2	5 mV	C4224		
	50 mV		C4200H	C4200G
	.5 V		C4200D	C4200C

f. Set: CH 1 VOLTS/DIV 5 mV
VERT MODE CH 1

g. ADJUST—C4171, C4173, and R4173 (see Fig. 6-4) for best transient response.

h. INTERACTION—Due to interaction between C4173, R4173, R4417, C4447, and R4412, it may be necessary to repeat steps B5a through B5d, then recheck transient response in channel 2. Aberrations should not exceed 3%.

B6. BANDWIDTH CHECK

a. Set VERT MODE to CH 1.

b. Connect sine-wave generator output to CH 1 input via 50 Ω cable and 10X attenuator.

c. Set generator to 50 kHz reference frequency and adjust output for 6 division display.

d. Increase generator freqeuncy to 50 MHz. Display amplitude should be at least 4.2 divisions.

e. Set VERT MODE to CH 2.

f. Move sine-wave generator setup to CH 2 input. Set generator to 50 kHz and adjust output for 6 division display.

g. Increase generator frequency to 50 MHz. Display amplitude should be at least 4.2 divisions.

NOTE

If display amplitude is less than 4.2 divisions, repeat step B5.

B7. CASCADED BANDWIDTH CHECK

a. Set VERT MODE to CH 1.

b. Connect 50 Ω cable and 50 Ω termination from CH 2 OUT connector (on rear panel) to CH 1 input connector (50 Ω termination at CH 1 connector).

c. Set generator to 50 kHz reference frequency and adjust output for 6 division display.

d. Increase generator frequency to 20 MHz. Display amplitude should be at least 4.2 divisions.

e. Disconnect test setup.

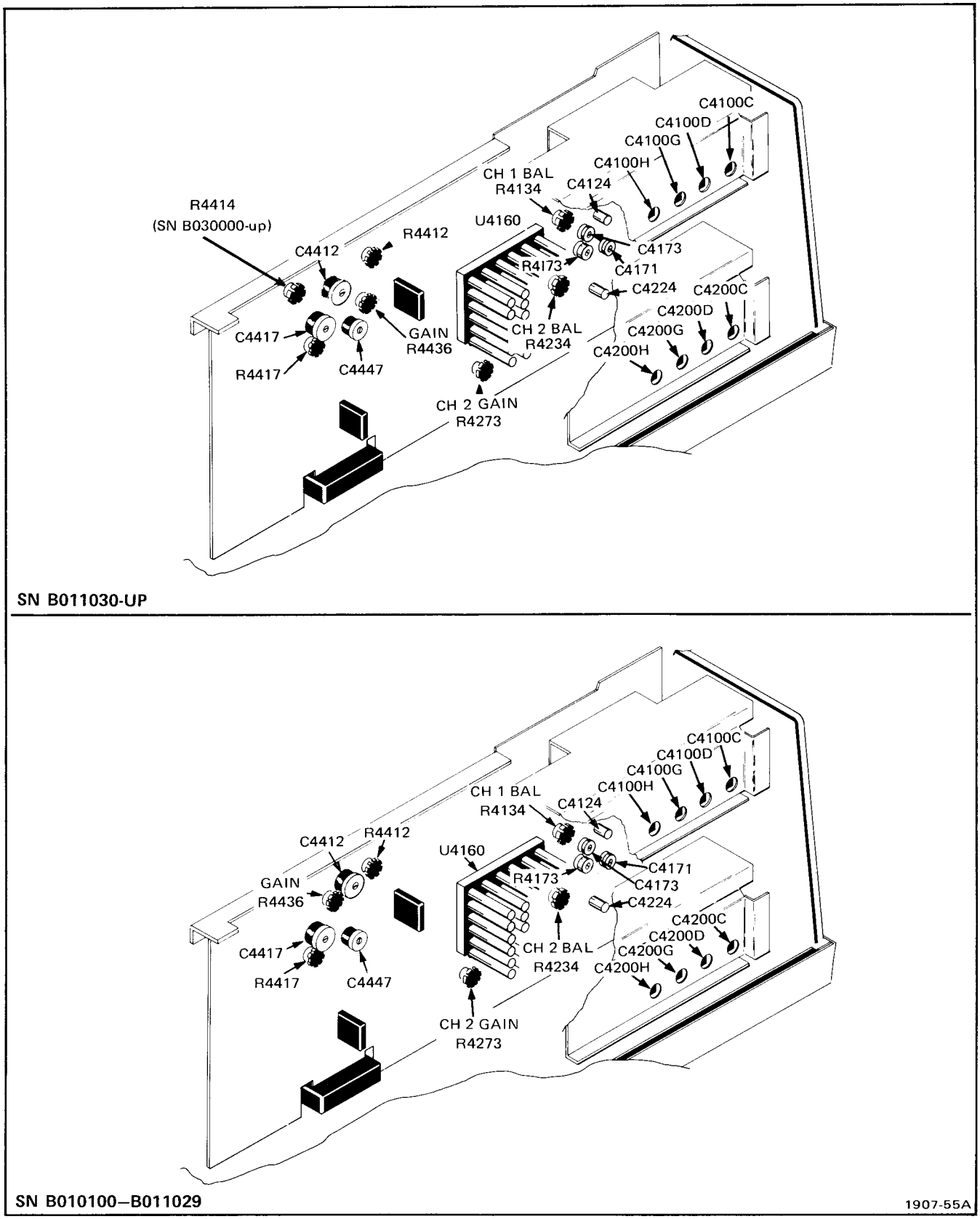


Fig. 6-4. Vertical adjustment locations.

C. HORIZONTAL MODULE

Equipment Required

1. Time-Mark Generator
2. Sine-Wave Generator
3. Amplitude Calibrator
4. 50 Ω Cable
5. 50 Ω Termination
6. Low-Capacitance Screwdriver
7. Screwdriver

Preset front panel controls as follows:

NOTE

Do not preset internal controls.

Crt	
INTENSITY	Midrange
Horizontal	
HORIZ DISPLAY	A INTEN
TRIG MODE	AUTO
X10 MAG	out (off)
A COUPLING	AC
A SOURCE	NORM
A TIME/DIV	1 ms
B TIME/DIV	5 μs
VAR TIME/DIV	Calibrated (detent) position
B SOURCE	STARTS AFTER DELAY

Set all other controls as desired.

The oscilloscope should produce a baseline trace with an intensified portion when the controls are set as above. Adjust INTENSITY and FOCUS controls as needed to maintain a well-defined display while making adjustments.

C1. SWEEP START-STOP

a. Connect 1 ms markers from time-mark generator to vertical input via 50 Ω cable and 50 Ω termination.

b. Set DELAY TIME POS control to 1.00. Center display.

c. ADJUST—Delay Start, R2782 (see Fig. 6-5), so that second time mark is intensified.

d. Set DELAY TIME POS control to 9.00.

e. ADJUST—Delay Stop, R2748 (see Fig. 6-5), so that 10th time mark is intensified.

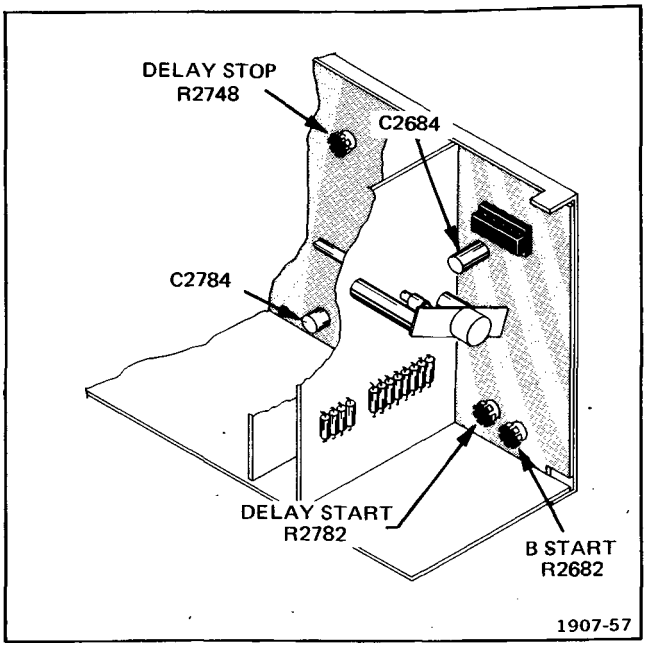


Fig. 6-5. Sweep adjustment locations.

f. INTERACTION—Due to interaction between R2782 and R2748, repeat steps b through e several times until no further adjustment is necessary.

g. Set HORIZ DISPLAY to B DLY'D.

h. Position start of sweep horizontally to graticule center-line. Note—if this is not possible, adjust Mag Reg, R2932 (see Fig. 6-6).

i. Set DELAY TIME POS control to 1.00.

j. ADJUST—Delay Start, R2782 (see Fig. 6-5), so that second major time mark coincides with graticule center-line.

k. Set DELAY TIME POS control to 9.00 (do not read-just horizontal POSITION control).

l. ADJUST—Delay Stop, R2748 (see Fig. 6-5), so that 10th major time mark coincides with graticule center-line.

m. INTERACTION—Due to interaction between R2782 and R2748, repeat steps i through l several times until no further adjustment is necessary.

C2. HORIZONTAL GAIN

a. Set HORIZ DISPLAY to A. Center display.

b. ADJUST—X1 Gain, R2923 (see Fig. 6-6), for one major time mark/division.

c. PARTIAL ADJUSTMENT INTERACTION—When making partial adjustment of X1 Gain, also adjust .5 μs and 5 ns timing.

d. Set X10 MAG pushbutton in (on).

e. Set time generator for .1 ms markers.

f. ADJUST—X10 Gain, R2925 (see Fig. 6-6), for 1 time mark/division.

C3. MAGNIFIER REGISTRATION

a. Position first time mark to graticule centerline.

b. Set X10 MAG pushbutton out (off).

c. ADJUST—Mag Reg. R2932 (see Fig. 6-6), so that first time mark coincides with graticule centerline.

d. INTERACTION—Repeat steps a through c until no trace shift exists while switching X10 MAG pushbutton off and on.

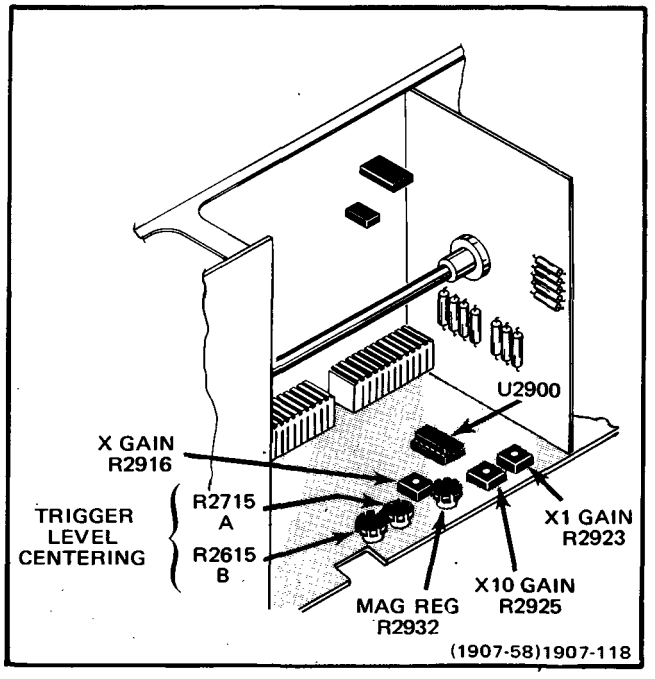


Fig. 6-6A. Horizontal and Trigger adjustment locations SN B044420 and up.

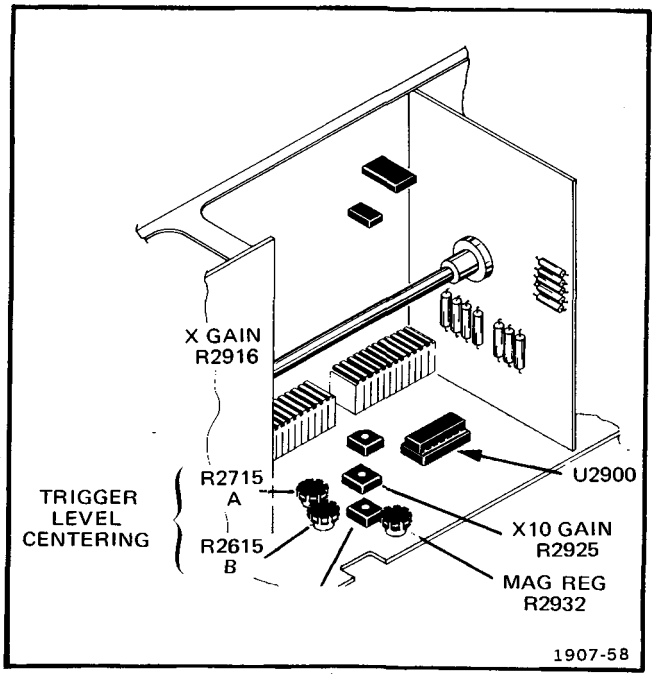


Fig. 6-6B. Horizontal and Trigger adjustment locations below SN B044420.

C4. B START LEVEL

a. Set:

B TIME/DIV	1 ms
X10 MAG	in (on)
DELAY TIME POS	Counterclockwise

b. Position start of A sweep to graticule centerline.

c. Set HORIZ DISPLAY switch to B DLY'D.

d. ADJUST–B Start R2682 (see Fig. 6-5) so that B sweep starts at graticule centerline. While changing HORIZ DISPLAY switch from A to B DLY'D, adjust R2682 so that A and B sweeps start at same point.

C5. .5 μs TIMING

a. Set:

HORIZ DISPLAY	A
A and B TIME/DIV	.5 μs
X10 MAG	out (off)

b. Set time-mark generator for 0.5 μs markers.

c. ADJUST–C2784 (see Fig. 6-5) for 1 time mark/division.

d. Set:

HORIZ DISPLAY	B DLY'D
DELAY TIME POS	1.00 or less

e. ADJUST–C2684 (see Fig. 6-5) for 1 time mark/division.

f. Set:

B TIME/DIV	.05 μs (pull to unlock knobs)
DELAY TIME POS	1.50

g. Position time mark to graticule centerline.

h. Set DELAY TIME POS control to 8.50.

i. ADJUST–C2784 (see Fig. 6-5) so that time mark coincides with graticule centerline.

j. PARTIAL ADJUSTMENT INTERACTION–When making partial adjustments, also adjust 5 ns timing.

C6. 5 ns TIMING

a. Set:

HORIZ DISPLAY	A
A TIME/DIV	.05 μs
A SOURCE	EXT

b. Set time-mark generator for 10 ns markers. Connect a 50 Ω cable and 50 Ω termination from time-mark generator trigger output to B2 external trigger input. Adjust vertical amplitude for about 4 divisions.

c. Center display with horizontal POSITION.

d. Set X10 MAG pushbutton in (on).

e. ADJUST—C232 and C272 (on Main Module, see Fig. 6-7) for 1 time-mark cycle/2 divisions. When properly adjusted, screws on these trimmer capacitors should be out approximately equal distance.

f. Disconnect test equipment.

C7. TRIGGER LEVEL CENTERING

a. Set:

A and B TIME/DIV	10 μs
A LEVEL	0
A SOURCE	NORM
X10 MAG	out (off)

b. Connect 50 kHz reference signal from sine-wave generator to vertical input via 50 Ω cable and 50 Ω termination.

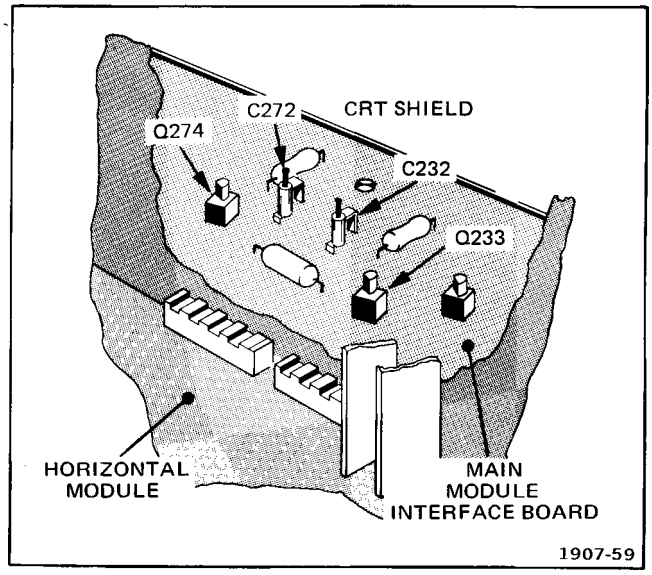


Fig. 6-7. C232 and C233 adjustment locations.

c. Set controls to display 6 divisions, 3 divisions above and 3 divisions below graticule horizontal centerline.

d. ADJUST—A Trigger Level Centering R2715 (see Fig. 6-6) so that sweep starts same distance from graticule horizontal centerline in both + and — positions of A SLOPE switch.

e. Set:

HORIZ DISPLAY	B DLY'D
A TIME/DIV	20 μs
B SOURCE	NORM
B LEVEL	0

f. ADJUST—B Trigger Level Centering R2615 (see Fig. 6-6) so that sweep starts same distance from graticule horizontal centerline in both+ and — positions of B SLOPE switch.

g. Disconnect test equipment.

C8. X GAIN

a. Set:

CH 1 VOLTS/DIV	5 mV
VERT MODE	CH 2
A TIME/DIV	X-Y

b. Connect 20 mV standard-amplitude calibrator signal to Channel 1 vertical input.

c. ADJUST—X GAIN R2916 (see Fig. 6-6) for 4 division display.

d. Disconnect test equipment.

INSTRUMENT OPTIONS

Your instrument may be equipped with one or more instrument options. A brief description of each option is given in the following discussion. Complete information is located behind this page.

Conversion kits for some options are available and can be installed at a later time. For further information on instrument options, see your Tektronix Catalog or contact your Tektronix Field Office.

OPTION 4

Modifies the 455 to meet the EMC requirements of MIL-STD-461A when tested in accordance with the following test methods of MIL-STD-462:

CE-01, CE-03, CS-01, CS-02, CS-06, RE-02 (limited to 1 GHz),
(T) RE-04, RS-01, and RS-03 (limited to 1 GHz).

OPTION 5

Adds a tv sync separator to the B2 module to provide stable triggering from composite video waveforms.

OPTION 7

Permits the 455 to be powered from a dc source of 12 volts or 24 volts in addition to the standard ac line operation. For battery operation, Option 7 makes the 455 compatible with the Tektronix 1106 Battery Pack.

OPTION 78

Changes crt type to one with a P11 phosphor.

OPTION 4

The 455 Option 4 oscilloscope is modified to meet the EMC requirements of MIL-STD-461A when tested in accordance with the following test methods of MIL-STD-462:

CE-01, CE-03, CS-01, CS-02, CS-06,
RE-02 (limited to 1 GHz), (T) RE-04,
RS-01, and RS-03 (limited to 1 GHz).

The following additions and changes are made to the standard 455 to meet the Option 4 specification requirements:

a. Three capacitors added across the power transformer secondary windings. Refer to Fig. 1.

b. EMI filter added in series with the ac-line cord.

c. The insides of both top and bottom cabinet sections coated with a metallic paint to provide shielding.

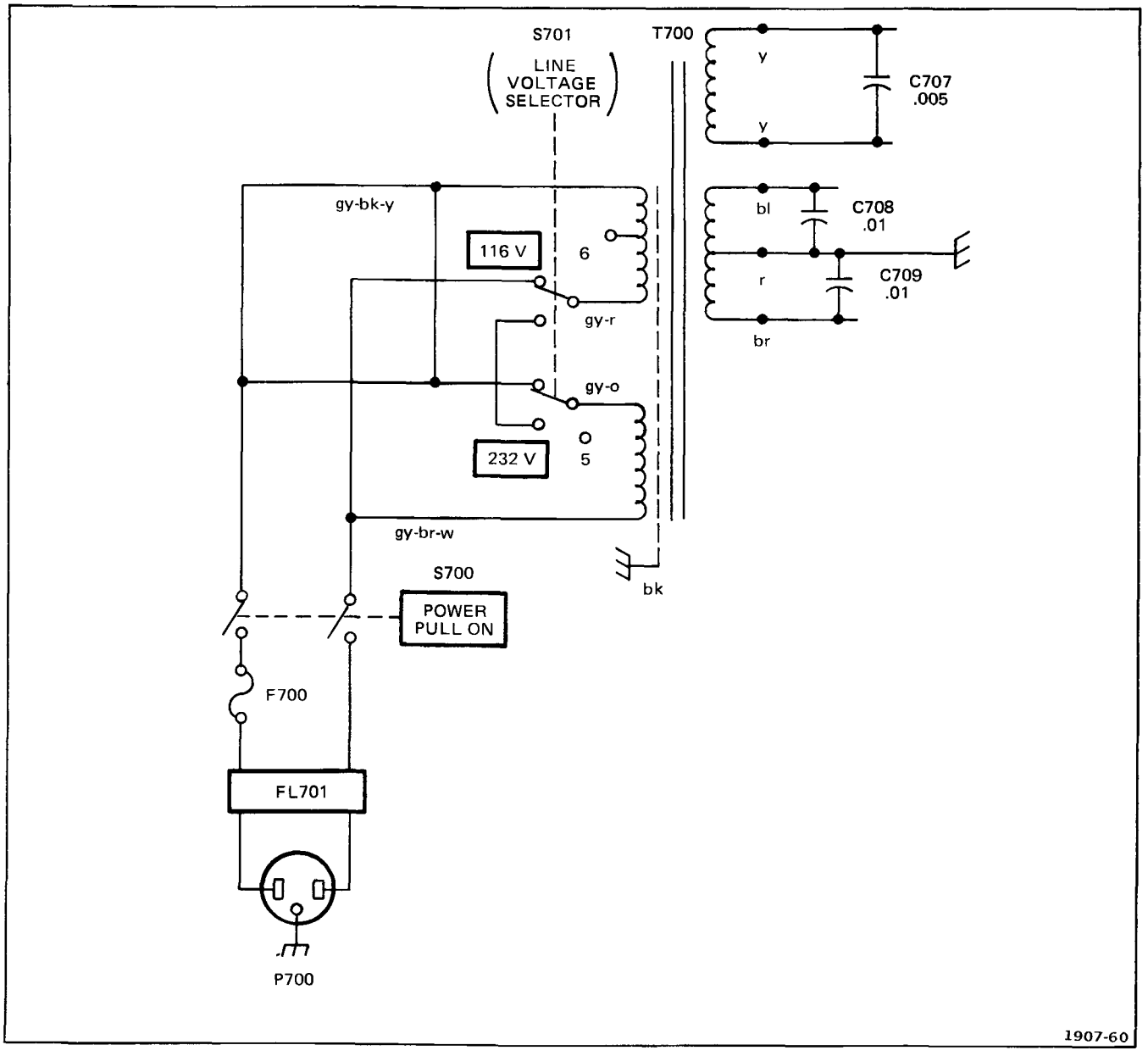


Fig. Option 4-1. Partial Power Supply diagram.

OPTION 4

REPLACEABLE ELECTRICAL PARTS

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C707	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C708	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C709	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
FL701	119-0376-01			FILTER,RAD INT:2 X 3A,250V,400 HZ	80009	119-0376-01

REPLACEABLE MECHANICAL 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	119-0376-01			1	FILTER,RAD INT:2 X 3A,250V,400 HZ	80009	119-0376-01
-2	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
-3	390-0449-01			1	COVER,SCOPE:TOP	80009	390-0449-01
	----- -----			-	(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
-4	441-1259-01			1	CHASSIS,SCOPE:MAIN,W/CONDUCTIVE PAINT	80009	441-1259-01
	----- -----			-	(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
-5	342-0308-00			1	INSULATOR,FILM:BOTTOM COVER,0.01 POLYEST	80009	342-0308-00
	334-3379-00	XB056840		1	MARKER,IDENT:MARKED GROUNDSYMBOL	80009	334-3379-00

OPTION 5

Option 5 adds a sync separator which provides additional processing for trigger signals to facilitate observation of composite video and related television waveforms.

Added circuitry provides amplification, selectable polarity inversion, clipping, and sync recognition. The output of this circuitry supplies both vertical (field-rate) and horizontal (line-rate) trigger signals to the A TRIGGER COUPLING switch and supplies horizontal (line-rate) trigger signals to the B (DLY'D) TRIGGER SOURCE switch.

The sync separator operates from either sync-negative or sync-positive video sources, 405 to 1201 lines, 50 or 60 Hz field rate. The A SOURCE switch determines the source of the signal supplied to the sync separator.

SPECIFICATION

The standard B2 Horizontal Module characteristics are applicable except as noted below:

1. The sync separator provides stable triggering of A Sweep at the line or field rate and stable triggering of B Sweep at the line rate. Accepts sync-positive or sync-negative composite video, 405 to 1201 line, 50 or 60 Hz field rate.

2. Adds 2 positions to the A COUPLING switch (FIELD and TV LINE). Adds 1 position to the B SOURCE switch (TV LINE).

3. Sensitivity. See Table 1.

TABLE 1

Sync Separator Trigger Sensitivity

A SOURCE Switch	Type of Signal	SENSITIVITY	
		Min	Max
NORM	Composite video (nominal)[1]	2 div	20 div
CH 1, CH 2	Composite Sync		
EXT	Composite video (nominal)[1]	200 mV	4 V
	Composite sync	75 mV	4 V
EXT ÷ 10	Composite video (nominal)[1]	2.0 V	40 V
	Composite sync	750 mV	40 V

[1] **Peak Video ≈ 7/3 sync amplitude.**

OPERATING INFORMATION

Typical operation of an Option 5 instrument uses A sweep to establish a basic field and frame-related display. Then, all detail measurements are made using B Sweep.

INSTALLATION AND SET-UP OF VIDEO GRATICULE

To install a video graticule, loosen the 4 captive screws holding the crt bezel in place, and remove the bezel. Snap the standard light filter from the bezel and replace with the desired graticule. Install the desired graticule with the markings on the outside and with the extended tab, at the bottom of the graticule, at the slightly wider (BOTTOM) margin of the bezel. While reinstalling the bezel, move the video graticule horizontally slightly so the video graticule lines up with the crt graticule.

With the video graticule installed, the 10 horizontal divisions along the 0 (zero) line correspond to the internal crt graticule divisions. The horizontal (time) calibration of the oscilloscope is correct.

The vertical divisions of the video graticule represent proportions of the 100-unit (CCIR) or 140-unit (NTSC) video waveform. To calibrate the vertical divisions for a standard TV (nominal) studio video signal, apply the 300 mV calibrator signal to the vertical input, then adjust the VOLTS/DIV and VAR controls so the displayed waveform occupies 30 units with the CCIR graticule or 42 units with the NTSC graticule.

SYNC SEPARATOR OPERATING REQUIREMENTS

The operation of the sync separator requires the performance of the following 3 steps:

1. Set the A COUPLING switch to TV FIELD or TV LINE.

2. Set the A SOURCE switch to the desired position. Be certain the SOURCE selected provides a trigger signal which meets the sensitivity requirements listed in Table 1. Adjustment of the VAR VOLTS/DIV control changes the amplitude of the signal supplied to the sync separator.

3. Set the A SLOPE switch to negative (–) for sync-negative input signals and positive (+) for sync-positive input signals.

NOTE

If the A SOURCE switch is set to CH 2 and the CH 2 INVERT button is set to INVERT (button in), the setting of the A SLOPE switch just discussed reverses. See Single Trace Modes under Vertical Operating Modes—Special Considerations.

TRIGGERING A SWEEP

If the sync separator operating requirements are met, adjustment of the A LEVEL control is all that is needed to trigger A Sweep on video waveforms.

In 405-line systems, the A LEVEL control may need to be rotated more clockwise to avoid line-rate artifacts on the field-sync signal. Adjustment of the A TRIGGER HOLDOFF control may also be helpful in obtaining a stable display.

To obtain displays free of interlace jitter for systems having 2:1 interlace, set the A TIME/DIV switch for an unmagnified display of an odd number of fields plus a fraction of a field. For 50 and 60 Hz field rates, set the A TIME/DIV switch to 2 ms. For some PAL system observations, an A TIME/DIV switch setting of 5 ms (2-1/2 field display), with the A TRIGGER holdoff control adjusted for an additional 1 field holdoff, may be desirable to maintain a stable display relationship to the 4-field PAL burst-blanking sequence.

TRIGGERING B SWEEP

To trigger B Sweep on video waveforms, perform the following procedure:

1. Be certain the Sync Separator Operating Requirements are met and A Sweep is triggered.

2. Set the B SOURCE switch to STARTS AFTER DELAY and the HORIZ DISPLAY switch to A INTEN.

3. Adjust the B TIME/DIV and DELAY TIME POS controls so the portion of the A Sweep display to be displayed in the B DLY'D mode is intensified.

4. Set the HORIZ DISPLAY switch to B DLY'D. This displays the portion of the A Sweep display that was intensified.

5. If there is too much horizontal jitter, set the B SOURCE switch to TV LINE and the B Slope switch to the same polarity as the A SLOPE switch. Adjust the B LEVEL control for a stable display.

With the B SOURCE switch set to STARTS AFTER DELAY and the A COUPLING switch set to TV FIELD, a stable B Sweep display of equalizing pulses may be difficult to obtain. If this is so, trigger B Sweep directly from the signal source. Use the NORM position of the B SOURCE switch for single trace displays and the CH 1 or CH 2 positions for dual trace displays.

VERTICAL OPERATING MODES—SPECIAL CONSIDERATIONS

Single Trace Modes

In the CH 1 and CH 2 vertical modes, any A SOURCE switch position, except LINE, may be used.

If the display is frequently switched between CH 1 and CH 2, use the NORM position of the A SOURCE switch. This eliminates the need to change the A SOURCE switch position each time the display is switched between CH 1 and CH 2.

When using the NORM or CH 2 positions of the A SOURCE switch, and when viewing Channel 2 inverted (CH 2 INVERT switch is set to the in position), the normal setting of the A SLOPE switch is reversed. This is because the trigger signal is picked off the Vertical Preamplifier after inversion. In this case, set the A SLOPE switch to negative (–) for sync-positive input signals and positive (+) for sync-negative input signals.

Dual Trace Modes

In the ALT or CHOP modes, all positions of the A SOURCE switch may be used except LINE and NORM. The sync separator cannot correctly process the signals supplied from the normal trigger pickoff. Therefore, stable simultaneous displays of 2 independent video signals that are not genlocked together are not possible.

ADD Mode

Any A SOURCE switch position except LINE may be used. The CH 1 and CH 2 trigger signals are picked off before signal addition and therefore are not affected by addition. The normal trigger signal is picked off after signal addition and therefore, is affected by addition.

When using the ADD Mode with CH 2 inverted, the CH 1 and CH 2 positions of the A SOURCE switch will provide adequate trigger signals if each individual Channel (when displayed alone) meets the sensitivity requirements listed in Table 1.

When the ADD Mode is used to display a full-sized signal from both sides of a balanced line (CH 2 not inverted), the NORM position of the A SOURCE switch may be used if neither signal alone (CH 1 or CH 2 positions of the A SOURCE switch) is of sufficient amplitude.

When using the ADD mode, the vertical calibration of the video graticule is valid only if both individual channels are correctly set up and both VOLTS/DIV switches are set to the same position.

SELECTING AN INDIVIDUAL LINE[1]

The Sync Separator does not differentiate between the 2 fields of an interlaced frame or the 4 fields of a PAL color frame sequence. However, using a 1-1/2 or 3-1/2 field A sweep cycle, the display will remain locked on a given field until the trigger signal is interrupted.

One Frame A Sweep Cycle

To display an entire vertical blanking interval and locate a specific line (e.g., one of the lines containing a specific VITS waveform), use the following procedure:

1. Set:	A TIME/DIV	2 ms
	B TIME/DIV	10 μs
	B SOURCE	STARTS AFTER DELAY
	A TRIGGER HOLDOFF	NORM
	HORIZ DISPLAY	A INTEN
	A LEVEL	As needed for a stable display

2. Horizontally position the second vertical blanking interval to the center of the crt.

[1] See Identifying Fields, Frames and Lines in 525/60 and 625/50 TV Systems.

3. Set the X10 MAG button to the in position and horizontally position the display desired. This provides sufficient resolution to identify the field.

4. If the displayed field is not the one desired, momentarily switch the A SLOPE to the opposite polarity several times until the desired field is displayed.

5. Horizontally position the display until the desired line becomes visible.

6. Adjust the DELAY TIME POS control to move the intensified zone to the desired line. It may be desirable to set the X10 MAG button to the unmagnified (button out) position to locate the intensified zone. With the X10 MAG button out, use the DELAY TIME POS control to move the intensified zone to the horizontal center of the crt. When the X10 MAG button is again set to the in position, the intensified zone will remain in the viewing area.

7. When the desired line is intensified, set the HORIZ DISPLAY switch to B DLY'D. This displays the desired line.

8. If there is too much jitter, set the B SOURCE switch to the TV LINE position and adjust the B LEVEL control for a stable display.

Two Frame A Sweep Cycle

If PAL burst blanking is to be checked, use the same procedure as for a one-frame A Sweep cycle with the following exceptions:

1. Set the A TIME/DIV switch to 5 ms instead of 2 ms.

2. Adjust the A TRIGGER HOLDOFF control for a display locked on a given field (increase hold off time by 1 field).

3. Momentarily switch the A SLOPE switch to the opposite polarity several times until the desired field is displayed in the desired position.

IDENTIFYING FIELDS, FRAMES, AND LINES

NTSC (CCIR System M)

Field 1 is defined as the field whose first equalizing pulse is one full horizontal interval (63.5 μs) from the preceding horizontal sync pulse. The Field 1 picture starts with a full line of video.

Field 1 lines are numbered 1—263, starting at the leading edge of the first equalizing pulse. The first regular horizontal sync pulse after the second equalizing interval is the start of line 10.

Field 2 starts with an equalizing pulse a half-line interval from the preceding horizontal sync pulse. The Field 2 picture starts with a half line of video.

Field 2 lines are number 1—262, starting at the leading edge of the **second** equalizing pulse. After the second equalizing interval, the first full line is line 9.

CCIR System B (including PAL)

In most 625-line, 50 Hz field-rate systems, identification of parts of the picture relies primarily on continuous line numbering rather than on field-and-line identification, except for PAL systems.

The CCIR frame starts with the first (wide) vertical sync pulse following a field which ends with a half-line of video. The first line after the second equalizing interval is line 6; the first picture line is line 23 (half-line of video). The first field of the frame contains lines 1 through the first half of line 313, the picture ending with a full line of video (line 310).

The second field of the frame commences with the leading edge of the first (wide) vertical sync pulse (middle of "line" 313), and runs through line 625 (end of equalizing interval). The first full line after the equalizing interval is line 318; the picture starts on line 336 (full line).

The first field is referred to as "odd", the second field as "even". Note that the identification systems for System M and System B are opposite.

In the four-field PAL sequence with Bruch Sequence Colorburst blanking, the fields are identified as follows:

Field 1: Field which follows a field ending in a half-line of video, and which preceding field has color burst on the last full line. Field 1 lines are 1 through 312 and half of line 313. Color burst starts on line 7 of Field 1; a half-line of video appears on line 23.

Field 2: Field which follows a field ending in a full line which does not carry color burst. Field 2 lines are the last half of line 313 through line 625. Color burst starts on line 319 (one line without burst following the last equalizing pulse); a full line of video appears at line 336.

Field 3: Field which follows a field ending in a half line and which preceding field has no color burst on its last full line. Field 3 lines are 1 through the first half of line 313. Burst starts on line 6 (immediately following the last equalizing pulse); a half-line of video appears on line 23.

Field 4: Field which follows a field ending in a full line carrying color burst. Field 4 lines are the second half of line 313 through line 625. Color burst for Field 4 starts on line 320 (two full lines without burst follow the last equalizing pulse); video starts with a full line on line 336.

PERFORMANCE CHECK

This procedure allows the basic performance specifications to be checked without removing the instrument covers. It is intended for use in incoming inspection to determine acceptability of newly purchased or recently recalibrated instruments.

TEST EQUIPMENT REQUIRED

The following test equipment, or equivalent, is required to check the performance of the B2 Option 5:

1. Television Test Signal Generator, Tektronix part 067-0601-00.

2. 405/50 Program Card, Tektronix part 067-5001-00.

3. 1201/60 Program Card, Tektronix part 067-5010-00.

4. 75 Ω Coaxial Cable, Tektronix part 012-0074-00.

5. 75 Ω Termination, Tektronix part 011-0055-00.

PRELIMINARY PROCEDURE

1. Set front panel controls as follows:

Vertical Module

VERT MODE	CH 2
CH 2 VOLTS/DIV	.5 V
INVERT	out (normal)

B2 Module

HORIZ DISPLAY	A
A and B TIME/DIV	20 μs
X10 MAG	out (off)
DELAY TIME POS	0.0
A SLOPE/SYNC	IN: –
B SLOPE	IN: –

B2 Module (continued)

A COUPLING	TV LINE
A SOURCE	NORM
B SOURCE	TV LINE

2. Install 405/50 Program Card into Television Test Generator.

3. Connect composite video output from Test Generator to Vertical Module CH 2 input via 75 Ω cable and 75 Ω termination.

4. Set Test Generator Average Picture Level control fully counterclockwise.

5. Adjust Test Generator Amplitude level for 0.6 division display.

6. Adjust Test Generator Average Picture Level control for 2 division peak-to-peak display.

PERFORMANCE CHECK

1. TV LINE RATE

a. CHECK—Stable display can be obtained by adjusting the A LEVEL control. Note that vertical blanking signal appears moving through the bottom portion of waveform.

2. TV FIELD AND LINE (405/50)

a. Set: A COUPLING FIELD

A TIME/DIV 1 ms

b. CHECK—Stable display can be obtained by adjusting A LEVEL control.

c. Push X10 MAG switch in (on).

d. Adjust A TRIG HOLDOFF until jitter stops.

e. Set: X10 MAG — out (off)
B TIME/DIV — .2 ms
HORIZ DISPLAY — B DLY'D

f. CHECK—Stable display can be obtained by adjusting B LEVEL control. Rotate DELAY TIME POS control through vertical blanking interval checking that a stable display can be obtained on each pulse of vertical blanking interval and several pulses after.

g. Reset DELAY TIME POS control to 0.0.

h. Set CH 2 VOLTS/DIV switch to 50 mV and repeat part f.

i. Set: INVERT (Vertical Module) — in (invert)
A and B SLOPE — OUT: +

j. Readjust A and B LEVEL controls for a stable display and repeat part f.

3. TV FIELD AND LINE (1201/60)

a. Install 1201/60 Program Card into Television Test Generator.

b. Set: A TIME/DIV — 50 μs
B TIME/DIV — 10 μs
HORIZ DISPLAY — A INTEN

c. CHECK—Stable display with intensified portion at start of sweep can be obtained by adjusting the B LEVEL control.

d. Set HORIZ DISPLAY to B DLY'D.

e. CHECK—Stable display can be obtained by adjusting B LEVEL control. Rotate DELAY TIME POS control through vertical blanking interval checking that stable display can be obtained on first 5 pulses. Next 6 pulses are equalizing pulses and you may not be able to trigger on them. Continue rotating DELAY TIME POS control and check that stable display can be obtained on rest of horizontal sync pulses and several horizontal sync pulses after vertical blanking interval.

f. Reset DELAY TIME POS control to 0.0.

g. Set: INVERT (Vertical Module) — out (non-invert)
A and B SLOPE — IN: –
HORIZ DISPLAY — A INTEN

h. Vertically center the display.

i. CHECK—Stable display with intensified portion at start of sweep can be obtained by adjusting the A and B LEVEL controls.

j. Set HORIZ DISPLAY to B DLY'D and repeat part e.

k. Set CH 2 VOLTS/DIV switch to .5 V and vertically center display.

l. Readjust A and B LEVEL controls for a stable display and repeat part e.

CIRCUIT DESCRIPTION

BLOCK DIAGRAM

Setting the A COUPLING switch to TV LINE or TV FIELD activates the sync separator circuit (see Fig. 1). The A SOURCE switch determines the source of the signal supplied to the sync separator. The input signal passes through an FET Input Buffer amplifier to an Inverting/Non-Inverting Amplifier. Whether the amplifier is inverting or non-inverting is determined by the setting of the A SLOPE/SYNC switch. The output of the Inverting/Non-Inverting Amplifier is supplied to the sync-separator circuit which strips the signal of video. The output of the sync-separator circuit supplies a composite-sync signal to the A and B trigger generators for use as a trigger signal in the TV LINE position of the A COUPLING and B SOURCE switches.

The output of the sync-separator circuit is also supplied to the vertical sync recognizer circuit. The vertical sync recognizer circuit processes the composite-sync signal and supplies a vertical-sync signal to the A trigger generator for use in the TV Field position of the A COUPLING switch.

SWITCHING

In the AC, LF REJ, HF REJ, and DC positions of the A COUPLING Switch, −5 volts is connected to the base of U2232E. This holds off U2232E, which holds off U2232A and U2232B. Therefore, the sync separator is inoperative.

In the TV FIELD and TV LINE positions of the A COUPLING switch, −5 volts is removed from the base of U2232E. The current now available from R2224 turns on U2232E. This turns on U2232A and U2232B which allows the sync separator to operate.

In the AC, LF REJ, HF REJ, and DC positions of the Ac COUPLING switch, no signal is applied to the Input Buffer (Q2212). In the TV FIELD and TV LINE positions of the A COUPLING switch, the signal selected by the A SOURCE Switch is supplied to the gate of Q2212.

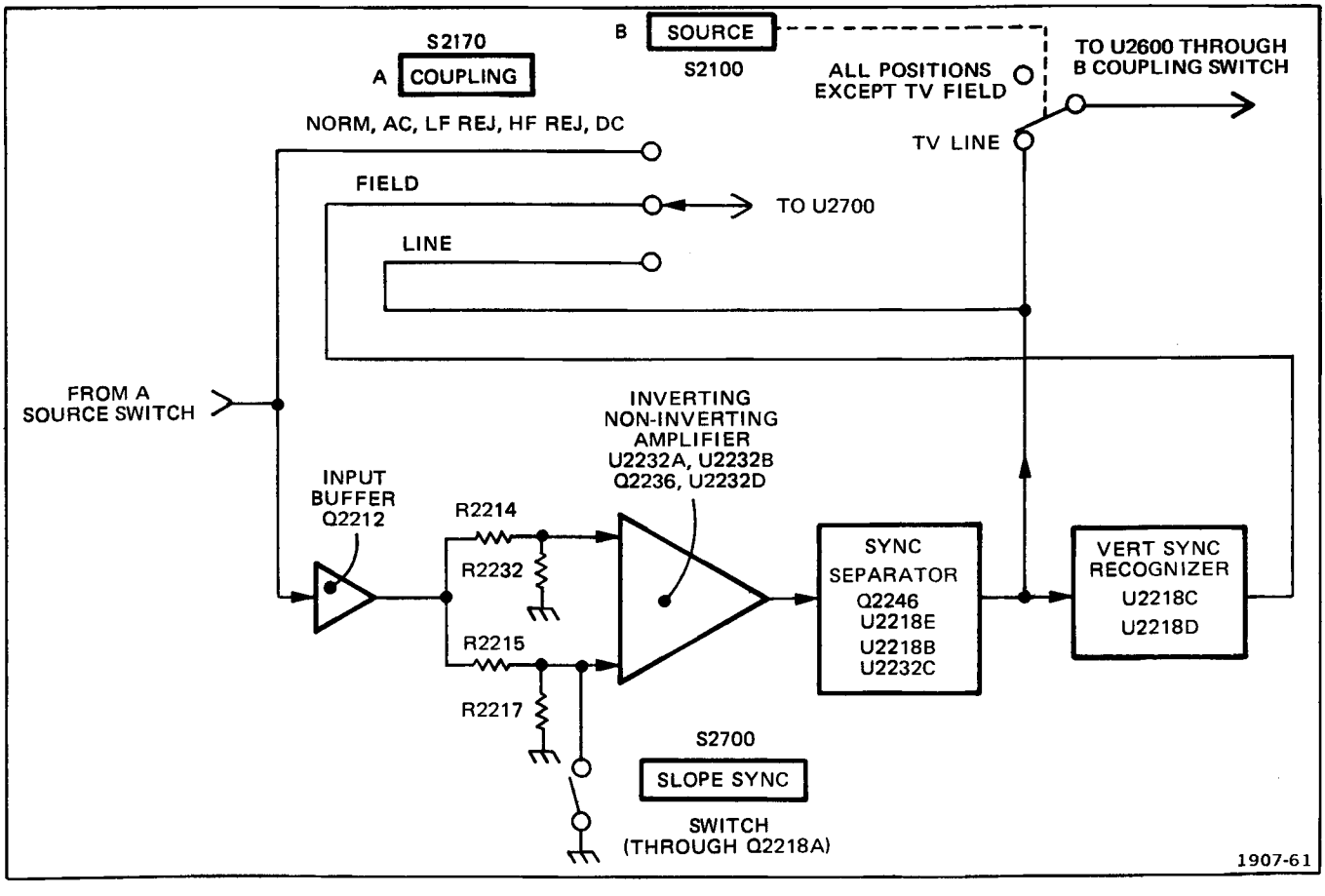


Fig. Option 5-1. Block diagram.

The output of the sync-separator circuit is supplied to the A and B trigger generators via the A COUPLING and B SOURCE switches. The output of the vertical sync recognizer is supplied to the A trigger generator via the A COUPLING Switch.

INPUT BUFFER AMPLIFIER

Q2212 is an FET source follower. It provides a high-impedance input for isolation and a low-impedance output to drive the input of the Inverting/Non-Inverting Amplifier.

INVERTING/NON-INVERTING AMPLIFIER

The Inverting/Non-Inverting Amplifier is basically an operational amplifier composed of U2232A, U2232B, and Q2236 (see Fig. 2). The base of U2232A is the inverting input. The base of U2232B is the non-inverting input. The collector of Q2236 is the output. R2223 is the feedback resistor. U2232D provides isolation between the Inverting/Non-Inverting Amplifier and the sync-separator circuit.

Non-Inverting Operation

Setting the A SLOPE switch to positive (+) connects the base of U2218A to ground through R2218. This holds off U2218 which allows the circuit to operate in the non-inverting mode. The input signal is supplied to both the inverting and non-inverting inputs of the operational amplifier through 2 voltage dividers. The signal supplied to the non-inverting input through voltage divider R2215 and R2217, is about twice the amplitude of the signal supplied to the inverting input through voltage divider R2214 and R2232. Therefore, the net gain of the circuit is about 6 with the output signal in phase with the input signal.

Inverting Operation

Setting the A SLOPE switch to negative (—) connects the base of U2218A to +5 volts through R2218. This turns on U2218A which effectively shorts the non-inverting input of the operational amplifier to ground. The net circuit gain is still about 6 but since only the inverting input of the operational amplifier is being driven, the output signal will be inverted with respect to the input signal.

SYNC-SEPARATOR CIRCUIT

Emitter follower U2232D buffers the output of the operational amplifier and provides a low-impedance drive to the input of the sync-separator circuit.

C2242 charges to the positive peak of each sync pulse through R2242, R2245, and CR2245. When the voltage on

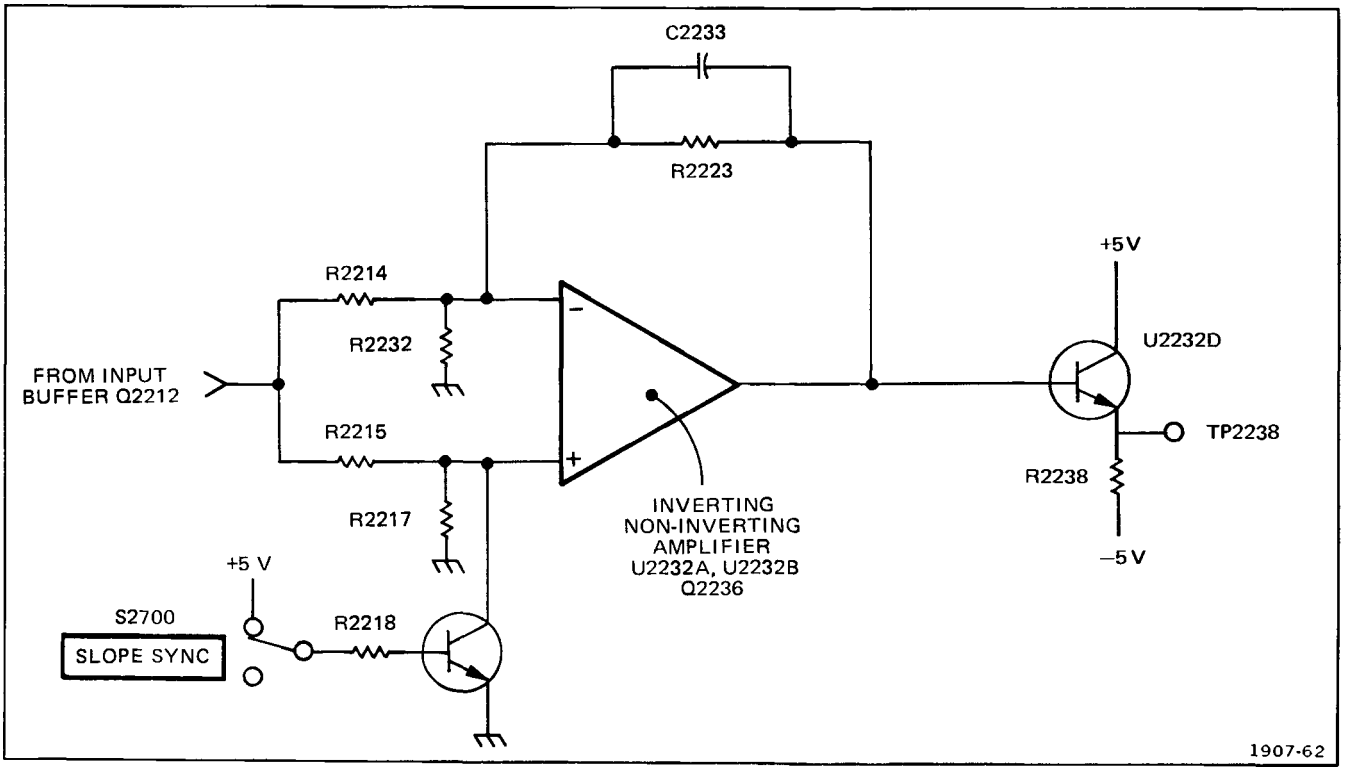


Fig. Option 5-2. Inverting/non-inverting amplifier block diagram.

the emitter of U2232D goes positive enough to overcome the charge on C2242, a positive-going signal is supplied to the base of U2218E through emitter follower Q2246. This causes U2218E to conduct through CR2245 and help charge C2242 to the new positive peak. As a result of this process, the signal at the collector of U2218E is an amplified and inverted version of the positive sync pulses at the emitter of U2232D. These negative-going sync pulses are level-shifted by R2252 and R2254, then regenerated and buffered by the Schmitt Trigger composed of U2232C and U2218B. The output of the Schmitt Trigger is supplied to the TV LINE positions of the A COUPLING and B SOURCE switches through CR2257 and C2258 in the negative (—) position of the A SLOPE/SYNC switch or through CR2251 and C2251 in the positive (+) position of the A SLOPE/SYNC switch.

VERTICAL SYNC RECOGNIZER

The negative-sync output at the collector of U2218B is applied to the input of the Vertical Sync Recognizer composed of U2218D and U2218C. The vertical sync pulse is wider than the horizontal sync pulse. Therefore, when the vertical sync pulse arrives, U2218D is turned off longer than for a horizontal sync pulse allowing C2262 to discharge through R2262. When the vertical sync pulse ends, U2218B turns on and conducts heavily to recharge C2262. The heavy conduction of U2218D causes its collector to go sufficiently less positive to turn on U2218C. The result is a negative-going, short-duration pulse occurring at the end of the vertical sync pulse. This short duration pulse is supplied to the TV FIELD position of the A COUPLING switch through R2267 and coupling capacitor C2267.

VOLTAGE CONDITIONS

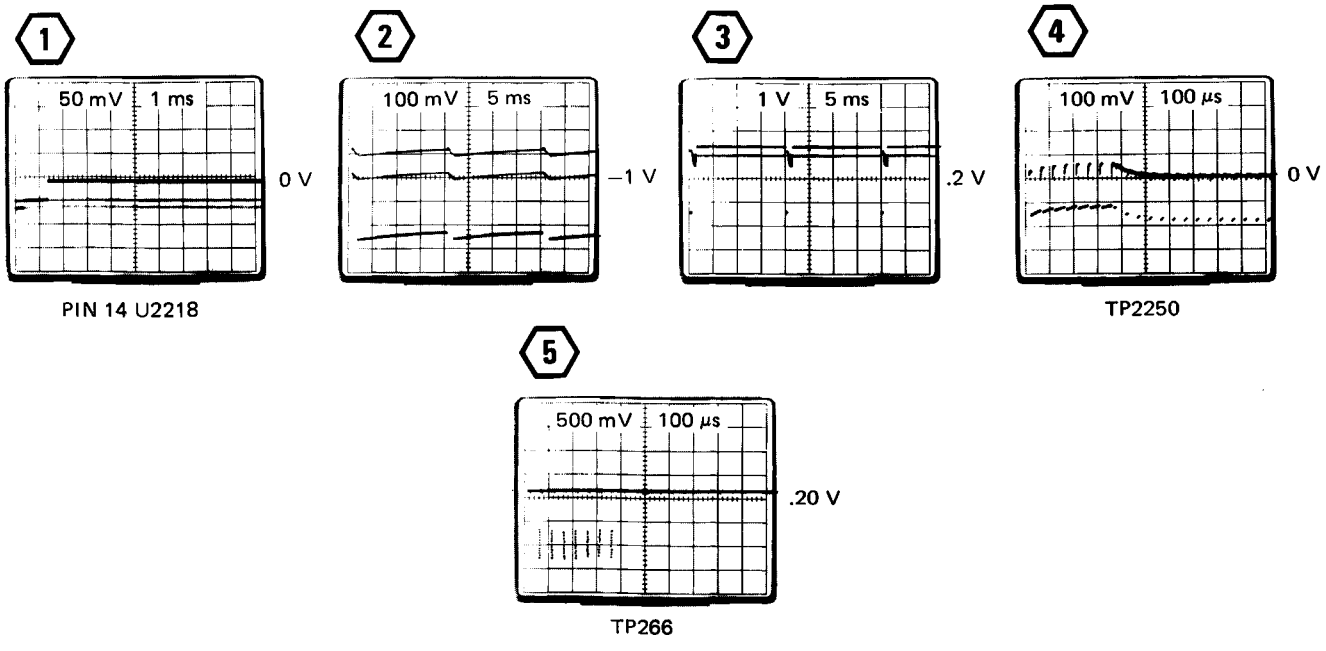
Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

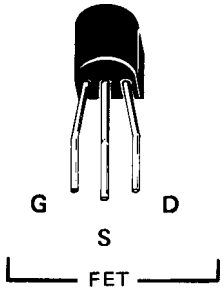
The B2 A COUPLING switch was set in the FIELD position.

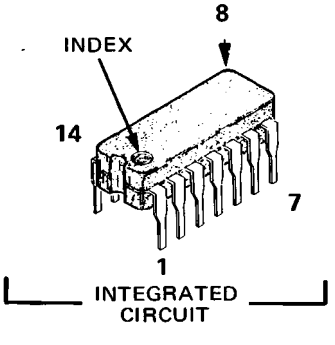
WAVEFORM CONDITIONS

Waveforms below were taken from a Tektronix 7000-series oscilloscope equipped with readout, 7B series time-base, 7A13 Differential comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

Composite video signal was supplied from a Tektronix Television Test Signal Generator 067-0601-00 with a 405/50 Program card 067-5001-00. Two divisions of composite video was displayed on the Main Module crt screen. The B2 A COUPLING was set to FIELD and the B SOURCE was set to LINE. The test oscilloscope was externally triggered from B2 test point TP2250.







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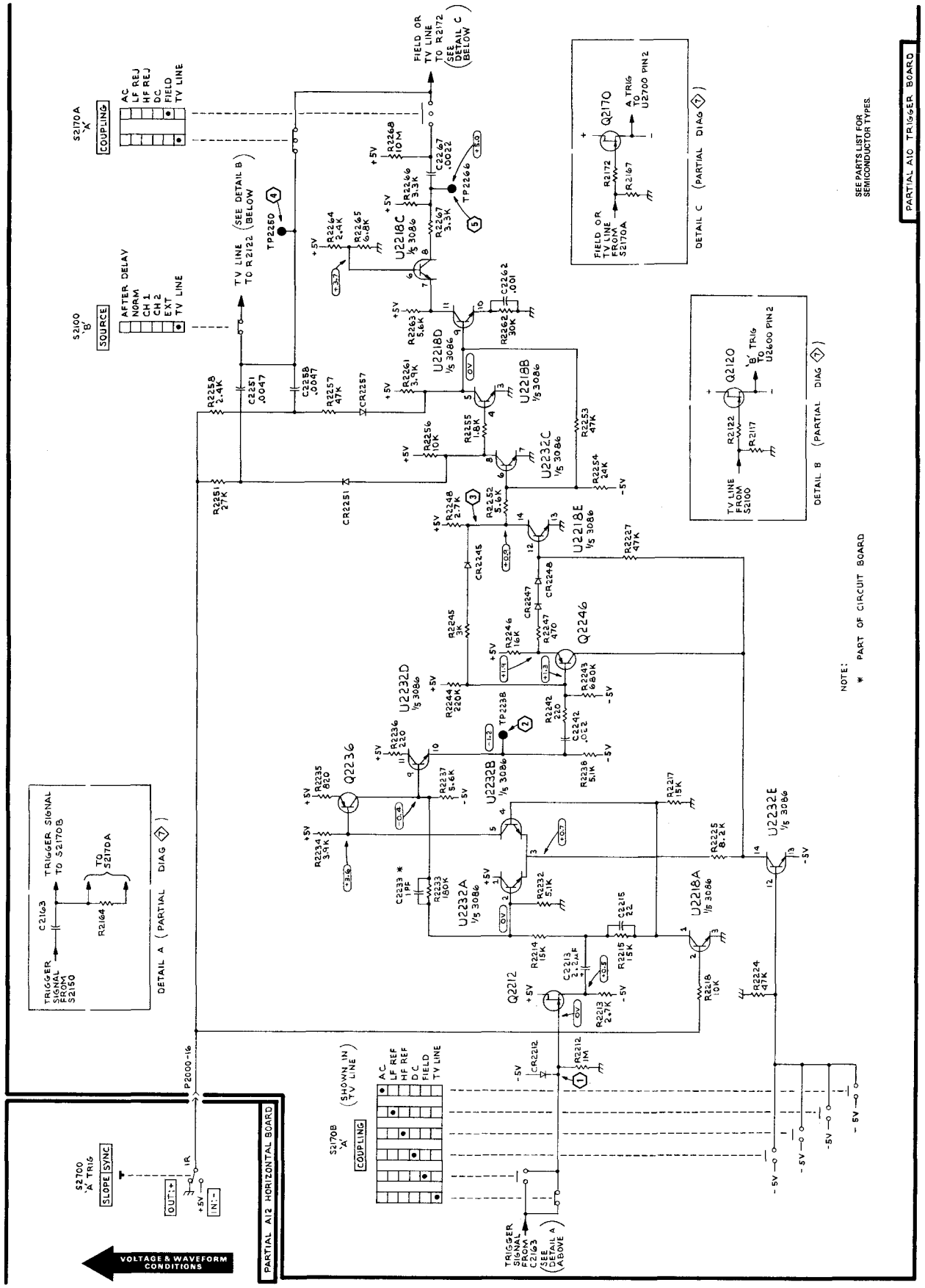

TV SYNC SEPARATOR
PARTIAL A10 TRIGGER BOARD
PARTIAL A12 HORIZONTAL BOARD
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
NOTE:
* PART OF CIRCUIT BOARD
DETAIL A (PARTIAL DIAG 7)
DETAIL B (PARTIAL DIAG 7)
DETAIL C (PARTIAL DIAG 7)
VOLTAGE & WAVEFORM CONDITIONS
S2700 A TRIG
S2100 B SOURCE
S2170A A COUPLING
S2170B A COUPLING
U2218A
U2218B
U2218C
U2218D
U2218E
U2232A
U2232B
U2232C
U2232D
U2232E
Q2120
Q2170
Q2212
Q2236
Q2246
455/A2/B2 (B2 OPTION 5)

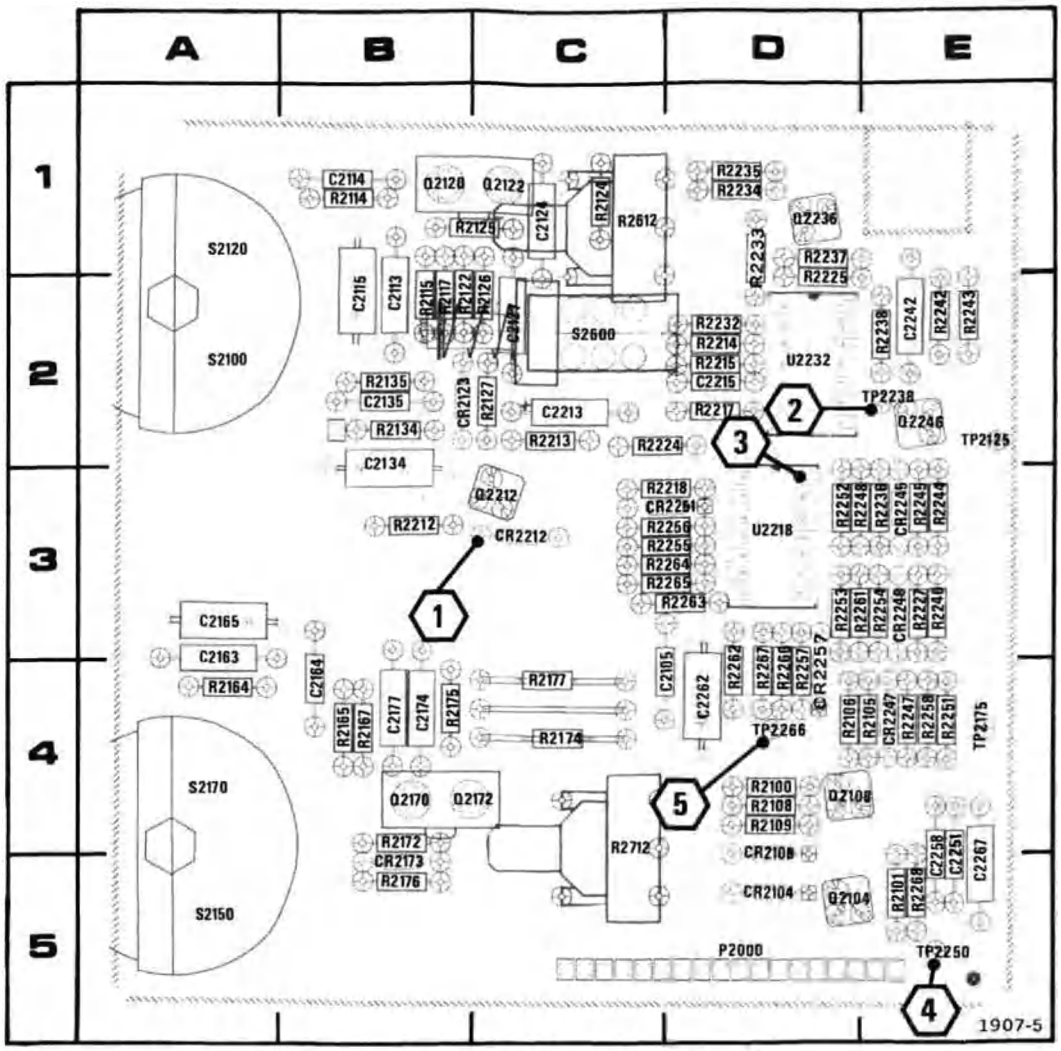


Fig. Option 5-3. Trigger board component locations.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C2105	4C	CR2104	5D	Q2212	3C	R2135	2B	R2233	2D	R2257	4D	TP2125	2E
C2113	2B	CR2108	4D	Q2236	1D	R2164	4A	R2234	1D	R2258	4E	TP2238	2E
C2114	1B	CR2123	2B	Q2246	2E	R2165	4B	R2235	1D	R2261	3D	TP2250	5E
C2115	2B	CR2173	5B			R2167	4B	R2236	3E	R2262	4D	TP2266	4D
C2124	1C	CR2212	3C	R2100	4D	R2172	4B	R2237	1D	R2263	3D	TP2175	4E
C2134	2B	CR2245	3E	R2101	5E	R2174	4C	R2238	2E	R2264	3D		
C2135	2B	CR2247	4E	R2105	4E	R2175	4B	R2243	2E	R2265	3D	U2218	3D
C2163	3A	CR2248	3E	R2106	4D	R2176	5B	R2242	2E	R2266	4D	U2232	2D
C2164	4B	CR2251	3D	R2108	4D	R2177	4C	R2244	3E	R2267	4D		
C2165	3A	CR2257	4D	R2109	4D	R2212	3B	R2245	3E	R2268	5E		
C2174	4B			R2114	1B	R2213	2C	R2246	3E	R2612	1C		
C2177	4B	P2000	5D	R2115	2B	R2214	2D	R2247	4E	R2712	4C		
C2213	2C			R2117	2B	R2215	2D	R2248	3D				
C2215	2D	Q2104	5D	R2122	2B	R2217	2D	R2251	4E	S2100	2A		
C2242	2E	Q2108	4D	R2124	1C	R2218	3D	R2252	3D	S2120	1A		
C2251	4E	Q2120	1B	R2125	1B	R2233	1D	R2253	3D	S2150	5A		
C2258	4E	Q2122	1C	R2126	2C	R2224	2C	R2254	3E	S2170	4A		
C2262	4D	Q2170	4B	R2127	2C	R2225	1D	R2255	3D	S2600	2C		
C2267	4E	Q2172	4C	R2134	2B	R2227	3E	R2256	3D				

OPTION 5

REPLACEABLE PARTS

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

REPLACEABLE ELECTRICAL PARTS

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A10	670-3549-01 ----- ----- ----- -----	B010100	B010374	CKT BOARD ASSY:TRIGGER (SAME AS STANDARD A10 WITH THE ADDITION OF THE FOLLOWING PARTS.)	80009	670-3549-01
A10	670-3549-03 ----- ----- ----- ----	B010375	B019999	CKT BOARD ASSY:TRIGGER (SAME AS STANDARD A10 WITH THE ADDITION OF THE FOLLOWING PARTS.)	80009	670-3549-03
A10	670-3549-05 ----- ----- ----- -----	B020000	B057559	CKT BOARD ASSY:TRIGGER (SAME AS STANDARD A10 WITH THE ADDITION OF THE FOLLOWING PARTS.)	80009	670-3549-05
A10	670-3549-07 ----- ----- ----- -----	B057560		CKT BOARD ASSY:TRIGGER (SAME AS STANDARD A10 WITH THE ADDITION OF THE FOLLOWING PARTS.)	80009	670-3549-07
C2213	290-0136-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	162D225X0020CD2
C2215	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C2233	----- -----			(PART OF CIRCUIT BOARD)		
C2242	285-1101-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	19396	223K02PT485
C2251	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C2258	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C2262	281-0770-00			CAP.,FXD,CER DI:0.001UF,20%,100V	72982	8035D9AADX5R102M
C2267	281-0771-00			CAP.,FXD,CER DI:0.0022UF,20%,200V	72982	314-022Z5U0222M
CR2212	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2245	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2247	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2248	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2251	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2257	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
Q2212	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q2236	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q2246	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2212	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2213	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2214	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2215	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2217	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2218	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2224	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2225	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R2227	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2232	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2233	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R2234	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R2235	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R2236	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2237	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R2238	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2242	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2243	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R2244	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R2245	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R2246	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R2247	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R2248	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2251	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R2252	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R2253	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2254	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R2255	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R2256	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2257	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2258	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2261	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R2262	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R2263	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R2264	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2265	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2266	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2267	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2268	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
S2100	214-2292-03			LEVER,SWITCH:6 POSN,W/CONT	80009	214-2292-03
S2170	214-2292-02			LEVER,SWITCH:6 POSN,W/CONT	80009	214-2292-02
U2218	156-0197-00			MICROCIRCUIT,LI:5 TRANSISTOR ARRAY	80009	156-0197-00
U2232	156-0197-00			MICROCIRCUIT,LI:5 TRANSISTOR ARRAY	80009	156-0197-00

REPLACEABLE MECHANICAL 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
					OPTION 5		
-1	333-1995-01	B010100	B046869	1	PANEL,FRONT:HORIZONTAL	80009	333-1995-01
	----- -----			-	(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
	333-1995-03	B046870		1	PANEL,FRONT:HORIZONTAL	80009	333-1995-03
-2	337-2122-02			1	SHLD,IMPLOSION:SMOKE GRAY,NTS	80009	337-2122-02
	----- -----			-	(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
-3	337-2122-03			1	SHLD,IMPLOSION:SMOKE GRAY,CCI	80009	337-2122-03
	----- -----			-	(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
-4	----- -----			1	CKT BOARD ASSY:TRIGGER(SEE A10 EPL)		
	----- -----			-	(SAME AS STANDARD A10, WITH THE ADDITION OF THE		
	----- -----			-	FOLLOWING PARTS.)		
-5	136-0269-00			2	SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	73803	CS9002-14
-6	214-0579-00			3	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-7	214-2292-02			1	LEVER,SWITCH:6 POSN,W/CONT	80009	214-2292-02
-8	214-2292-03			1	LEVER,SWITCH:6 POSN,W/CONT	80009	214-2292-03
	390-0449-01			1	COVER,SCOPE:TOP	80009	390-0449-01
	441-1259-01			1	CHASSIS,SCOPE:MAIN,W/CONDUCTIVE PAINT	80009	441-1259-01
	342-0252-00	B010100	B045098	1	INSULATOR:HORIZONTAL	80009	342-0252-00
	----- -----			-	(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
	342-0367-00	B045099		1	INSULATOR,PLATE:FRONT PANEL,HORIZONTAL	80009	342-0367-00
	----- -----			-	(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		

OPTION 7

Option 7 permits the Tektronix 455 oscilloscope to be powered from a dc source of 12 volts or 24 volts in addition to the standard ac line operation. For battery operation, Option 7 makes the 455 compatible with the Tektronix 1106 Battery Pack.

Option 7 consists mainly of a dc to ac inverter which is installed as an integral part of the oscilloscope. The modified oscilloscope has a two-position voltage-selector switch in place of the push-pull power switch on standard oscilloscopes.

A dc input connector is located on the rear panel. The circuitry is protected in the event that 24 volts should be connected when in the 12 volt mode.

SPECIFICATIONS

AC Requirements

AC requirements are the same as those of oscilloscopes without Option 7.

DC Requirements

11.5 to 14 volts or 22 to 28 volts. Voltage at + or − power lead with respect to the oscilloscope chassis ground must not exceed 50 volts.

Temperature

The same operating and non-operating range as instruments without Option 7.

SAFETY CONSIDERATIONS

Since Option 7 becomes a part of the instrument, safety considerations for the modified oscilloscope are the same as those for the standard oscilloscope.

FUNCTIONS OF CONTROLS AND CONNECTORS

POWER AC-DC Switch (see Fig. 1)—Selects either ac or dc voltage. With POWER switch pushed in, rotate knob clockwise for dc or counterclockwise for ac, then pull out to turn on the oscilloscope.

AC—Applies ac power to the oscilloscope.

DC—Permits 12 or 24 volts dc operation of the oscilloscope from an external source.

Dc Voltage Selector Switch (see Fig. 2)—Selects either 12 volts or 24 volts operation.

12 V—Permits operation from a 12 volt dc source.

24 V—Permits operation of the oscilloscope from either an external 24 volt power source or from the 1106 Battery Pack, which can be fastened to the bottom of the oscilloscope.

DC INPUT Connector (see Fig. 2)—Rear panel connector for input of dc power.

PERFORMANCE CHECK

Set the oscilloscope for the power source available as listed in Table 1.

Connect the oscilloscope to ground (earth) reference. Turn on the oscilloscope and check that it operates properly on the available power sources.

Be sure to set the 1106 Line Selector switch to the correct line voltage when charging the batteries.

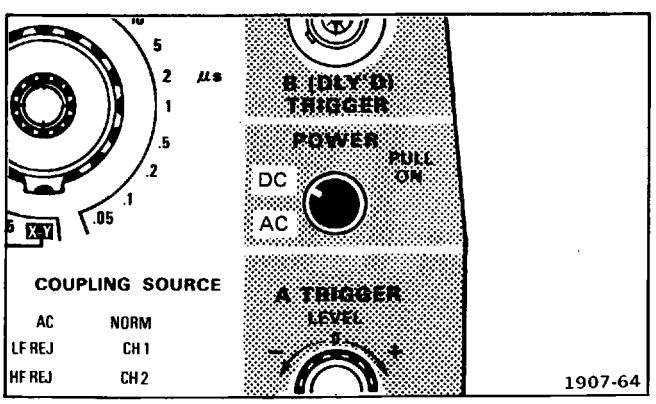


Fig. Option 7-1. Power switch.

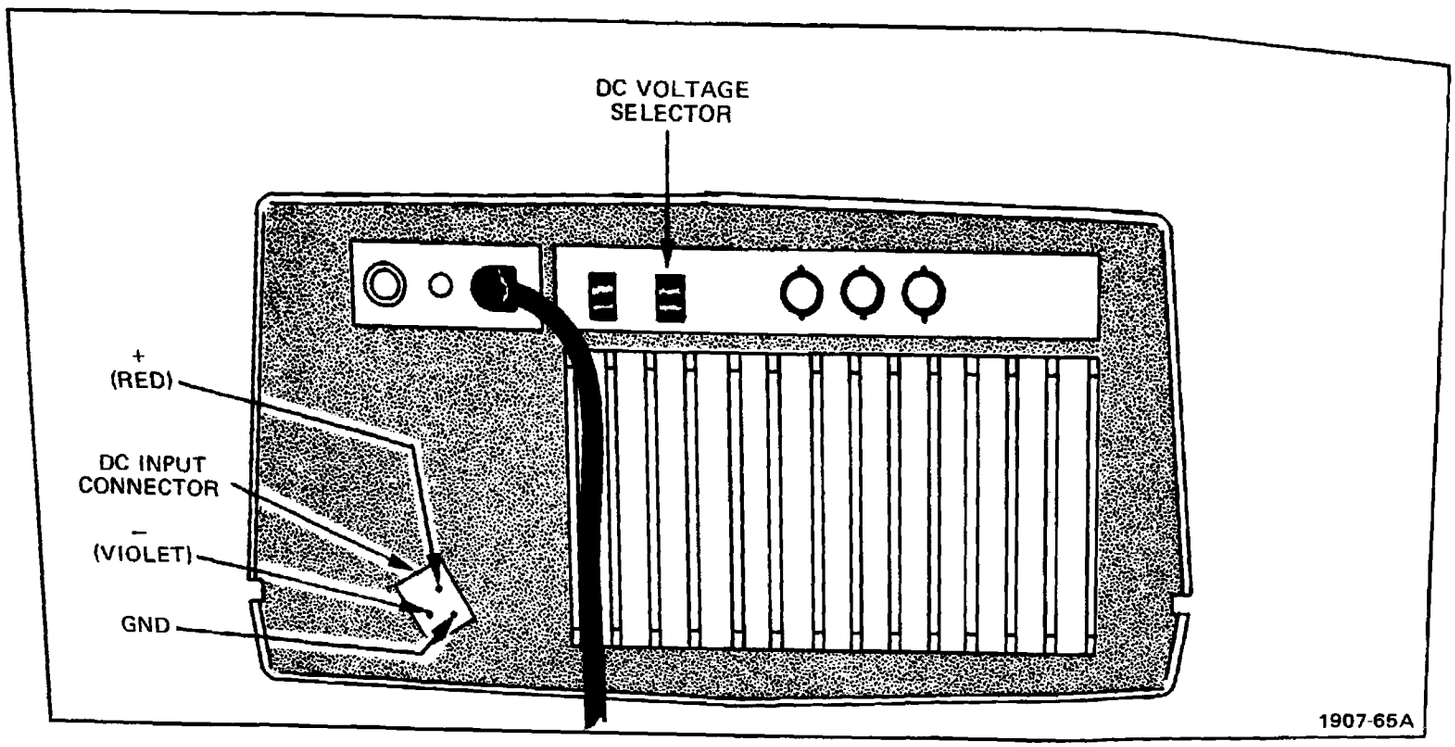


Fig. Option 7-2. Dc voltage selector switch and dc input connector.

TABLE 1

Option 7 Power Sources

Power Source	Oscilloscope Voltage Selectors	POWER Switch
115 V AC	116 V	AC
230 V AC	232 V	AC
12 V DC	12 V	DC
24 V DC	24 V	DC
1106	24 V	DC

CIRCUIT DESCRIPTION

Option 7 consists basically of a dc to ac inverter that operates on 12 or 24 volts. The circuit description discusses 24 volt operation unless noted otherwise. Refer to the schematic diagrams for additional details.

The operating frequency of the inverter is approximately 400 Hz.

BLOCK DIAGRAM (See Fig. 3)

The DC Input voltage is applied to the Turn-Off Circuit, the Start circuit and the primary of T700. In 24 volt operation, if the dc input voltage is above the level set by Turn Off Level Adjustment R625, the Turn-Off Circuit will not operate.

The Start circuit provides a large current surge through T661 secondary to the bases of Q662 and Q666. This starts the inverter. The Turn-Off Circuit is activated in two ways. In 24 volt operation, Q632 is turned on by the dc input voltage dropping below 22 volts. In 12 volt mode, Q632 is turned on by the accidental application of 24 volts dc. Once the Turn-Off Circuit has been activated, the inverter stops operating and can only be restarted by turning the oscilloscope off and on with the Power Switch (S600).

DETAILED CIRCUIT DESCRIPTION

Start Circuit

Closing S600 applies the dc input voltage to C653, CR656, R657 and R656. The initial voltage step is coupled to the base of Q652 through C653 and R654. This provides sufficient base current to keep Q652 saturated until C653 is charged to the dc input voltage. R653 and R654 provide the current to charge C653. When Q652 is saturated, base current is provided to turn Q656 on. Diodes CR656 and CR657, turned on by the current supplied through Q652, provide bias voltage for Q656. This bias voltage, minus the base-emitter voltage of Q656, causes current to flow through R657 and the collector of Q656. This is the start current applied to the inverter transistors through the secondary of T661.

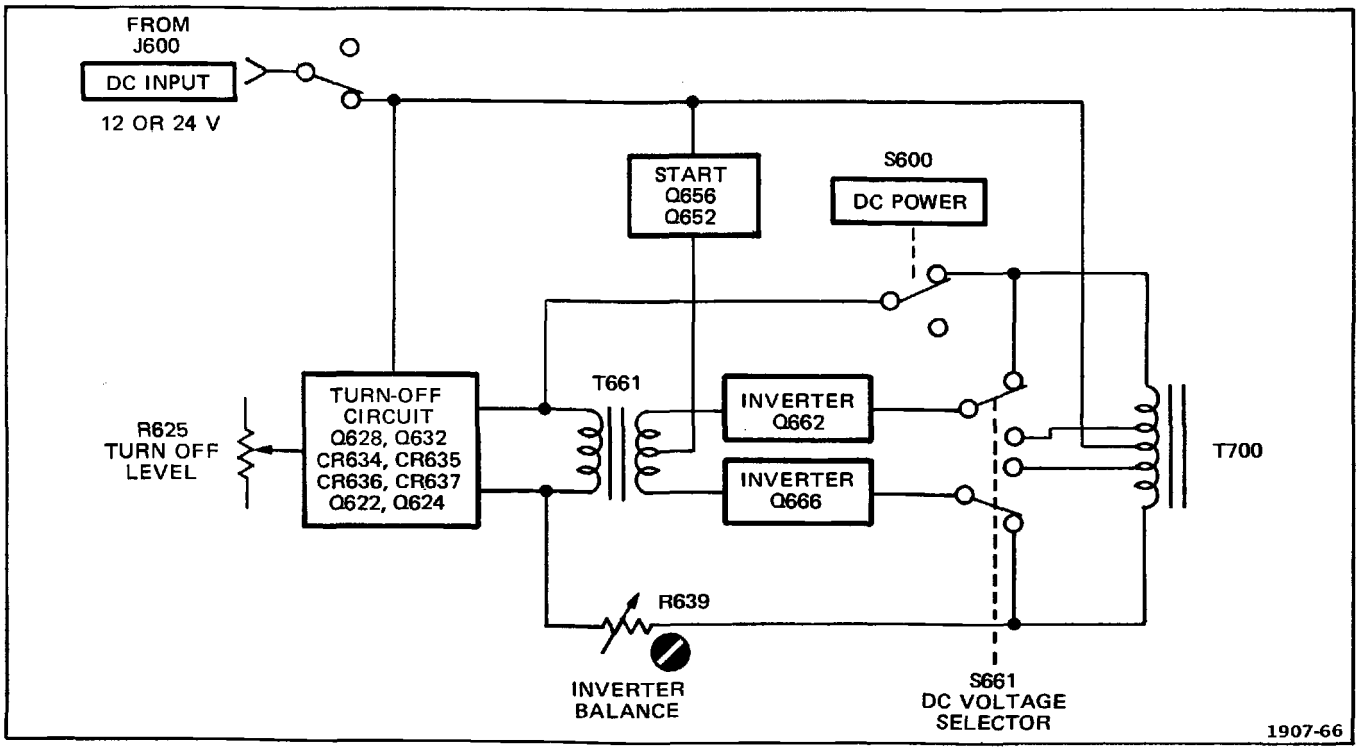


Fig. Option 7-3. Simplified block diagram.

Inverter Circuit

The Start current is applied to the base of Q662 and Q666 through T661, R662 and R666. Since the transistors do not have identical parameters, one will conduct before the other, and start the inverter. Operating base current is provided through CR658.

R635, R638 and T661 primary and secondary are the main frequency-determining components of the inverter. C662 and C666 reduce the high frequency response and reduce transients.

Feedback to maintain inverter operation is provided from T700 primary to T661 primary through R635, R634, R639, CR638 and CR639. Resistors R635 and R638 provide frequency stability and current limiting. R639, CR638 and CR639 compensate for differences in transistors and other components. CR638 and CR639 conduct during different inverter half-cycles and permit R639 to balance the drive to T700.

C707, C708, and C709 are added to the secondary of T700 to provide optimum reduction of transients during inverter operation.

Turn-Off Circuit

The voltage reference for the base of Q624 is set to about 16.9 volts by R613, VR613 and VR612. This sets the junction of R615 and the emitters of Q622 and Q624 to about 16.3 volts. Dc input voltages higher than 22 volts cause increased current through R613, Q622 and R617. Transistor Q624 is cut off by the increased voltage across R617 and the resulting change across divider, R624-R625-R622. This prevents current flow through R622 and cuts off Q628. If the dc input voltage drops to less than 22 volts, Q624 conducts, taking current from Q622 and causing less drop across R617. This makes Q624 conduct more and Q622 is cut off. Current flow through R622 turns on Q628. Transistor Q628 then provides current to the gate of silicon controlled rectifier Q632, which turns on and shorts out the bridge rectifier. Capacitor C612 prevents Q622 from turning on when the inverter is started, allowing the power source time to recover after providing the initial start surge.

During 12 volt dc operation, no current flows through VR612 and VR613, since their series drop of about 17 volts exceeds the applied voltage. The base current of Q622 through R612, turns Q622 on enough to take all the current through R615, which causes Q624 to be cut off. Therefore, Q628 is cut off.

CR634, CR635, CR636 and CR637 form a bridge rectifier which rectifies the inverter waveform to provide operating power for the Turn-Off Circuit. Capacitor C633 filters the inverter spikes to keep them from turning on Q632. Resistor R634 prevents C633 from charging to the peak-to-peak inverter spikes.

Transistor Q632 turns on and shorts out the bridge rectifier and the primary of T661, stopping the inverter. R632 prevents Q632 from being turned on by inverter noise. R633 and C633 provide holding current for Q632 until the inverter has stopped oscillating. CR633 permits rapid charging of C633.

If 24 volts dc is accidentally applied when the Dc Voltage Selector switch is in the 12 volt position, transformer T700 attempts to produce two times the correct feedback. This is sufficient to cause VR632 to conduct. VR632 provides the turn on current for Q632.

DC Input

External power is applied through P600. Diode CR601 is normally reverse biased. If the wrong polarity external power is applied, CR601 becomes forward biased and blows fuse F600. Low-pass filter network T600, R600, C601, C602 and C603 reduces transients to the dc source.

MAINTENANCE

OBTAINING REPLACEMENT PARTS

Standard Parts

All electrical and mechanical part replacements for Option 7 can be obtained through your local 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.

Special Parts

In addition to the standard electronic components, some special components are used in Option 7. These components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., include the following information:

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

ADJUSTMENTS

Equipment Required

1. DC Voltmeter. 22 to 30 volts.
2. DC Power Source. Variable from 22 to 28 volts and from 11.5 to 14 volts.

A source voltage of less than 22 volts will turn off Option 7 when in the 24 volt mode. Starting current in 24 volt mode is approximately 4 amperes. The dc source must be capable of handling this current without dropping below 22 volts. The 12 volt starting current is approximately 8 amperes.

Option 7 is calibrated at the factory using a variable power supply with the above specifications. This permits the most accurate adjustment of the Turn-Off Level and the Inverter Balance. The alternative supplies listed below may also be used.

a. Variable power supply with an adequate current rating, in series with items c or d.

b. 1106 Battery Pack.[1] An 1106 Battery Pack will operate the oscilloscope for about 4 hours.

c. Two 12 volt wet-cell storage batteries, in series, tapped at 20, 22, or 24 volts.[2]

d. 18 to 23 NiCd D cells, 4.0 Amp hr. or greater, furnishing 20 to 28 volts.[2]

CAUTION

This procedure is for an external dc source with the negative lead at ground potential (negative ground system).

[1] To set the turn off level, the battery is charged above the cut-off point (22 volts). An oscilloscope is connected and the battery allowed to discharge while its voltage is being monitored. As it reaches 22 volts, the turn-off point is set to cut off Option 7. The turn-off point on Option 7 approximately coincides with the meter zero on the 1106.

[2] This does not permit accurate adjustment of the turn off level. NiCd batteries can be used, following the technique used for item b.

ADJUSTMENT PROCEDURE

1. OPERATING RANGE

a. Connect the dc source to the oscilloscope equipped with Option 7. Operate the oscilloscope in the 24 V mode. Connect the voltmeter between fuse, F1601 (B) and the common negative return (A). Vary the dc source from 28 V to 22 V.

CHECK—Oscilloscope should operate over the voltage range.

b. Change the dc source to 12 V. Operate the oscilloscope in the 12 V mode. Vary the dc source from 14 V to 11.5 V.

CHECK—Oscilloscope should operate over the voltage range.

2. INVERTER BALANCE

NOTE

If you intend to operate the oscilloscope primarily from a 12 V dc source, perform this step while operating the oscilloscope and the variable power supply on 12 V.

a. Operate the oscilloscope in the 24 V mode.

b. Set the variable power supply output for 24 V.

c. ADJUST—Inverter Balance control R639 (see Fig. 4) for the quietest operation of transformer T700.

3. TURN-OFF LEVEL

a. Set the Variable power supply output for 21.8 V.

b. ADJUST—Turn Off Level R625 (see Fig. 4) slowly until the inverter turns off.

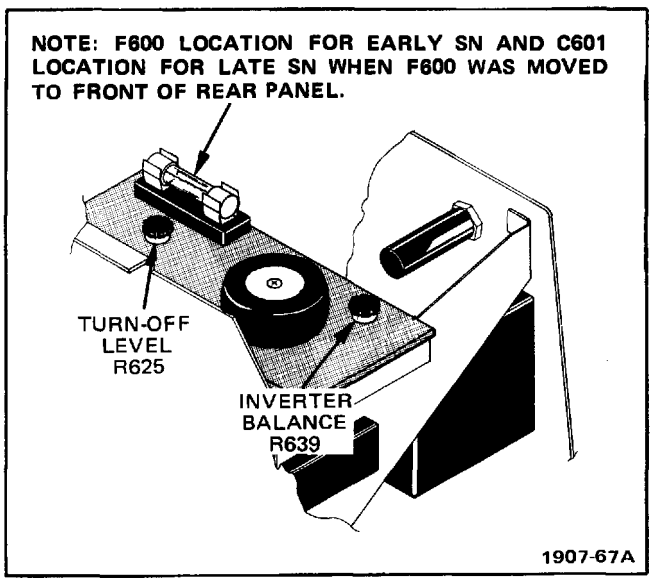


Fig. Option 7-4. Adjustment locations.

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

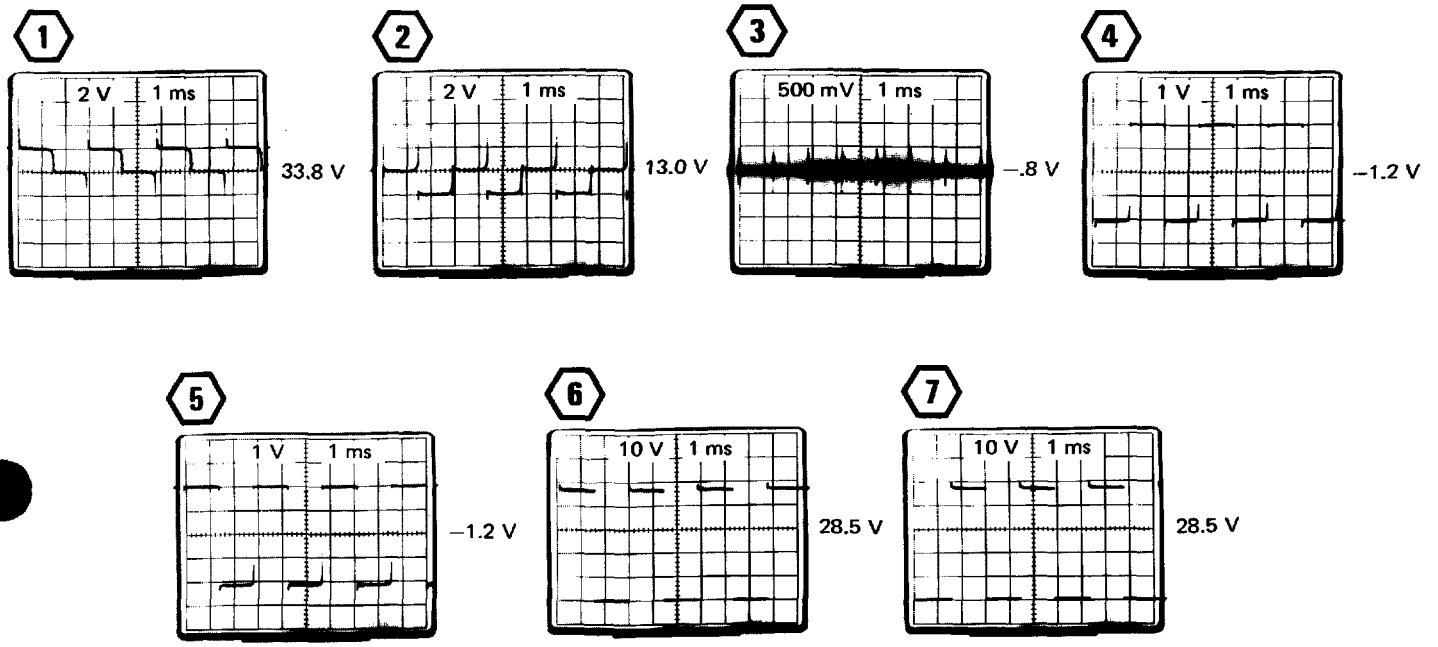
The B2 A COUPLING switch was set in the FIELD position.

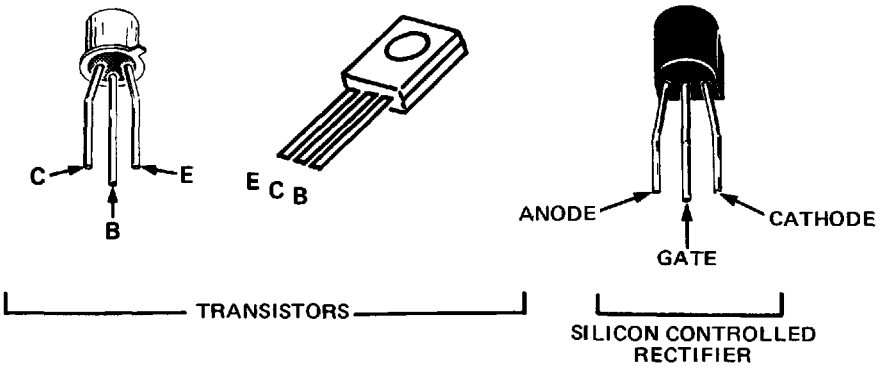
WAVEFORM CONDITIONS

Waveforms below were taken from a Tektronix 7000-series oscilloscope equipped with readout, 7B series time-base, 7A13 Differential Comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

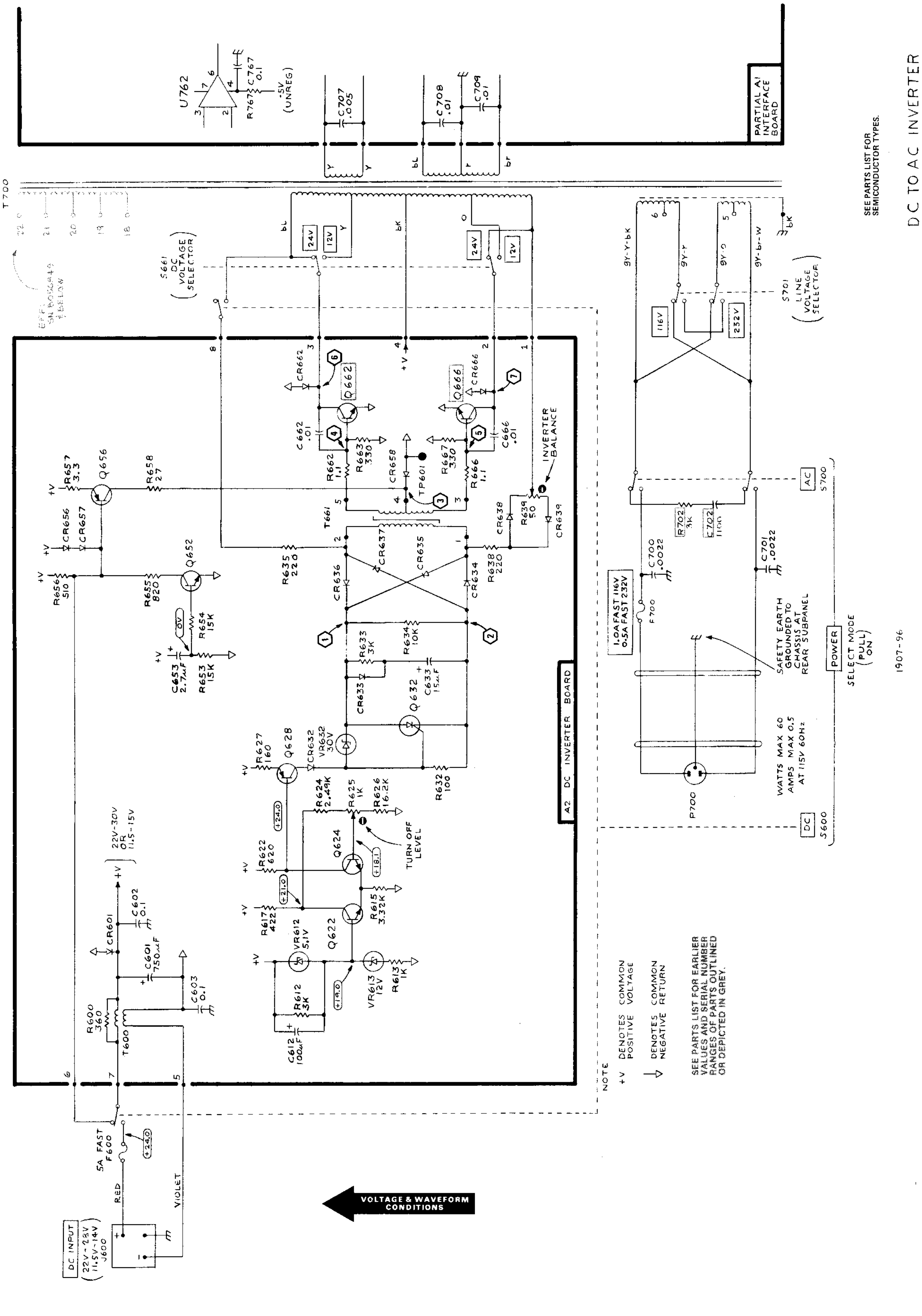
The 455 was powered from a 24 V dc source. The INTENSITY control was set for normal trace brightness or about midrange.

The test oscilloscope was externally triggered using the waveform at the collector of Q662.





1907-4



REV E AUG 1979

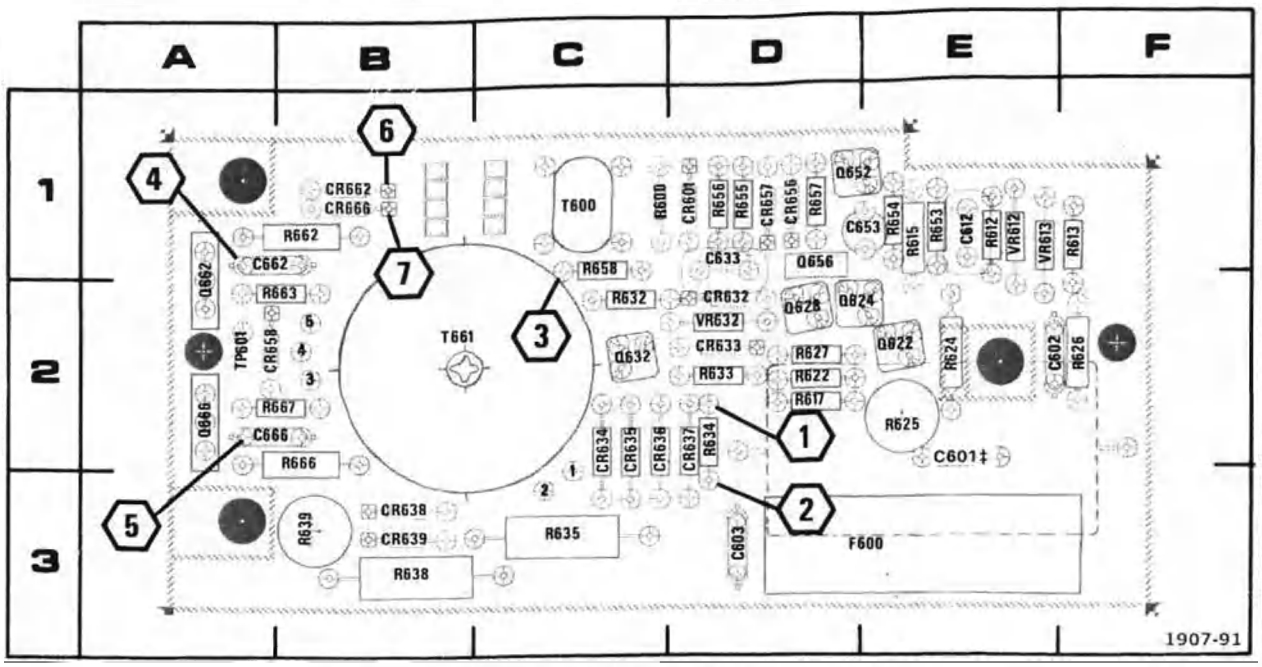


Fig. Option 7-5. A2—DC Inverter board component locations.

† Located on back of board.

‡ Late production location.

†† Early production location.

‡‡ F600 moved to front of rear subpanel for late production.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C601†		CR634	2C	F600††	3E	R612	1E	R635	3C	R667	2B
C601‡	2E	CR635	2C	F600‡‡		R613	1F	R638	3B		
C602	2E	CR636	2C			R615	1E	R639	3B	T600	1C
C603	3D	CR637	2D	Q622	2E	R617	2D	R653	1E	T661	2B
C612	1E	CR638	3B	Q624	2D	R622	2D	R654	1E		
C633	1D	CR639	3B	Q628	2D	R624	2E	R655	1D	TP601	2A
C653	1E	CR656	1D	Q632	2C	R625	2E	R656	1D		
C662	1A	CR657	1D	Q652	1D	R626	2F	R657	1D	VR612	1E
C666	2A	CR658	2A	Q656	1D	R627	2D	R658	1C	VR613	1E
		CR662	1B	Q662	2A	R632	2C	R662	1B	VR632	2D
CR601	1D	CR666	1B	Q666	2A	R633	2D	R663	2B		
CR632	2D					R634	2D	R666	2B		
CR633	2D			R600	1C						

OPTION 7
REPLACEABLE ELECTRICAL PARTS

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C700	283-0263-00			CAP.,FXD,CER DI:0.0022UF,20%,3000V	56289	33C319
C701	283-0263-00			CAP.,FXD,CER DI:0.0022UF,20%,3000V	56289	33C319
C702	283-0000-00	B010100	B033249	CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C702	283-0088-00	B033250		CAP.,FXD,CER DI:1100PF,5%,500V	56289	20C285
C707	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C708	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C709	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C767	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
CR741	152-0462-01			SEMICOND DEVICE:RECT,SI,200V,2.5A	12969	652-1085
J600	131-1556-01	B010100	B057009	CONN,RCPT,ELEC:PWR,MALE,125VAC,15A	80009	131-1556-01
J600	131-1556-03	B057010		CONN,RCPT,ELEC:PWR,MALE,125VAC,15A	80009	131-1556-03
R702	302-0102-00	B010100	B033249	RES.,FXD,CMPSN:1K OHM,10%,0.50W	01121	EB1021
R702	308-0421-00	B033250		RES.,FXD,WW:3K OHM,5%,3W	91637	CW-2B B30000J
S600	260-1222-00	B010100	B070539	SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
S600	260-1222-01	B070540		SWITCH,PUSH:DPDT,40A,250AC,PUSH-PULL	91929	2DM301
S661	260-1780-00			SWITCH,SLIDE:DPDT,3A,125V	82389	11A-1700
S700	260-1222-00	B010100	B070539	SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
S700	260-1222-01	B070540		SWITCH,PUSH:DPDT,40A,250AC,PUSH-PULL	91929	2DM301
T700	120-0983-00	B010100	B056849	XFMR,PWR,STPDN:	80009	120-0983-00
T700	----- -----			(T700, REPLACES STANDARD TRANSFORMER.)		
T700	120-1189-00	B056850		XFMR,PWR,STPDN:	80009	120-1189-00
A2	670-3765-00	B010100	B033249	CKT BOARD ASSY:DC INVERTER	80009	670-3765-00
A2	670-3765-01	B033250	B057349	CKT BOARD ASSY:DC INVERTER	80009	670-3765-01
A2	670-3765-02	B057350		CKT BOARD ASSY:DC INVERTER	80009	670-3765-02
C601	290-0324-00			CAP.,FXD,ELCTLT:750UF,+75-10%,40V	56289	D46454
C602	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
C603	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
C612	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C633	290-0528-00			CAP.,FXD,ELCTLT:15UF,20%,50V	90201	TDC156M050WLC
C653	290-0573-00			CAP.,FXD,ELCTLT:2.7UF,20%,50V	56289	196D275X0050JA1
C662	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C666	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
CR601	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR632	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR633	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR634	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR635	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR636	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR637	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR638	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR639	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR656	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR657	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR658	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR662	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR666	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
F600	159-0014-00	B010100	B057349	FUSE,CARTRIDGE:3AG,5A,250V,FAST-BLOW	71400	MTH5
F600	159-0059-00	B057350		FUSE,WIRE LEAD:5A,FAST-BLOW	71400	GFA5
Q622	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q624	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q628	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q632	151-0519-00			SCR:SILICON	04713	SCR5016K

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q652	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q656	151-0335-00			TRANSISTOR:SILICON,PNP	04713	SJE917
Q662	151-0436-00	B010100	B033249	TRANSISTOR:SILICON,NPN	80009	151-0436-00
Q662	153-0636-00	B033250		TRANSISTOR:SILICON,NPN,SELECTED	80009	153-0636-00
Q666	151-0436-00	B010100	B033249	TRANSISTOR:SILICON,NPN	80009	151-0436-00
Q666	153-0636-00	B033250		TRANSISTOR:SILICON,NPN,SELECTED	80009	153-0636-00
R600	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R612	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R613	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R615	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R617	321-0157-00			RES.,FXD,FILM:422 OHM,1%,0.125W	91637	MFF1816G422R0F
R622	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R624	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R625	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R626	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W	91637	MFF1816G16201F
R627	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R632	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R633	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R634	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R635	303-0221-00			RES.,FXD,CMPSN:220 OHM,5%,1W	01121	GB2215
R638	303-0221-00			RES.,FXD,CMPSN:220 OHM,5%,1W	01121	GB2215
R639	311-1568-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91-90-0
R653	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R654	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R655	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R656	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R657	307-0104-00			RES.,FXD,CMPSN:3.3 OHM,5%,0.25W	01121	CB33G5
R658	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R662	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
R663	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R666	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
R667	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
T661	120-0852-00			XFMR,TOROID:2 WINDINGS	80009	120-0852-00
VR612	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0279-00
VR613	152-0168-00			SEMICOND DEVICE:ZENER,0.4W,12V,5%	80009	152-0168-00
VR632	152-0282-00			SEMICOND DEVICE:ZENER,0.4W,30V,5%	04713	1N972B

REPLACEABLE MECHANICAL PARTS

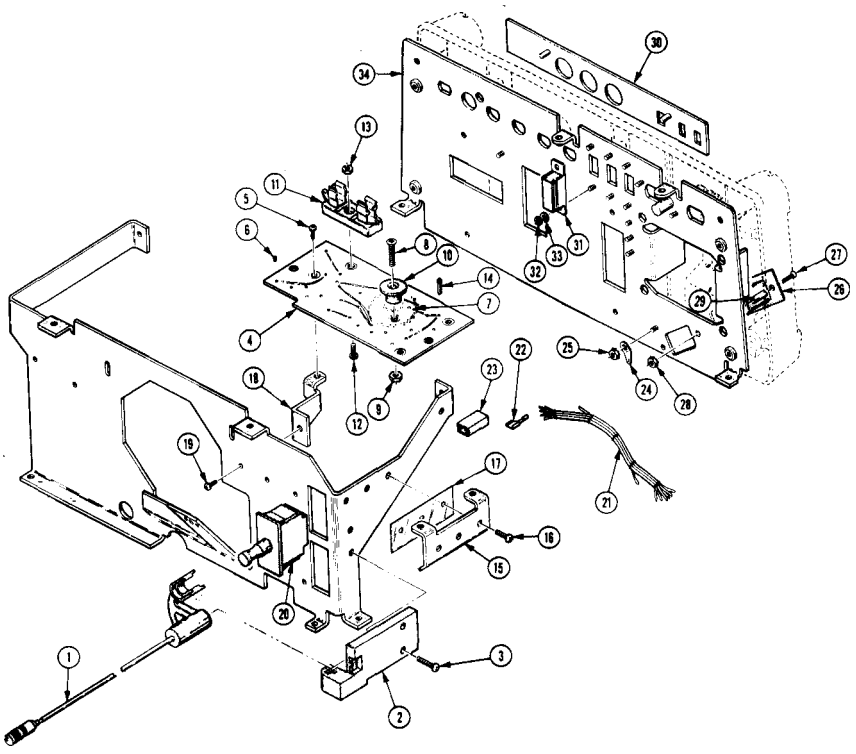


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	105-0695-00			1		ACTR ASSY,SW:POWER	80009	105-0695-00
	----- -----			-		(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
	358-0560-00			1		BUSHING,SLEEVE:0.254 ID,PLASTIC,0.34 OD	80009	358-0560-00
-2	407-1702-01			1		BRKT,ASSY,SW AC:	80009	407-1702-01
						(ATTACHING PARTS)		
-3	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-4	----- -----			1		CKT BOARD ASSY:DC INVERTER(SEE A2 EPL)		
						(ATTACHING PARTS)		
-5	211-0008-00			3		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-6	136-0252-04			15		. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-7	----- -----			1		. TRANSFORMER:TOROID,(SEE T661 EPL)		
						(ATTACHING PARTS)		
-8	212-0011-00			1		. SCREW,MACHINE:8-32 X 0.750 INCH,FLH STL	83385	OBD
-9	210-0409-00			1		. NUT,PLAIN,HEX.:8-32 X 0.312 INCH,BRS	73743	3046-402
-10	343-0443-00			1		. RETAINER,XFMR:	80009	343-0443-00
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-11	352-0031-00	B010100	B057349X	1		. FUSEHOLDER:3AG FUSE	75915	357001
	----- -----			-		. (HOLDER FOR F600 DELETED AT S/N B057350 & C601		
	----- -----			-		. INSTALLED AT THAT LOCATION. F600 MOVED TO		
	----- -----			-		. FRONT OF REAR SUBPANEL.)		
						(ATTACHING PARTS)		
-12	211-0504-00	B010100	B057349X	1		. SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-13	210-0407-00	B010100	B057349X	1		. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
	210-0006-00	B010100	B057349X	1		. WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
						- - - * - - -		
-14	214-0579-00			1		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-15	407-1637-00			1		BRACKET,ANGLE:CKT BOARD	80009	407-1637-00
						(ATTACHING PARTS)		
-16	211-0507-00			3		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-17	253-0202-00			FT		INSUL TAPE,ELEC:POLYMIDE	99742	221
-18	407-1713-00			1		BRACKET,ANGLE:CKT BOARD	80009	407-1713-00
						(ATTACHING PARTS)		
-19	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-20	260-1222-00			1		SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
-21	179-2189-00	B010100	B057169	1		WIRING HARNESS:INVERTER	80009	179-2189-00
	179-2189-01	B057170		1		WIRING HARNESS:INVERTER	80009	179-2189-01
-22	131-0861-00			5		. TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
-23	200-1075-00			5		. COVER,ELEC CONN:PLASTIC	00779	1-480435-0
-24	201-0201-00			1		TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
						(ATTACHING PARTS)		
-25	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-26	131-1556-01	B010100	B057009	1		CONN,RCPT,ELEC:PWR,MALE,125VAC,15A	80009	131-1556-01
	----- -----			-		(ALSO USED IN OPTION 37)		
	131-1556-03	B057010		1		CONN,RCPT,ELEC:PWR,MALE,125VAC,15A	80009	131-01556-03
	----- -----			-		(ALSO USED IN OPTION 37)		
						(ATTACHING PARTS)		
-27	211-0086-00			2		SCREW,MACHINE:4-40 X 0.75 100" DEG,FLH STL	83385	OBD
-28	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
-29	166-0026-00			2		SPACER,SLEEVE:0.375 L X 0.125 ID,AL	71590	P7610-1
						- - - * - - -		
-30	333-2073-01			1		PANEL,REAR:	80009	333-2073-01
	----- -----			-		(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
-31	260-1780-00			1		SWITCH,SLIDE:DPDT,3A,125V	82389	11A-1700
						(ATTACHING PARTS)		
-32	210-0406-00			2		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-33	210-0004-00			2		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
-34	386-3132-02	XB057350		1		SUBPANEL,REAR:	80009	386-3132-02
	----- -----			1		TRANSFORMER:POWER(SEE T700 EPL)		
	----- -----			-		(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
	441-1259-02			1		CHASSIS,SCOPE:MAIN	80009	441-1259-02
	----- -----			-		(REPLACES EXISTING PART IN STANDARD INSTRUMENT)		
	198-4205-00	XB057170		1		WIRE SET,ELEC:	80009	198-4205-00

STANDARD ACCESSORIES

	161-0094-00			1		CABLE ASSY,PWR,:3.18 AWG,125V,36.0 L	16428	KH7667

OPTION 78

This option adds a Type P11 phosphor CRT to the instrument.

Parts List Changes

DELETE:

V560	154-0731-00	Crt, P31 Phosphor, Int. Scale

ADD:

V560	154-0731-04	Crt, P11 Phosphor, Int. Scale

If this option is being added to an instrument which is already equipped with a different phosphor, or if the cathode-ray tube requires replacement, use the following procedure:

1). Follow the crt removal and installation procedure in the maintenance section of this manual.

2). After completing crt installation, perform Adjustments procedure in Section 6 and Performance Check in Section 3 of this manual.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02111	SPECTROL ELECTRONICS CORPORATION	17070 EAST GALE AVENUE	CITY OF INDUSTRY, CA 91745
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05397	UNION CARBIDE CORPORATION, MATERIALS SYSTEMS DIVISION	11901 MADISON AVENUE	CLEVELAND, OH 44101
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14552	MICRO SEMICONDUCTOR CORP.	2830 F FAIRVIEW ST.	SANTA ANA, CA 92704
16546	U.S. CAPACITOR CORP/CENTRALAB ELECTRONICS DIV.	4561 COLORADO	LOS ANGELES, CA 90039
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
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
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
52763	STETTNER-TRUSH, INC.	67 ALBANY STREET	CAZENOVIA, NY 13035
53184	XCITON CORPORATION	5 HEMLOCK STREET	LATHAM, NY 12110
53944	ELT INC., GLOW LITE DIVISION	BOX 698	PAULS VALLEY, OK 73075
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74276	SIGNALITE DIV., GENERAL INSTRUMENT CORP.	1933 HECK AVE.	NEPTUNE, NJ 07753
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
80294	BOURNS, INC., INSTRUMENT DIV.	6135 MAGNOLIA AVE.	RIVERSIDE, CA 92506
82104	STANDARD GRIGSBY CO., DIV. OF SUN CHEMICAL CORPORATION	920 RATHBONE AVENUE	AURORA, IL 60507
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
92966	SYLVANIA MINIATURE LIGHTING PRODUCTS, INC., SUB OF GTE SYLVANIA, LIGHT. PROD.	526 ELM STREET	KEARNY, NJ 07032

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-3555-00	B010100	B033529	CKT BOARD ASSY:INTERFACE	80009	670-3555-00
A1	670-3555-01	B033530	B049999	CKT BOARD ASSY:INTERFACE	80009	670-3555-01
A1	670-3555-02	B050000	B068539	CKT BOARD ASSY:INTERFACE	80009	670-3555-02
A1	670-3555-03	B068540		CKT BOARD ASSY:INTERFACE	80009	670-3555-03
A3	388-4703-00			CKT BOARD ASSY:SCALE ILLUMINATION	80009	388-4703-00
A10	670-3549-00	B010100	B010374	CKT BOARD ASSY:TRIGGER	80009	670-3549-00
A10	670-3549-02	B010375	B019999	CKT BOARD ASSY:TRIGGER	80009	670-3549-02
A10	670-3549-04	B020000	B068539	CKT BOARD ASSY:TRIGGER	80009	670-3549-04
A10	670-3549-06	B068540		CKT BOARD ASSY:TRIGGER	80009	670-3549-06
A11	670-3548-00	B010100	B010224	CKT BOARD ASSY:SWEEP	80009	670-3548-00
A11	670-3548-01	B010225	B010324	CKT BOARD ASSY:SWEEP	80009	670-3548-01
A11	670-3548-02	B010325	B011099	CKT BOARD ASSY:SWEEP	80009	670-3548-02
A11	670-3548-03	B011100	B019999	CKT BOARD ASSY:SWEEP	80009	670-3548-03
A11	670-3548-04	B020000	B039999	CKT BOARD ASSY:SWEEP	80009	670-3548-04
A11	670-3548-05	B040000	B043979	CKT BOARD ASSY:SWEEP	80009	670-3548-05
A11	670-3548-06	B043980	B049999	CKT BOARD ASSY:SWEEP	80009	670-3548-06
A11	670-3548-07	B050000	B068664	CKT BOARD ASSY:SWEEP	80009	670-3548-07
A11	670-3548-08	B068665		CKT BOARD ASSY:SWEEP	80009	670-3548-08
A12	670-3553-00	B010100	B010609	CKT BOARD ASSY:HORIZONTAL	80009	670-3553-00
A12	670-3553-01	B010610	B044419	CKT BOARD ASSY:HORIZONTAL	80009	670-3553-01
A12	670-3553-02	B044420	B068664	CKT BOARD ASSY:HORIZONTAL	80009	670-3553-02
A12	670-3553-03	B068665		CKT BOARD ASSY:HORIZONTAL	80009	670-3553-03
A13	670-3550-00	B010100	B011099	CKT BOARD ASSY:A SWEEP TIMING	80009	670-3550-00
A13	670-3550-01	B011100	B068664	CKT BOARD ASSY:A SWEEP TIMING	80009	670-3550-01
A13	670-3550-02	B068665		CKT BOARD ASSY:A SWEEP TIMING	80009	670-3550-02
A14	670-3551-00	B010100	B011099	CKT BOARD ASSY:B SWEEP TIMING	80009	670-3551-00
A14	670-3551-01	B011100	B057711	CKT BOARD ASSY:B SWEEP TIMING	80009	670-3551-01
A14	670-3551-03	B057712		CKT BOARD ASSY:B SWEEP TIMING	80009	670-3551-03
A20	670-3554-00	B010100	B010224	CKT BOARD ASSY:VERTICAL	80009	670-3554-00
A20	670-3554-01	B010225	B010399	CKT BOARD ASSY:VERTICAL	80009	670-3554-01
A20	670-3554-02	B010400	B010609	CKT BOARD ASSY:VERTICAL	80009	670-3554-02
A20	670-3554-04	B010610	B011029	CKT BOARD ASSY:VERTICAL	80009	670-3554-04
A20	670-3554-05	B011030	B019999	CKT BOARD ASSY:VERTICAL	80009	670-3554-05
A20	670-3554-06	B020000	B029999	CKT BOARD ASSY:VERTICAL	80009	670-3554-06
A20	670-3554-07	B030000	B032134	CKT BOARD ASSY:VERTICAL	80009	670-3554-07
A20	670-3554-09	B032135	B039999	CKT BOARD ASSY:VERTICAL	80009	670-3554-09
A20	670-3554-10	B040000	B044540	CKT BOARD ASSY:VERTICAL	80009	670-3554-10
A20	670-3554-11	B044541	B049999	CKT BOARD ASSY:VERTICAL	80009	670-3554-11
A20	670-3554-12	B050000	B057559	CKT BOARD ASSY:VERTICAL	80009	670-3554-12
A20	670-3554-13	B057560	B068664	CKT BOARD ASSY:VERTICAL	80009	670-3554-13
A20	670-3554-14	B068665		CKT BOARD ASSY:VERTICAL	80009	670-3554-14
A4100	307-1049-01			ATTEN,THK FILM:CHANNEL 1	80009	307-1049-01
A4162	307-1050-01			RES,NTWK,FXD,FI:GAIN SWITCH,CH 1	80009	307-1050-01
A4200	307-1049-01			ATTEN,THK FILM:CHANNEL 1	80009	307-1049-01
A4262	307-1050-02			RES,NTWK,FXD,FI:GAIN SWITCH,CH 2	80009	307-1050-02
C232	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2502A0R503VP02F0
C233	281-0756-00			CAP.,FXD,CER DI:2.2PF,0.5%,200V	72982	0314022C0K0229D
C236	285-1098-00			CAP.,FXD,PLSTC:0.22UF,10%,80V	56289	192P2249R8
C242	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C244	285-1101-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	19396	223K02PT485
C246	281-0771-00			CAP.,FXD,CER DI:0.0022UF,20%,200V	72982	314-0222Z5U0222M
C272	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2502A0R503VP02F0
C273	281-0756-00			CAP.,FXD,CER DI:2.2PF,0.5%,200V	72982	0314022C0K0229D
C282	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C284	285-1101-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	19396	223K02PT485
C286	281-0771-00			CAP.,FXD,CER DI:0.0022UF,20%,200V	72982	314-0222Z5U0222M

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C288	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C354	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C376	285-1100-00			CAP.,FXD,PLSTC:0.022UF,5%,200V	19396	223J02PT485
C383	281-0766-00			CAP.,FXD,CER DI:100PF,20%,200V	72982	314-022X5P101M
C386	290-0187-00			CAP.,FXD,ELCTLT:4.7UF,20%,35V	56289	150D475X0035B2
C503	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C515	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C516	281-0220-00			CAP.,VAR,CER DI:1-5.5PF,400V	80031	2502A015R5VP0ZF0
C518	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C522	285-1095-00			CAP.,FXD,PLSTC:3300PF,10%,400V	19396	332K06PP481
C523	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C524	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C527	----- -----			(PART OF CIRCUIT BOARD)		
C528	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C533	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	473M02PT605
C543	290-0164-00			CAP.,FXD,ELCTLT:1UF,+50-10%,150V	56289	500D105F150BA7
C546	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C548	285-1119-00			CAP.,FXD,PLSTC:0.082UF,10%,200V	19396	PP680C823K
C558	290-0716-00			CAP.,FXD,ELCTLT:8.2UF,20%,75V	05397	T11C825M075AS
C564	285-1040-00			CAP.,FXD,PLSTC:0.0012UF,10%,4000V	56289	430P522
C566	285-1095-00			CAP.,FXD,PLSTC:3300PF,10%,400V	19396	332K06PP481
C572	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C575	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C576	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C577	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C582	290-0758-00			CAP.,FXD,ELCTLT:2.2UF,+50-10%,160V	56289	502D227
C584	290-0159-00			CAP.,FXD,ELCTLT:2UF,+50-10%,150V	56289	30D205F150BB9
C585	290-0758-00			CAP.,FXD,ELCTLT:2.2UF,+50-10%,160V	56289	502D227
C601	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C602	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C603	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C612	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C633	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C652	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C662	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C666	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C700	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C701	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C702	----- -----			(SEE OPTION SECTION 7, FOR PART NUMBER & VALUE)		
C707	----- -----			(SEE OPT SECTION 7 & 4 FOR PART NUMBER & VALUE)		
C708	----- -----			(SEE OPT SECTION 7 & 4 FOR PART NUMBER & VALUE)		
C709	----- -----			(SEE OPT SECTION 7 & 4 FOR PART NUMBER & VALUE)		
C721	290-0586-01			CAP.,FXD,ELCTLT:1000UF,+75-10%,75V	90201	PFP102MN3A0P1
C722	281-0766-00			CAP.,FXD,CER DI:100PF,20%,200V	72982	314-022X5P101M
C723	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	473M02PT605
C725	285-1101-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	19396	223K02PT485
C735	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	473M02PT605
C738	290-0117-00			CAP.,FXD,ELCTLT:50UF,+75-10%,50V	56289	30D506G050DD9
C741	290-0508-01			CAP.,FXD,ELCTLT:18,000UF,+100-10%,15V	56289	OBD
C743	281-0766-00			CAP.,FXD,CER DI:100PF,20%,200V	72982	314-022X5P101M
C748	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C761	290-0508-01			CAP.,FXD,ELCTLT:18,000UF,+100-10%,15V	56289	OBD
C763	281-0766-00			CAP.,FXD,CER DI:100PF,20%,200V	72982	314-022X5P101M
C767	----- -----			(SEE OPT SECTION 7 & 4 FOR PART NUMBER & VALUE)		
C768	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C773	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C2105	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2113	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2114	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C2115	281-0766-00			CAP.,FXD,CER DI:100PF,20%,200V	72982	314-022X5P101M
C2124	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2127	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2134	281-0760-00			CAP.,FXD,CER DI:22PF,10%,500V	72982	0314021 C0G0220K
C2135	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C2154	281-0755-00			CAP.,FXD,CER DI:1.8PF,0.1%,100V	72982	314021C0K0189B
C2155	281-0765-00			CAP.,FXD,CER DI:100PF,5%,100V	51642	G1710100X5P101J
C2156	281-0787-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	0314021C0G0150J
C2157	281-0787-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	0314021C0G0150J
C2163	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2164	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C2165	281-0766-00			CAP.,FXD,CER DI:100PF,20%,200V	72982	314-022X5P101M
C2174	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2177	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2213	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2215	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2233	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2242	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2251	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2258	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2262	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2267	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
C2616	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2618	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2681	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C2683	283-0126-00	B010100	B044699	CAP.,FXD,CER DI:82PF,5%,1000V	56289	33C180
C2683	281-0816-00	B044700		CAP.,FXD,CER DI:82PF,5%,100V	16546	C40A820J
C2684	281-0160-00			CAP.,VAR,CER DI:7-25PF,350V	72982	538-011B7-25
C2685	290-0136-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	162D225X0020CD2
C2686	281-0505-00			CAP.,FXD,CER DI:12PF,+/-1.2PF,500V	72982	301-012C0G0120K
C2687	281-0775-00	XB040000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2688	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C2697	281-0763-00	XB011100		CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C2698	281-0785-00			CAP.,FXD,CER DI:68PF,10%,100V	72982	8035D2AADC0G680K
C2716	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2717	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2718	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ5U223M
C2722	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	8035D9AADC0G270M
C2744	290-0136-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	162D225X0020CD2
C2752	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2756	281-0792-00	B010100	B010224	CAP.,FXD,CER DI:82PF,10%,100V	72982	8035D2AADC0G820K
C2756	281-0550-00	B010225	B039999	CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C2756	281-0549-00	B040000		CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C2757	290-0264-00			CAP.,FXD,ELCTLT:0.22UF,10%,35V	56289	162D224X9035BC2
C2758	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C2759	281-0785-00			CAP.,FXD,CER DI:68PF,10%,100V	72982	8035D2AADC0G680K
C2762	281-0623-00	B010100	B019999	CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C2762	281-0788-00	B020000		CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C2763	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C2764	285-1101-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	19396	223K02PT485
C2765	290-0327-00			CAP.,FXD,ELCTLT:0.56UF,20%,100V	56289	150D564X0100A2
C2766	290-0136-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	162D225X0020CD2
C2767	290-0167-00			CAP.,FXD,ELCTLT:10UF,20%,15V	56289	150D106X0015B2

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C2781	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C2783	283-0126-00	B010100	B044699	CAP.,FXD,CER DI:82PF,5%,1000V	56289	33C180
C2783	281-0816-00	B044700		CAP.,FXD,CER DI:82PF,5%,100V	16546	C40A820J
C2784	281-0160-00			CAP.,VAR,CER DI:7-25PF,350V	72982	538-011B7-25
C2785	290-0136-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	162D225X0020CD2
C2786	281-0542-00			CAP.,FXD,CER DI:18PF,10%,500V	72982	301-002C0G0180K
C2788	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C2791	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C2797	281-0763-00	XB011100		CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C2812	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C2814	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C2911	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2913	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C2917	283-0067-00	XB010700	B034303	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C2217	281-0770-00	B034304		CAP.,FXD,CER DI:0.001UF,20%,100V	72982	8035D9AADX5R102M
C2919	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2941	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F2010F0
C3122	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C3125A	295-0177-00			CAP.SET,MATCHED:0.01UF,1UF,10UF,1UF,0.01UF	80009	295-0177-00
C3125B	----- -----			(C3125A-C3125E, INDIVIDUAL TIMING CAPACITORS IN		
C3125C	----- -----			THIS ASSEMBLY MUST BE ORDERED BY THE 9-DIGIT		
C3125D	----- -----			PART NUMBER, LETTER SUFFIX & TOLERANCE PRINTED		
C3125E	----- -----			ON THE TIMING CAPACITOR TO BE REPLACED. THE		
	----- -----			LETTER SUFFIX & THE TOLERANCE SHOULD BE THE		
	----- -----			SAME FOR ALL OF THE TIMING CAPACITORS IN THE		
	----- -----			ASSEMBLY. EXAMPLE: 285-XXXX-XX F -)		
C3242	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C4100A	285-0816-01			CAP.,FXD,PLSTC:0.019UF,10%,600V	80009	285-0816-01
	----- -----			(FURNISHED AS A UNIT WITH A4100)		
C4100C	281-0215-00			CAP.,VAR,CER DI:1.2-10.2PF,400V	80031	2222-802-96043
	----- -----			(FURNISHED AS A UNIT WITH A4100)		
C4100D	281-0217-00			CAP.,VAR,CER DI:0.5-3.5PF,400V	52763	RT202-08SB.6/3.5
	----- -----			(FURNISHED AS A UNIT WITH A4100)		
C4100E	307-1049-01			ATTEN,THK FILM:CHANNEL 1	80009	307-1049-01
	----- -----			(FURNISHED AS A UNIT WITH A4100)		
C4100G	281-0216-00			CAP.,VAR,CER DI:0.8-6.8PF,400V	52763	R-TRIK0-122-09SD
	----- -----			(FURNISHED AS A UNIT WITH A4100)		
C4100H	281-0222-00			CAP.,VAR,CER DI:1-6.5PF,400V	52763	RT202-08SD 1/5
	----- -----			(FURNISHED AS A UNIT WITH A4100)		
C4100J	307-1049-01			ATTEN,THK FILM:CHANNEL 1	80009	307-1049-01
	----- -----			(FURNISHED AS A UNIT WITH A4100)		
C4101	281-0609-00	XB056114		CAP.,FXD,CER DI:1PF,+/-0.1PF,500V	72982	374-005C0K0109B
	----- -----			(ADDED AS NEEDED)		
C4123	283-0238-00	B010100	B010399	CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C4123	283-0005-00	B033500		CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C4124	281-0213-00			CAP.,VAR,CER DI:0.8-3.8PF,400V	52763	RT201-04SD.5/3.5
C4125	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4160	307-1050-01			RES.,NTWK,FXD,FI:GAIN SWITCH CH 1	80009	307-1050-01
	----- -----			(FURNISHED AS A UNIT WITH A4162)		
C4161	307-1050-01			RES.,NTWK,FXD,FI:GAIN SWITCH,CH 1	80009	307-1050-01
	----- -----			(FURNISHED AS A UNIT WITH A4162)		
C4162	281-0627-00	B010100	B010749	CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000C0K0109C
C4162	281-0557-00	B010750		CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-000C0K0189B
C4171	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	2807C00218MH02F0
C4172	281-0605-00	B010100	B044540	CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C4172	281-0809-00	B044541		CAP.,FXD,CER DI:200PF,5%,100V	72982	8013T2ADDC1G201J
C4173	281-0207-00	B010100	B010224	CAP.,VAR,PLSTC:2-18PF,100V	80031	2807C00218MH02F0
C4173	281-0208-00	B010225		CAP.,VAR PLSTC:5.5-50PF,100V	80031	2810C5R5506H02F0
C4191	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z

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C4192	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4200A	285-0816-01			CAP.,FXD,PLSTC:0.019UF,10%,600V	80009	285-0816-01
	----- -----			(FURNISHED AS A UNIT WITH A4200)		
C4200C	281-0215-00			CAP.,VAR,CER DI:1.2-10.2PF,400V	80031	2222-802-96043
	----- -----			(FURNISHED AS A UNIT WITH A4200)		
C4200D	281-0217-00			CAP.,VAR,CER DI:0.5-3.5PF,400V	52763	RT202-08SB.6/3.5
	----- -----			(FURNISHED AS A UNIT WITH A4200)		
C4200E	307-1049-01			ATTEN,THK FILM:CHANNEL 1	80009	307-1049-01
	----- -----			(FURNISHED AS A UNIT WITH A4200)		
C4200G	281-0216-00			CAP.,VAR,CER DI:0.8-6.8PF,400V	52763	R-TRIKO-122-09SD
	----- -----			(FURNISHED AS A UNIT WITH A4200)		
C4200H	281-0222-00			CAP.,VAR,CER DI:1-6.5PF,400V	52763	RT202-08SD 1/5
	----- -----			(FURNISHED AS A UNIT WITH A4200)		
C4200J	307-1049-01			ATTEN,THK FILM:CHANNEL 1	80009	307-1049-01
	----- -----			(FURNISHED AS A UNIT WITH A4200)		
C4201	281-0609-00	XB056114		CAP.,FXD,CER DI:1PF,+/-0.1PF,500V	72982	374-005C0K0109B
	----- -----			(ADDED AS NEEDED)		
C4223	283-0238-00	B010100	B010399	CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C4223	283-0180-00	B010400	B033499	CAP.,FXD,CER DI:5600PF,20%,200V	72982	8121N204 E 562M
C4223	283-0005-00	B033500		CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C4224	281-0213-00			CAP.,VAR,CER DI:0.8-3.8PF,400V	52763	RT201-04SD.5/3.5
C4225	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4260	307-1050-02			RES.,NTWK,FXD,FI:GAIN SWITCH,CH 2	80009	307-1050-02
	----- -----			(FURNISHED AS A UNIT WITH A4262)		
C4262	281-0627-00			CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000C0K0109C
C4270	281-0811-00	XB057600		CAP.,FXD,CER DI:10PF,10%,100V	72982	8035D2AADC1G100K
C4271	281-0759-00	B010100	B010609	CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C4271	281-0509-00	B010610	B044540	CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C4271	281-0797-00	B044541		CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
C4272	281-0605-00	B010100	B044540	CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C4272	281-0809-00	B044541		CAP.,FXD,CER DI:200PF,5%,100V	72982	8013T2ADDC1G201J
C4273	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4274	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4288	281-0791-00	B010100	B010224	CAP.,FXD,CER DI:270PF,10%,100V	72982	8035D2AADX5R271K
C4288	281-0605-00	B010225	B010609	CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C4288	281-0786-00	B010610		CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C4292	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4316	285-0643-00			CAP.,FXD,PLSTC:0.0047UF,5%,100V	56289	410P374
C4333	290-0263-00			CAP.,FXD,ELCTLT:2.7UF,15V	56289	162D275X9015CD2
C4335	281-0785-00			CAP.,FXD,CER DI:68PF,10%,100V	72982	8035D2AADC0G680K
C4336	290-0263-00			CAP.,FXD,ELCTLT:2.7UF,15V	56289	162D275X9015CD2
C4363	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4364	281-0775-00	XB010225		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C4365	281-0759-00	B010100	B010224	CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C4365	281-0763-00	B010225		CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C4373	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4375	281-0759-00	B010100	B010224	CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C4375	281-0763-00	B010225		CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C4384	281-0775-00	B010100	B010224X	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C4386	281-0797-00	XB057000		CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
C4410	281-0785-00			CAP.,FXD,CER DI:68PF,10%,100V	72982	8035D2AADC0G680K
C4411	283-0104-00	B010100	B044540	CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J
C4411	283-0142-00	B044541	B057599	CAP.,FXD,CER DI:0.0027UF,5%,200V	72982	875-571-Y5E0272J
C4411	283-0104-00	B057600		CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J
C4412	281-0205-00			CAP.,VAR,PLSTC:4-65PF,100V	80031	2810C5R565QJ02F0
C4413	281-0605-00	B010100	B044540	CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C4413	281-0809-00	B044541		CAP.,FXD,CER DI:200PF,5%,100V	72982	8013T2ADDC1G201J
C4414	283-0643-00	B010100	B010609	CAP.,FXD,MICA D:22PF,+/-0.5PF,300V	00853	D105C220D
C4414	281-0763-00	B010610	B029999	CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K

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C4414	281-0625-00	B030000		CAP.,FXD,CER DI:35PF,5%,500V	72982	308-000C0G0350J
C4417	281-0208-00			CAP.,VAR PLSTC:5.5-50PF,100V	80031	2810C5R5506H02F0
C4418	283-0238-00	XB010400		CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C4434	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4435	283-0328-00	XB032135		CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	8131N225Z5U0303Z
C4437	281-0792-00	B010100	B010224X	CAP.,FXD,CER DI:82PF,10%,100V	72982	8035D2AADC0G820K
C4438	281-0797-00	XB057600		CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
C4444	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4447	281-0208-00	B010100	B010224	CAP.,VAR PLSTC:5.5-50PF,100V	80031	2810C5R5506H02F0
C4447	281-0207-00	B010225		CAP.,VAR,PLSTC:2-18PF,100V	80031	2807C00218MH02F0
C4464	----- -----			(PART OF CIRCUIT BOARD)		
C4466	283-0010-00	XB030000		CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C4474	----- -----			(PART OF CIRCUIT BOARD)		
C4479	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C4493	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
CR235	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR236	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR351	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR352	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR353	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR358	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR372	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR373	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR504	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR505	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR506	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR507	152-0061-00	XB050000		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR513	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR514	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR518	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR524	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR525	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR528	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR541	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR552	152-0107-04			SEMICOND DEVICE:SILICON,400V,400MA,SEL	80009	152-0107-04
CR553	152-0107-04			SEMICOND DEVICE:SILICON,400V,400MA,SEL	80009	152-0107-04
CR554	152-0398-00			SEMICOND DEVICE:SILICON,200V,1A	04713	SR3609RL
CR555	152-0107-04			SEMICOND DEVICE:SILICON,400V,400MA,SEL	80009	152-0107-04
CR556	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR557	152-0398-00			SEMICOND DEVICE:SILICON,200V,1A	04713	SR3609RL
CR582	152-0629-00			SEMICOND DEVICE:SILICON,225V,5UA	80009	152-0629-00
CR584	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR601	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR632	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR633	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR634	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR635	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR636	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR637	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR638	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR639	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR656	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR657	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR658	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR662	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
CR666	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR721	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	3N55 FAMILY
CR734	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR735	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR738	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR741	152-0556-00			SEMICOND DEVICE:BRIDGE,50V,2.5A	04713	SDA10271K
CR744	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR748	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR762	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR763	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR764	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR765	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR766	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR768	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR2104	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2108	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2123	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR2173	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR2213	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2215	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2233	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2242	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2251	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2258	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2262	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2267	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
CR2655	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2656	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2657	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2686	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2688	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2689	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2690	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2691	152-0061-00	XB050000		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR2692	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2694	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2695	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2741	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2742	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2743	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2756	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2757	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2759	152-0141-02	XB010225		SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2763	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2764	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2765	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2766	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2767	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2774	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2786	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2788	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2791	152-0061-00	XB050000		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR2793	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2795	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR2804	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4115	150-1036-00	B010100	B056949	LAMP,LED:RED,3.0V,40MA	01295	TIL 209A

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR4115	150-1031-00	B056950		LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
CR4117	150-1036-00	B010100	B056949	LAMP,LED:RED,3.0V,40MA	01295	TIL 209A
CR4117	150-1031-00	B056950		LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
CR4121	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR4122	152-0322-00	XB010400		SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR4124	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR4129	152-0141-02	XB040000		SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4215	150-1036-00	B010100	B056949	LAMP,LED:RED,3.0V,40MA	01295	TIL 209A
CR4215	150-1031-00	B056950		LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
CR4216	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4217	150-1036-00	B010100	B056949	LAMP,LED:RED,3.0V,40MA	01295	TIL 209A
CR4217	150-1031-00	B056950		LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
CR4221	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR4222	152-0322-00	XB010400		SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR4224	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR4229	152-0141-02	XB040000		SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4284	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4286	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4287	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4312	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4318	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4322	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4328	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4382	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR4436	152-0269-00	XB010225		SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR4437	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR4448	152-0322-00	XB010610		SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR4449	152-0322-00	XB010610		SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
DL4400	119-0712-00			DELAY LINE,ELEC:140 NS	80009	119-0712-00
DS563	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	74276	NE-2T(T2)
DS564	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	74276	NE-2T(T2)
DS784	150-0129-00			LAMP,INCAND:6.3V,200MA	08806	2112D
DS786	150-0129-00			LAMP,INCAND:6.3V,200MA	08806	2112D
DS2755	150-0130-00			LAMP,INCAND:5V,60MA	92966	34254-TINNED
DS2756	150-0130-00			LAMP,INCAND:5V,60MA	92966	34254-TINNED
DS2920	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
DS3129	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
DS4142	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
DS4242	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
F600	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
F700	159-0022-00			FUSE,CARTRIDGE:3AG,1A,250V,FAST-BLOW	71400	AGC 1
	----- -----			(116V OPERATION)		
F700	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
	----- -----			(232V OPERATION)		
F736	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
F746	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
F768	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
FL701	----- -----			(SEE OPTION SECTION 4 FOR PART NUMBER & VALUE)		
J2	131-1784-00	B010100	B049999	CONNECTOR,RCPT,:CKT CD,15/30 FEMALE,600V	05574	000-201-4897
J2	131-2063-00	B050000		CONN,RCPT,ELEC:CIRCUIT CARD,15/30 FEMALE	05574	000-201-4986
J4	131-1784-00	B010100	B049999	CONNECTOR,RCPT,:CKT CD,15/30 FEMALE,600V	05574	000-201-4897
J4	131-2063-00	B050000		CONN,RCPT,ELEC:CIRCUIT CARD,15/30 FEMALE	05574	000-201-4986
J358	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J359	131-0352-02			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR166-1
J503	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J513	131-0352-02			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR166-1

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
J600	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
J2100	131-0352-02			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR166-1
J2150	131-0352-02			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR166-1
J4100	131-0679-02			CONNECTOR,RCPT,:BNC,MALE,3 CONTACT	24931	28JR270-1
J4200	131-0679-02			CONNECTOR,RCPT,:BNC,MALE,3 CONTACT	24931	28JR270-1
J4287	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J4289	131-0352-02			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR166-1
L386	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L554	108-0820-00			COIL,RF:72UH	80009	108-0820-00
L558	108-0422-00			COIL,RF:FIXED,82UH	80009	108-0422-00
L571	108-0818-00			COIL,TUBE DEFLE:TRACE ROTATION	80009	108-0818-00
L573	108-0819-00			COIL,TUBE DEFLE:X-Y ALIGNMENT	80009	108-0819-00
L582	108-0691-00			COIL,RF:1.8MH	76493	02279
L2688	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L2788	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L2812	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L2814	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L4128	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L4228	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L4267	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L4268	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L4273	108-0429-00			COIL,RF:1.2UH	80009	108-0429-00
Q232	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q234	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q244	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q246	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q274	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q284	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q286	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q356	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q358	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q376	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q382	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q386	151-0164-00			TRANSISTOR:SILICON,PNP	01295	SKB3334
Q514	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q518	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q524	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q526	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q544	151-0126-00			TRANSISTOR:SILICON,NPN	04713	ST1046
Q548	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q552	151-0426-01	B010100	B032969	TRANSISTOR:SILICON,NPN,SEL FROM D44H11	80009	151-0426-01
Q552	151-0426-02	B032970	B068844	TRANSISTOR:SILICON,NPN,SEL FROM 044H242	80009	151-0426-02
Q552	151-0701-00	B068845		TRANSISTOR:SILICON,NPN	80009	151-0701-00
Q556	151-0364-00			TRANSISTOR:SILICON,PNP	80009	151-0364-00
Q622	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q624	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q628	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q632	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q652	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q656	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q662	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q666	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
Q732	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q734	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q736	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q742	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q744	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q746	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q764	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q766	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q768	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q784	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q2104	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q2108	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q2120	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
Q2122						
Q2170	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
Q2172						
Q2212	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
Q2236	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
Q2246	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
Q2682	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
Q2684						
Q2686	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2688	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2782	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
Q2784						
Q2786	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2788	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2804	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q4114	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q4116	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q4124A,B	151-1090-02			TRANSISTOR:SILICON,FE,DUAL,N-CHANNEL	80009	151-1090-02
Q4214	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q4216	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q4224A,B	151-1090-02			TRANSISTOR:SILICON,FE,DUAL,N-CHANNEL	80009	151-1090-02
Q4282	151-0190-02			TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q4316	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q4326	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q4334	151-0190-00	B010100	B010224	TRANSISTOR:SILICON,NPN	07263	S032677
Q4334	151-0460-00	B010225		TRANSISTOR:SILICON,NPN	80009	151-0460-00
Q4338	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q4362	151-0458-00			TRANSISTOR:SILICON,PNP	80009	151-0458-00
Q4372	151-0458-00			TRANSISTOR:SILICON,PNP	80009	151-0458-00
Q4384	151-0458-00			TRANSISTOR:SILICON,PNP	80009	151-0458-00
Q4434	151-0458-00	B010100	B029999	TRANSISTOR:SILICON,PNP	80009	151-0458-00
Q4434	151-0434-00	B030000		TRANSISTOR:SILICON,PNP	04713	SS7144
Q4444	151-0458-00	B010100	B029999	TRANSISTOR:SILICON,PNP	80009	151-0458-00
Q4444	151-0434-00	B030000		TRANSISTOR:SILICON,PNP	04713	SS7144
Q4462	151-0472-00			TRANSISTOR:SILICON,NPN	80009	151-0472-00
Q4464	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q4466	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q4472	151-0472-00			TRANSISTOR:SILICON,NPN	80009	151-0472-00
Q4474	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q4476	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
R232	323-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.50W	75042	CECT0-8871F
R233	323-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.50W	75042	CECT0-8871F
R235	321-0354-00			RES.,FXD,FILM:47.5K OHM,1%,0.125W	91637	MFF1816G47501F
R236	321-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.125W	91637	MFF1816G54900F
R241	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R242	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R243	301-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.50W	01121	EB2235
R244	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R245	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R246	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R247	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R272	323-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.50W	75042	CECT0-8871F
R273	323-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.50W	75042	CECT0-8871F
R275	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R276	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R282	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R283	301-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.50W	01121	EB2235
R284	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R285	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R286	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R287	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R288	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R352	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R353	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R354	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R356	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R358	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R372	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R373	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R374	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R375	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R376	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R377	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R382	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R383	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R386	311-1223-00			RES.,VAR,NONWIR:TRMR,250 OHM,0.5W	02111	63M251T602
R387	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	MFF1816G715R0F
R388	321-0071-00			RES.,FXD,FILM:53.6 OHM,1%,0.125W	91637	MFF1816G53R60F
R502	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R503	321-0176-00			RES.,FXD,FILM:665 OHM,1%,0.125W	91637	MFF1816G665R0F
R504	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R505	301-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.50W	01121	EB1625
R506	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R512	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F
R513	323-0259-00			RES.,FXD,FILM:4.87K OHM,1%,0.50W	91637	MFF1226G48700F
R514	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
R515	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R516	323-0313-00			RES.,FXD,FILM:17.8K OHM,1%,0.50W	75042	CECT0-1782F
R517	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R521	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R522	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R523	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R524	301-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.50W	01121	EB2235
R525	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R526	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R532	311-1557-00			RES.,VAR,NONWIR:25K OHM,20%,0.50W	73138	91-79-00
R533	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R541	315-0334-00	B010100	B010749	RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R541	315-0104-00	B010750		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R542	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R543	315-0623-00	B010100	B010749	RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R543	315-0474-00	B010750		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R544	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R546	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R547	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R548	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R553	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R554	315-0120-00			RES.,FXD,CMPSN:12 OHM,5%,0.25W	01121	CB1205
R556	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R563A-D	307-0471-00			RES,NTWK,FXD,FI:HIGH VOLTAGE DIVIDER	80009	307-0471-00
R564	311-1790-00			RES.,VAR,NONWIR:5M OHM,20%,2W	12697	CM40963
R566A,B	311-1769-00			RES.,VAR,NONWIR:2K OHM/2M OHM,10%,0.5/0.25W	12697	D388-CM40910
R571	311-1726-00			RES.,VAR,NONWIR:2K OHM,10%,2W	80294	3858Z-X04-202E
R572	311-1554-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	91-76-0
R573	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91-84-0
R574	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R575	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R576	311-1727-00			RES.,VAR,NONWIR:20K OHM,10%,2W	12697	381-CM40962
R577	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R585	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R600	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R612	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R613	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R615	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R617	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R622	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R624	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R625	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R626	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R627	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R632	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R633	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R634	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R635	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R638	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R639	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R653	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R655	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R656	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R657	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R658	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R662	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R663	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R666	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R667	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R702	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
R721	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R722	303-0302-00			RES.,FXD,CMPSN:3K OHM,5%,1W	01121	GB3025
R723	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	91637	MFF1816G11801F
R725	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R728	303-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,1W	01121	GB4725
R731	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R732	321-0174-00			RES.,FXD,FILM:634 OHM,1%,0.125W	91637	MFF1816G634R0F
R733	321-0337-00			RES.,FXD,FILM:31.6K OHM,1%,0.125W	91637	MFF1816G31601F
R734	308-0703-00			RES.,FXD,WW:1.8 OHM,5%,2W	75042	BWH-1R800J
R735	321-0696-00			RES.,FXD,FILM:40.2K OHM,0.5%,0.125W	91637	MFF1816D40201D
R736	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91-83-0
R737	321-0684-00			RES.,FXD,FILM:15K OHM,0.5%,0.125W	91637	MFF1816D15001D
R738	303-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,1W	01121	GB2425
R740	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R741	321-1656-03			RES.,FXD,FILM:27K OHM,0.25%,0.125W	91637	MFF1816D27001C

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R742	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R743	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R745	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R746	321-0198-00			RES.,FXD,FILM:1.13K OHM,1%,0.125W	91637	MFF1816G11300F
R747	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
R748	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R761	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R762	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R763	321-1655-03			RES.,FXD,FILM:32K OHM,0.25%,0.125W	91637	MFF1816D32001C
R764	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R765	321-0320-00			RES.,FXD,FILM:21K OHM,1%,0.125W	91637	MFF1816G21001F
R766	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R767	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R768	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R769	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R772	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R773	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R776	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R777	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R782	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R785	311-1725-00			RES.,VAR,NONWIR:10K OHM,10%,2W	80294	3859Z-X05-103F
R2100	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R2101	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R2102	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R2103	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R2104	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R2105	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2106	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2107	315-0820-00	B010100	B019999	RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R2107	315-0390-00	B020000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R2108	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R2109	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R2110	315-0820-00	B010100	B019999	RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R2110	315-0390-00	B020000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R2114	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R2115	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2117	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2122	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2124	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2125	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R2126	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R2127	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2133	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2134	315-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.25W	01121	CB7545
R2135	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R2153	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2154	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R2155	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R2156	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2157	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
R2164	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R2165	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2167	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2172	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2174	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2175	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805

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R2176	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R2177	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2212	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2213	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2214	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2215	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2217	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2218	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2224	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2225	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2227	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2232	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2233	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2234	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2235	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2236	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2237	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2238	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2242	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2243	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2244	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2245	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2246	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2247	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2248	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2251	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2252	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2253	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2254	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2255	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2256	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2257	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2258	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2261	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2262	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2263	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2264	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2265	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2266	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2267	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2268	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2600	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
R2612	311-1724-00			RES.,VAR,NONWIR:PNL,20K OHM,10%,2W	12697	CM40959
R2613	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R2614	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2615	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R2616	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2618	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2652	321-0229-00			RES.,FXD,FILM:2.37K OHM,1%,0.125W	91637	MFF1816G23700F
R2653	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2654	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2655	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2656	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2657	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2680	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2681	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2682	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R2683	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2684	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R2685	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2686	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2687	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R2688	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2689	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R2692	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2693	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2697	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R2698	316-0156-00	B010100	B011099	RES.,FXD,CMPSN:15M OHM,10%,0.25W	01121	CB1561
R2698	315-0475-00	B011100		RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R2700	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2712	311-1724-00			RES.,VAR,NONWIR:PNL,20K OHM,10%,2W	12697	CM40959
R2713	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R2714	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2715	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R2716	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2717	315-0110-00			RES.,FXD,CMPSN:11 OHM,5%,0.25W	01121	CB1105
R2718	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2722	315-0430-00	B010100	B010224	RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R2722	315-0470-00	B010225		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2724	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R2725	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R2732	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R2733	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R2735	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R2736	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R2741	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R2742	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R2743	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2744	321-0378-00			RES.,FXD,FILM:84.5K OHM,1%,0.125W	91637	MFF1816G84501F
R2745	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	91637	MFF1816G56200F
R2746	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2747	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R2748	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91-83-0
R2749	311-1729-00			RES.,VAR,WW:10K OHM,5%,2W	32997	3540S-561-103
R2752	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R2753	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2755	307-0106-00	B010100	B043979	RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R2755	315-0150-00	B043980		RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R2757	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R2758	315-0100-00	B010100	B043979	RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2758	307-0106-00	B046980		RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R2759	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2762	315-0103-00	B010100	B019999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2762	315-0752-00	B020000		RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2763	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2764	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2765	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2766	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2767	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2774	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R2776	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R2777	311-1728-00			RES.,VAR,NONWIR:1M OHM,20%,2W	80294	381-CM40943

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R2780	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2782	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R2783	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2784	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R2785	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2786	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2787	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R2788	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2789	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R2791	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R2792	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2793	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2794	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2795	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2797	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2798	316-0156-00	B010100	B011099	RES.,FXD,CMPSN:15M OHM,10%,0.25W	01121	CB1561
R2798	315-0475-00	B011100		RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R2802	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2804	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2911	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R2912	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R2913	311-1722-00	B010100	B010139	RES.,VAR,NONWIR:2.5K OHM,5%,2W	12697	381-CM40951
R2913A,B	311-1722-00	B010140		RES.,VAR,NONWIR:2.5K OHM,5%,2W	12697	381-CM40951
R2914	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R2915	315-0752-00	XB010140		RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2916	311-1223-00	B010100	B010699	RES.,VAR,NONWIR:TRMR,250 OHM,0.5W	02111	63M251T602
R2916	311-1224-00	B010700		RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R2917	315-0201-00	B010100	B010699	RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R2917	315-0820-00	B010700		RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R2919	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R2920	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2921	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R2922	321-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.125W	91637	MFF1816G16900F
R2923	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R2925	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
R2927	321-0108-00			RES.,FXD,FILM:130 OHM,1%,0.125W	91637	MFF1816G130R0F
R2932	311-1560-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	73138	91-82-0
R2933	321-0295-00			RES.,FXD,FILM:11.5K OHM,1%,0.125W	91637	MFF1816G11501F
R2934	321-0295-00			RES.,FXD,FILM:11.5K OHM,1%,0.125W	91637	MFF1816G11501F
R2936	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R2937	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R2942	321-0329-00			RES.,FXD,FILM:26.1K OHM,1%,0.125W	91637	MFF1816G26101F
R2943	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2944	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R3113	321-0373-04			RES.,FXD,FILM:75K OHM,0.1%,0.125W	91637	MFF1816D75001B
R3114	321-1651-04			RES.,FXD,FILM:37.5K OHM,0.1%,0.125W	91637	MFF1816D37501B
R3115	321-1651-04			RES.,FXD,FILM:37.5K OHM,0.1%,0.125W	91637	MFF1816D37501B
R3122	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R3123	321-1653-04			RES.,FXD,FILM:2.25M OHM,0.1%,0.125W	91637	HMF188D22503B
R3124	321-0469-04			RES.,FXD,FILM:750K OHM,0.1%,0.125W	91637	MFF1816D75002B
R3125	321-1652-04			RES.,FXD,FILM:375K OHM,0.1%,0.125W	91637	MFF1816D37502B
R3127	321-1652-04			RES.,FXD,FILM:375K OHM,0.1%,0.125W	91637	MFF1816D37502B
R3128	311-1793-00			RES.,VAR,NONWIR:20K OHM,20%,1W,DPST SW	12697	381CM40935
	----- -----			**(FURNISHED AS A UNIT WITH S3128A,B)**		
R3129	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R3130	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545

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R3132	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R3133	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R3134	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R3135	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R3136	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R3137	315-0225-00	XB011100		RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R3212	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R3213	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R3214	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R3215	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R3216	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R3217	315-0225-00	XB011100		RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R3222	321-1652-04			RES.,FXD,FILM:375K OHM,0.1%,0.125W	91637	MFF1816D37502B
R3223	321-1652-04			RES.,FXD,FILM:375K OHM,0.1%,0.125W	91637	MFF1816D37502B
R3224	321-0469-04			RES.,FXD,FILM:750K OHM,0.1%,0.125W	91637	MFF1816D75002B
R3225	321-1653-04			RES.,FXD,FILM:2.25M OHM,0.1%,0.125W	91637	HMF188D22503B
R3236	321-1651-04			RES.,FXD,FILM:37.5K OHM,0.1%,0.125W	91637	MFF1816D37501B
R3237	321-1651-04			RES.,FXD,FILM:37.5K OHM,0.1%,0.125W	91637	MFF1816D37501B
R3238	321-0373-04			RES.,FXD,FILM:75K OHM,0.1%,0.125W	91637	MFF1816D75001B
R3242	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R4100A	----- -----			(FURNISHED AS A PART OF A4100)		
R4100C	----- -----			(FURNISHED AS A PART OF A4100)		
R4100D	----- -----			(FURNISHED AS A PART OF A4100)		
R4100E	----- -----			(FURNISHED AS A PART OF A4100)		
R4100F	----- -----			(FURNISHED AS A PART OF A4100)		
R4100G	----- -----			(FURNISHED AS A PART OF A4100)		
R4100H	----- -----			(FURNISHED AS A PART OF A4100)		
R4100J	----- -----			(FURNISHED AS A PART OF A4100)		
R4101	317-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.125W	01121	BB4305
R4112	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R4113	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R4115	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R4116	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R4117	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R4121	317-0681-00	B010100	B010224	RES.,FXD,CMPSN:680 OHM,5%,0.125W	01121	BB6815
R4121	317-0511-00	B010225		RES.,FXD,CMPSN:510 OHM,5%,0.125W	01121	BB5115
R4122	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R4123	315-0474-00	B010100	B010399	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R4123	315-0224-00	B010400	B033499	RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R4123	315-0474-00	B033500		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R4125	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4126	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4127	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4129	315-0470-00	XB040000		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4134	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R4135	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4136	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4137	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R4141	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R4142	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R4143	311-1792-00			RES.,VAR,NONWIR:5K OHM,20%,1W,DPST SW	12697	381CM40934
	----- -----			(FURNISHED AS A UNIT WITH S4143)		
R4144	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R4145	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R4153	311-1723-00			RES.,VAR,NONWIR:10K OHM,10%,2W	12697	CM40958
R4154	315-0122-00	B010100	B010609	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R4154	315-0162-00	B010610		RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4156	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4160A	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160B	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160C	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160D	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160E	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160F	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160G	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160H	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4160J	----- -----			(FURNISHED AS A UNIT WITH A4162)		
R4170	315-0152-00	B010100	B010224	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R4170	315-0821-00	B010225		RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R4171	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R4172	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R4173	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R4174	315-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R4175	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R4192	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4200A	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4200C	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4200D	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4200E	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4200F	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4200G	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4200H	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4200J	----- -----			(FURNISHED AS A UNIT WITH A4200)		
R4201	317-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.125W	01121	BB4305
R4212	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R4213	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R4215	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R4216	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R4217	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R4221	317-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.125W	01121	BB6815
R4222	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R4223	315-0474-00	B010100	B010399	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R4223	315-0224-00	B010400	B033499	RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R4223	315-0474-00	B033500		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R4225	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4226	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4227	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4229	315-0470-00	XB040000		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4234	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R4235	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4236	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4237	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R4241	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R4242	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R4243	311-1792-00			RES.,VAR,NONWIR:5K OHM,20%,1W,DPST SW	12697	381CM40934
	----- -----			(FURNISHED AS A UNIT WITH S4243)		
R4244	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R4245	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R4246	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R4247	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R4253	311-1723-00			RES.,VAR,NONWIR:10K OHM,10%,2W	12697	CM40958
R4254	315-0122-00	B010100	B010609	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225

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R4254	315-0162-00	B010610		RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R4256	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4260A	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260B	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260C	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260D	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260E	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260F	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260G	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260H	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4260J	----- -----			(FURNISHED AS A UNIT WITH A4262)		
R4271	315-0510-00	B010100	B029999	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R4271	315-0101-00	B030000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4272	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R4273	311-1560-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	73138	91-82-0
R4276	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R4280	315-0201-00	XB010610		RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R4281	315-0240-00	B010100	B010349	RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R4281	315-0360-00	B010350		RES.,FXD,CMPSN:36 OHM,5%,0.25W	01121	CB3605
R4282	315-0750-00	B010100	B010349	RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R4282	315-0121-00	B010350		RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R4283	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R4284	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4285	321-0063-00			RES.,FXD,FILM:44.2 OHM,1%,0.125W	91637	MFF1816G44R20F
R4286	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R4287	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4288	321-0082-00			RES.,FXD,FILM:69.8 OHM,1%,0.125W	91637	MFF1816G69R80F
R4292	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4312	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
R4313	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R4314	321-0141-00			RES.,FXD,FILM:287 OHM,1%,0.125W	91637	MFF1816G287R0F
R4317	321-0156-00			RES.,FXD,FILM:412 OHM,1%,0.125W	91637	MFF1816G412R0F
R4318	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	91637	MFF1816G294R0F
R4322	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
R4323	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R4324	321-0141-00			RES.,FXD,FILM:287 OHM,1%,0.125W	91637	MFF1816G287R0F
R4327	321-0156-00			RES.,FXD,FILM:412 OHM,1%,0.125W	91637	MFF1816G412R0F
R4328	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	91637	MFF1816G294R0F
R4332	315-0201-00	XB040000		RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R4333	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R4334	315-0273-00	B010100	B010224	RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R4334	315-0223-00	B010225		RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R4335	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R4336	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R4337	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4338	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R4361	321-0094-00			RES.,FXD,FILM:93.1 OHM,1%,0.125W	91637	MFF1816G93R10F
R4362	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
R4363	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R4364	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4365	321-0076-00			RES.,FXD,FILM:60.4 OHM,1%,0.125W	91637	MFF1816G60R40F
R4366	321-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.125W	91637	MFF1816G11000F
R4371	321-0094-00			RES.,FXD,FILM:93.1 OHM,1%,0.125W	91637	MFF1816G93R10F
R4372	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
R4373	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R4375	321-0076-00			RES.,FXD,FILM:60.4 OHM,1%,0.125W	91637	MFF1816G60R40F

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R4377	321-0067-00			RES.,FXD,FILM:48.7 OHM,1%,0.125W	91637	MFF1816G48R70F
R4382	321-0119-00			RES.,FXD,FILM:169 OHM,1%,0.125W	91637	MFF1816G169R0F
R4383	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4384	315-0470-00	B010100	B010224	RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4384	315-0101-00	B010225		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4385	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4386	315-0151-00	B010100	B019999	RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4386	315-0101-00	B020000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4400	315-0470-00	XB043980		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4411	315-0472-00	B010100	B044540	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4411	315-0302-00	B044541		RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R4412	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R4413	315-0562-00	B010100	B044540	RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R4413	315-0392-00	B044541		RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R4414	315-0621-00	B010100	B010609	RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4414	315-0301-00	B010610	B029999	RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R4414	311-1563-00	B030000		RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R4415	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R4416	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R4417	311-1564-00			RES.,VAR,NONWIR:TRMR,500 OHM,0.5W	73138	91-86-0
R4418	315-0123-00	XB010400	B044540	RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R4418	315-0912-00	B044541		RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R4432	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R4433	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R4434	315-0680-00	B010100	B029999	RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R4434	315-0121-00	B030000		RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R4435	321-0149-00			RES.,FXD,FILM:348 OHM,1%,0.125W	91637	MFF1816G348R0F
R4436	311-1563-00	B010100	B029999	RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R4436	311-1749-00	B030000		RES.,VAR,NONWIR:TRMR,1.5K OHM,0.75W	73138	91-97-0
R4437	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
R4442	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R4443	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R4444	315-0680-00	B010100	B029999	RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R4444	315-0121-00	B030000		RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R4445	321-0149-00			RES.,FXD,FILM:348 OHM,1%,0.125W	91637	MFF1816G348R0F
R4446	321-0126-00	B010100	B029999	RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4446	321-0114-00	B030000		RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R4447	321-0111-00			RES.,FXD,FILM:140 OHM,1%,0.125W	91637	MFF1816G140R0F
R4448	315-0273-00	B010100	B010224	RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R4448	315-0333-00	B010225		RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R4449	321-0165-00	XB010610		RES.,FXD,FILM:511 OHM,1%,0.125W	91637	MFF1816G511R0F
R4462	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R4463	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4464	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R4465	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R4466	308-0298-00			RES.,FXD,WW:560 OHM,5%,3W	91637	CW2B-B560R0J
R4472	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R4473	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4474	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R4475	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R4476	308-0298-00			RES.,FXD,WW:560 OHM,5%,3W	91637	CW2B-B560R0J
R4479	321-0036-00			RES.,FXD,FILM:23.2 OHM,1%,0.125W	91637	MFF1816G23R20F
RT4437	307-0127-00			RES.,THERMAL:1K OHM,10%	50157	2D1596
RT4448	307-0124-00			RES.,THERMAL:5K OHM,10%	50157	1D1618
S500	260-1686-00			SWITCH,PUSH:1 STA,2 POLE,MOMENTARY	80009	260-1686-00

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S600	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
S661	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
S700	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
S700	----- -----			(SEE OPTION SECTION 7 FOR ALTERNATE VERSION)		
S701	260-1780-00			SWITCH,SLIDE:DPDT,3A,125V	82389	11A-1700
S2100	214-2293-02			LEVER,SWITCH:5 POSN,W/CONT	80009	214-2293-02
S2100	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
S2120	214-2294-01			LEVER,SWITCH:4 POSN,W/CONT	80009	214-2294-01
S2150	214-2292-03			LEVER,SWITCH:6 POSN,W/CONT	80009	214-2292-03
S2170	214-2294-01			LEVER,SWITCH:4 POSN,W/CONT	80009	214-2294-01
S2170	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
S2600	260-1211-00			SWITCH,PUSH:1A,28VDC	80009	260-1211-00
S2650	260-1544-01			SWITCH,PUSH:3 BUTTON	82104	OBD
S2700	260-1771-00			SWITCH,PUSH:1 BUTTON,DPDT	80009	260-1771-00
S2750	260-1720-00			SWITCH,PUSH:3 BUTTON	71590	OBD
S2920	260-1453-00			SWITCH,PUSH:1 BUTTON	80009	260-1453-00
S3100	263-1110-00			ACTR ASSY,RTRY:TIMING SWITCH	80009	263-1110-00
S3100	----- -----			(S3100, FURNISHED AS A UNIT WITH S3200)		
S3128A,B	----- -----			(S3128A,B, FURNISHED AS A UNIT WITH R3128)		
S3200	----- -----			(S3200, FURNISHED AS A UNIT WITH S3100)		
S4100A	105-0682-00			ACTUATOR,CAM SW:LOGIC,W/LEVER	80009	105-0682-00
S4100B	105-0681-00			ACTUATOR,CAM SW:LOGIC	80009	105-0681-00
S4100B	----- -----			(S4100B, FURNISHED AS A UNIT WITH S4162)		
S4143	----- -----			(FURNISHED AS A UNIT WITH R4143)		
S4162	----- -----			(FURNISHED AS A UNIT WITH S4100B)		
S4200A	105-0682-00			ACTUATOR,CAM SW:LOGIC,W/LEVER	80009	105-0682-00
S4200B	105-0681-00			ACTUATOR,CAM SW:LOGIC	80009	105-0681-00
S4200B	----- -----			(S4200B, FURNISHED AS A UNIT WITH S4262)		
S4240	260-1445-01			SWITCH,PUSH:1 STA,2 POLE,W/O MTG EARS	80009	260-1445-01
S4243	----- -----			(FURNISHED AS A UNIT WITH R4243)		
S4262	----- -----			(FURNISHED AS A UNIT WITH S4200B)		
S4330	260-1424-01			SWITCH,PUSH:5 STA,2 POLE INTERLOCK	80009	260-1424-01
S4380	260-1767-00			SWITCH,PUSH:1 BUTTON	71590	OBD
T550	120-0984-00			XFMR,PWR,SDN&SU:HIGH VOLTAGE	80009	120-0984-00
T600	120-0639-00			XFMR,TOROID:8 TURN,BIFILAR	80009	120-0639-00
T661	----- -----			(SEE OPT 7 FOR ALTERNATE PART NUMBER & VALUE)		
T700	120-0982-00	B010100	B056849	XFMR,PWR,STPDN:	80009	120-0982-00
T700	120-1188-00	B056850		XFMR,PWR,STPDN:	80009	120-1188-00
T700	----- -----			(SEE OPT 7 FOR ALTERNATE VERSION)		
T4335	120-0384-00			XFMR,TOROID:2 TURNS	80009	120-0384-00
U550	152-0635-00			VOLTAGE MULTR:SILICON,HV MULTIPLIER	80009	152-0635-00
U722A,B	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U762	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U2218	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
U2232	----- -----			(SEE OPTION SECTION 5 FOR PART NUMBER & VALUE)		
U2600	155-0121-00			MICROCIRCUIT,LI:A AND B TRIGGER	80009	155-0121-00
U2690	155-0123-00			MICROCIRCUIT,LI:A AND B SWP/PICKOFF	80009	155-0123-00
U2700	155-0121-00			MICROCIRCUIT,LI:A AND B TRIGGER	80009	155-0121-00
U2740A,B	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U2750	155-0122-00			MICROCIRCUIT,DI:A & B LOGIC	80009	155-0122-00
U2790	155-0123-00			MICROCIRCUIT,LI:A AND B SWP/PICKOFF	80009	155-0123-00
U2900	155-0124-00			MICROCIRCUIT,LI:HORIZONTAL PREAMPL	80009	155-0124-00
U4160	155-0120-00	B010100	B044919	MICROCIRCUIT,LI:VERTICAL PREAMPL	80009	155-0120-00
U4160	155-0155-00	B044920		MICROCIRCUIT,LI:VERTICAL PREAMPLIFIER	80009	155-0155-00
V560	154-0731-00			ELECTRON TUBE:W/ANODE LEAD	80009	154-0731-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
V560	154-0731-04			ELECTRON TUBE:CRT,P11,INT SCALE	80009	154-0731-04
	----- -----			(OPTION 78 ONLY)		
VR288	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	1N965B
VR353	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR524	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	1N965B
VR533	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	SZ12461KRL
VR552	152-0289-00	B010100	B033529	SEMICOND DEVICE:ZENER,0.4W,180V,5%	04713	SZ12484KRL
VR552	152-0428-00	B033530		SEMICOND DEVICE:ZENER,0.4W,120V,5%	80009	152-0428-00
VR553	152-0357-00	XB033530		SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	SZ12461KRL
VR566	152-0247-00			SEMICOND DEVICE:ZENER,0.4W,150V,5%	80009	152-0247-00
VR612	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
VR613	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
VR632	----- -----			(SEE OPTION SECTION 7 FOR PART NUMBER & VALUE)		
VR722	152-0411-00			SEMICOND DEVICE:ZENER,0.25W,9V,5%	04713	SZ12483K
VR725	152-0265-00			SEMICOND DEVICE:ZENER,0.4W,24V,5%	04713	SZG35009K8
VR736	152-0229-00			SEMICOND DEVICE:ZENER,1W,39V,5%	04713	1N3034B
VR738	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	1N965B
VR749	152-0309-00			SEMICOND DEVICE:ZENER,1W,6.2V,5%	04713	SZ14310
VR769	152-0309-00			SEMICOND DEVICE:ZENER,1W,6.2V,5%	04713	SZ14310
VR782	152-0647-00			SEMICOND DEVICE:ZENER,0.4W,6.8V,5%	80009	152-0647-00
VR3128	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
W2173	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
W2178	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
W2179	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
W2700	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

Resistors = Ohms (Ω).

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

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

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

Abbreviations are based on ANSI Y1.1-1972.

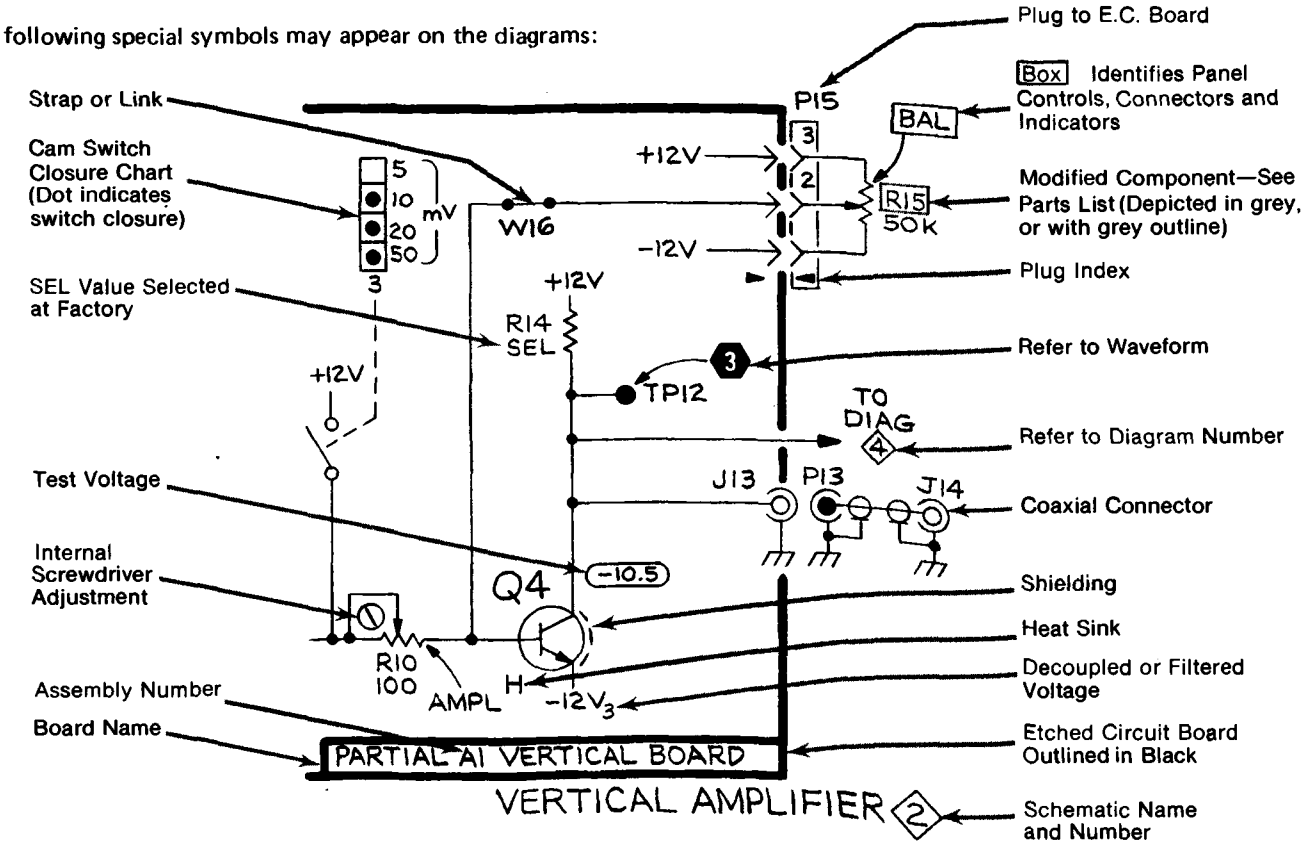
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

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

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

The following special symbols may appear on the diagrams:



REV. B NOV 1977

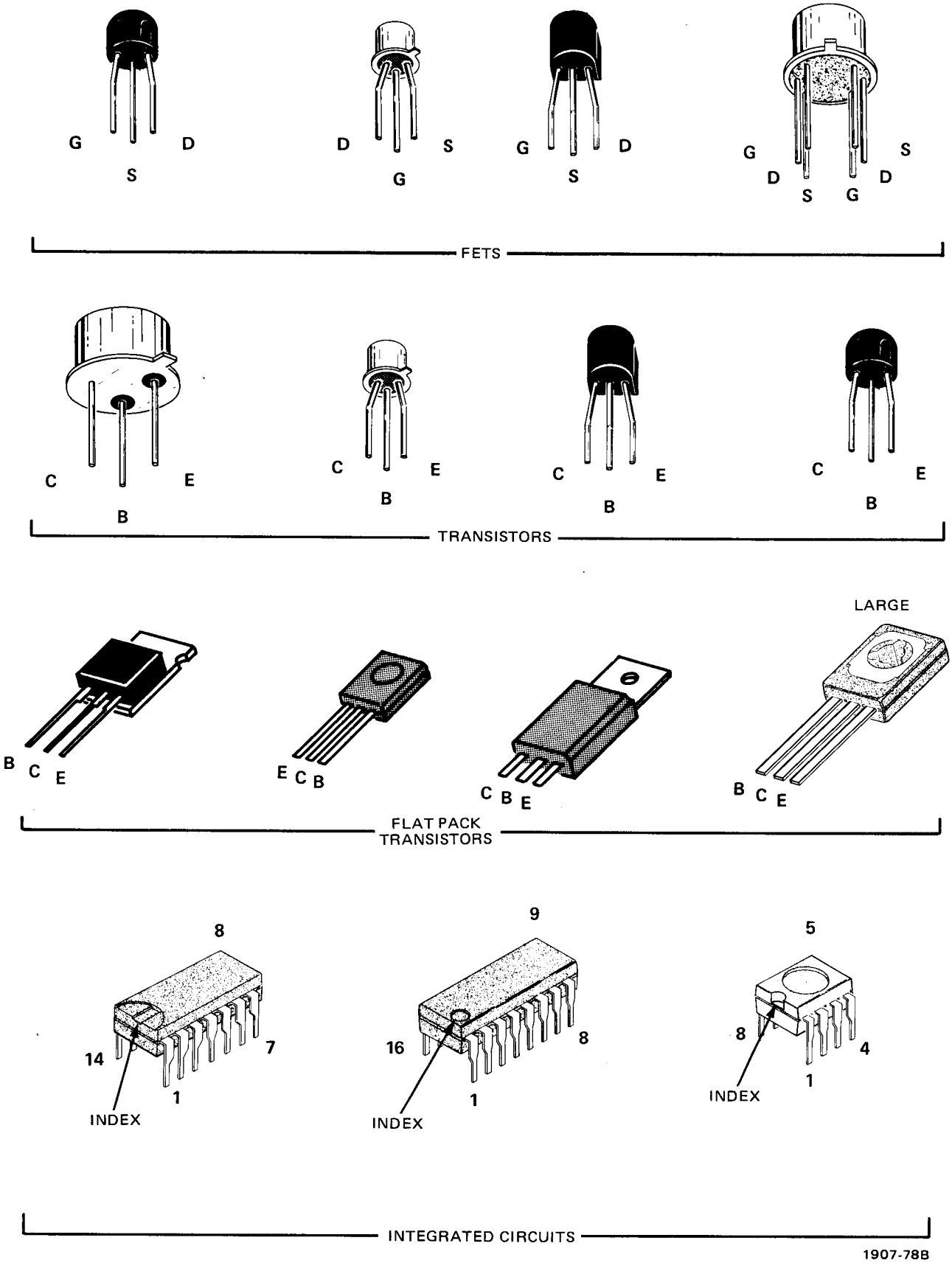
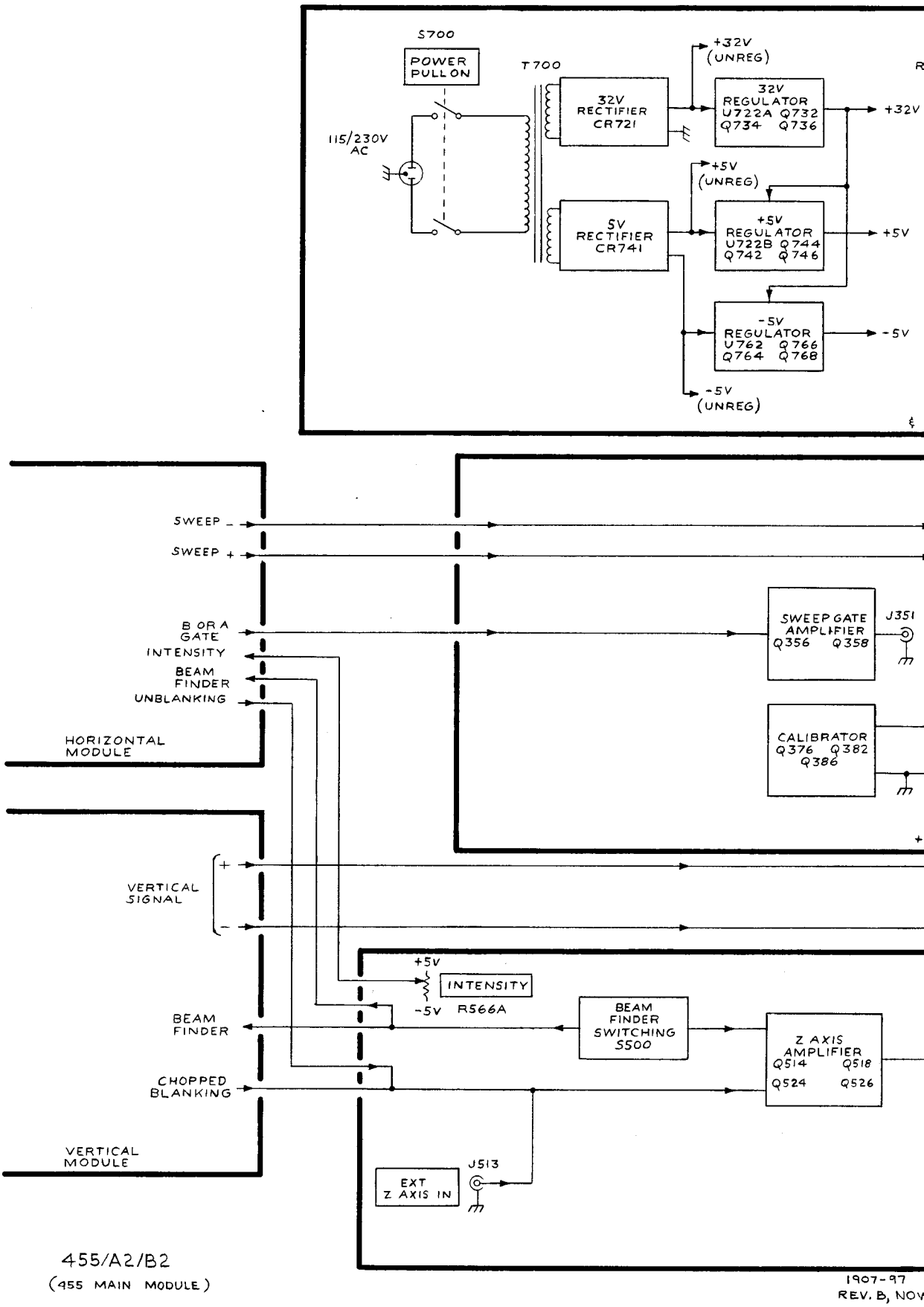
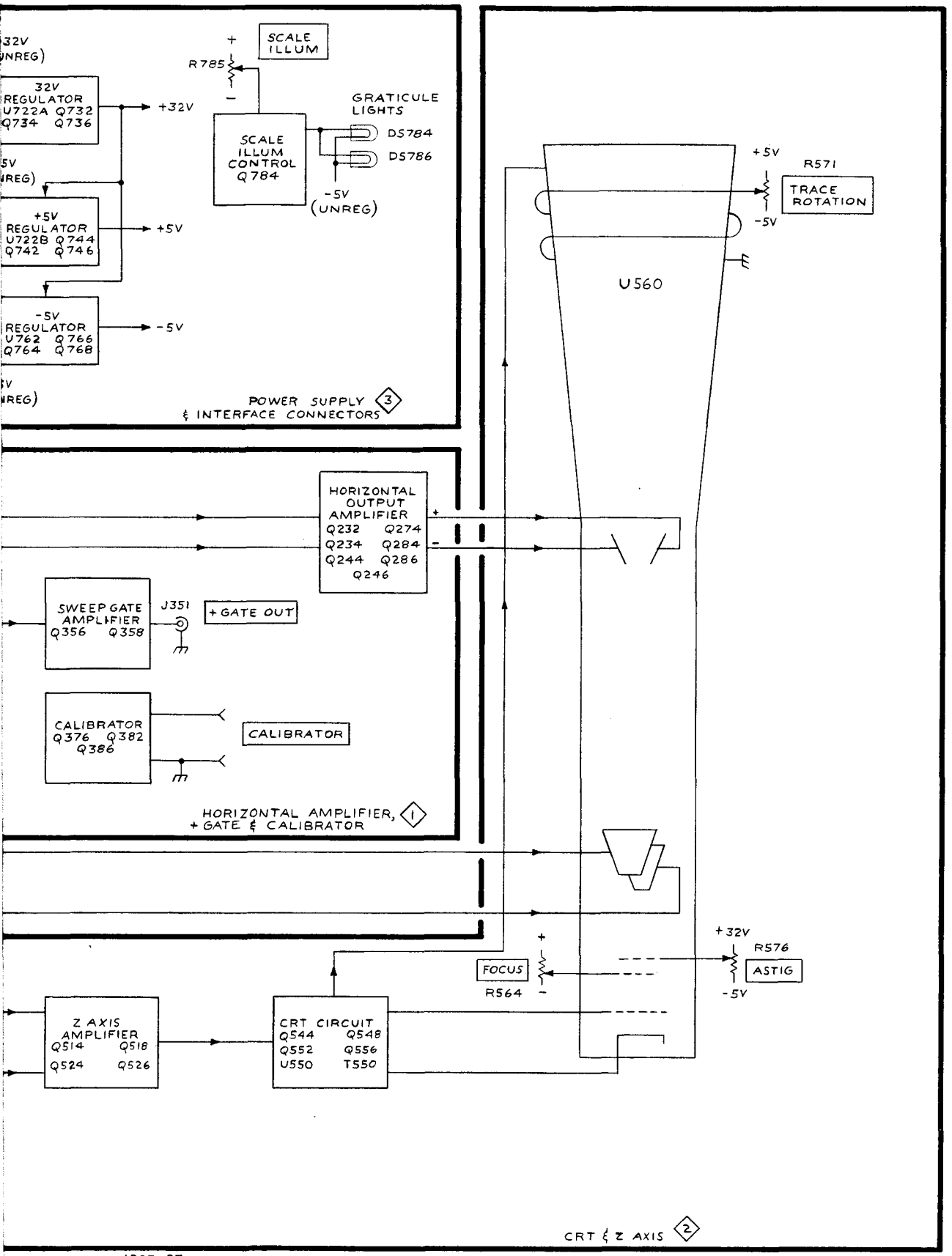


Fig. 9-1. Semiconductor lead identification.



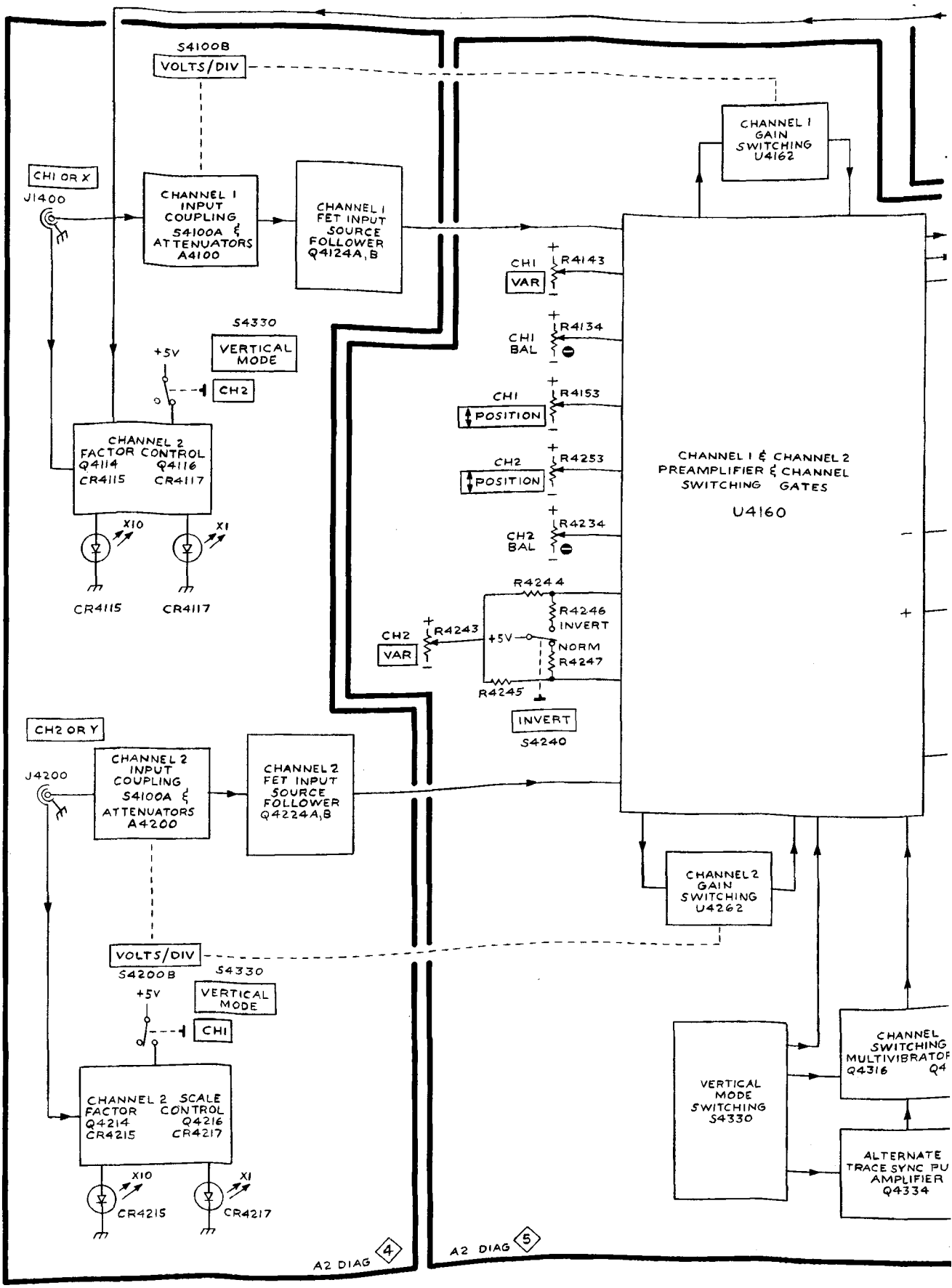
455/A2/B2

(455 MAIN MODULE)



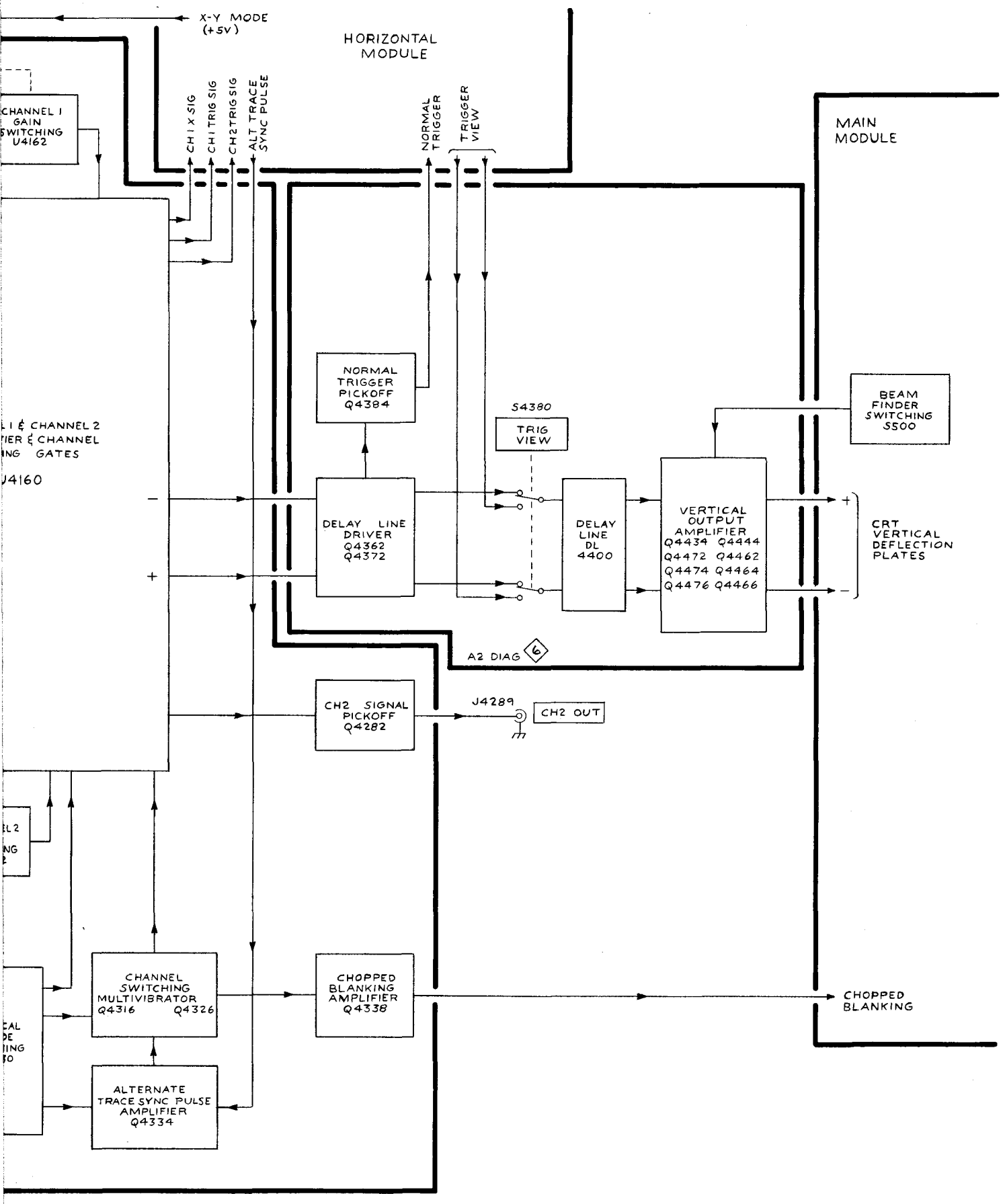
1907-97
REV. B, NOV. 1977

455 MAIN MODULE BLOCK DIAGRAM



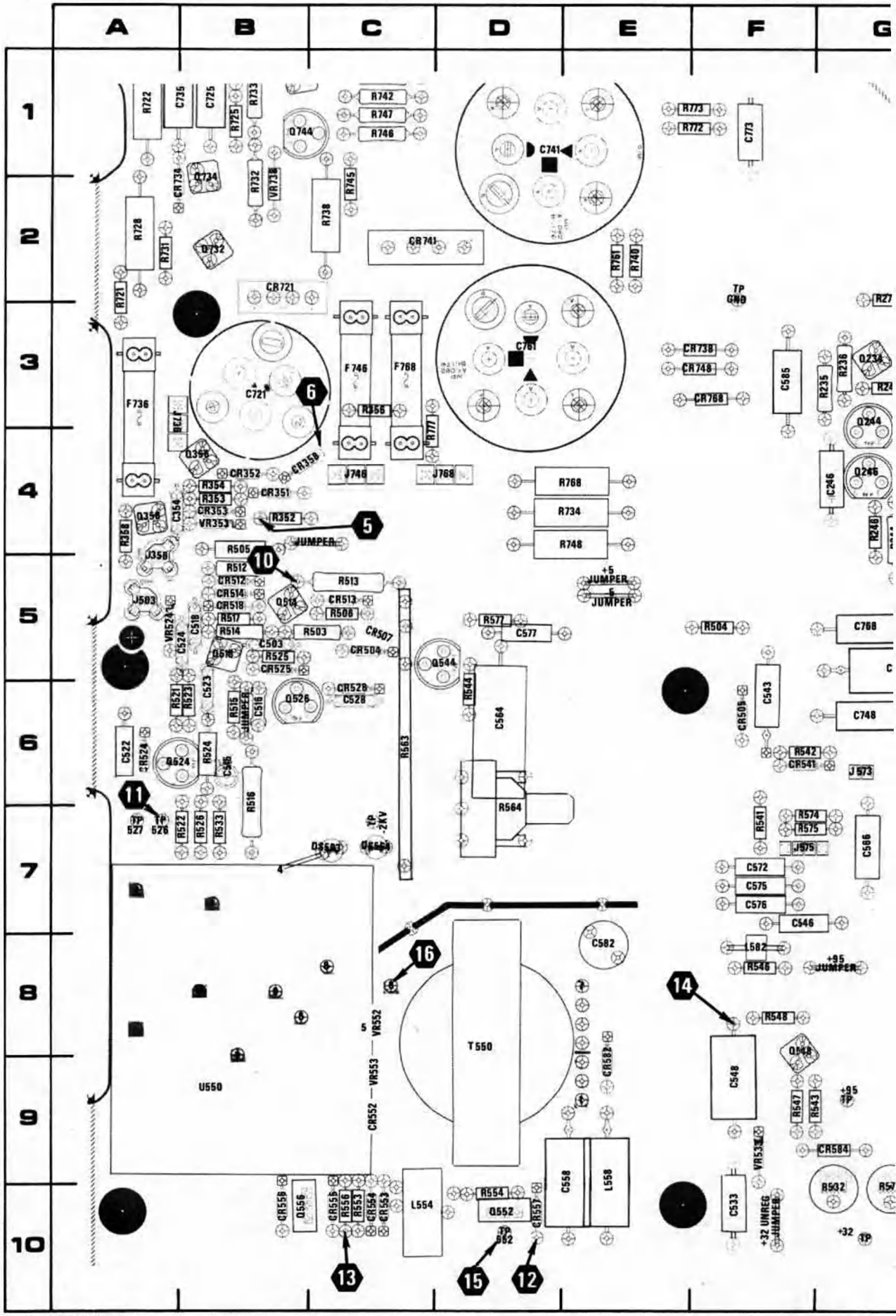
455/A2/B2

(A2 VERTICAL MODULE)



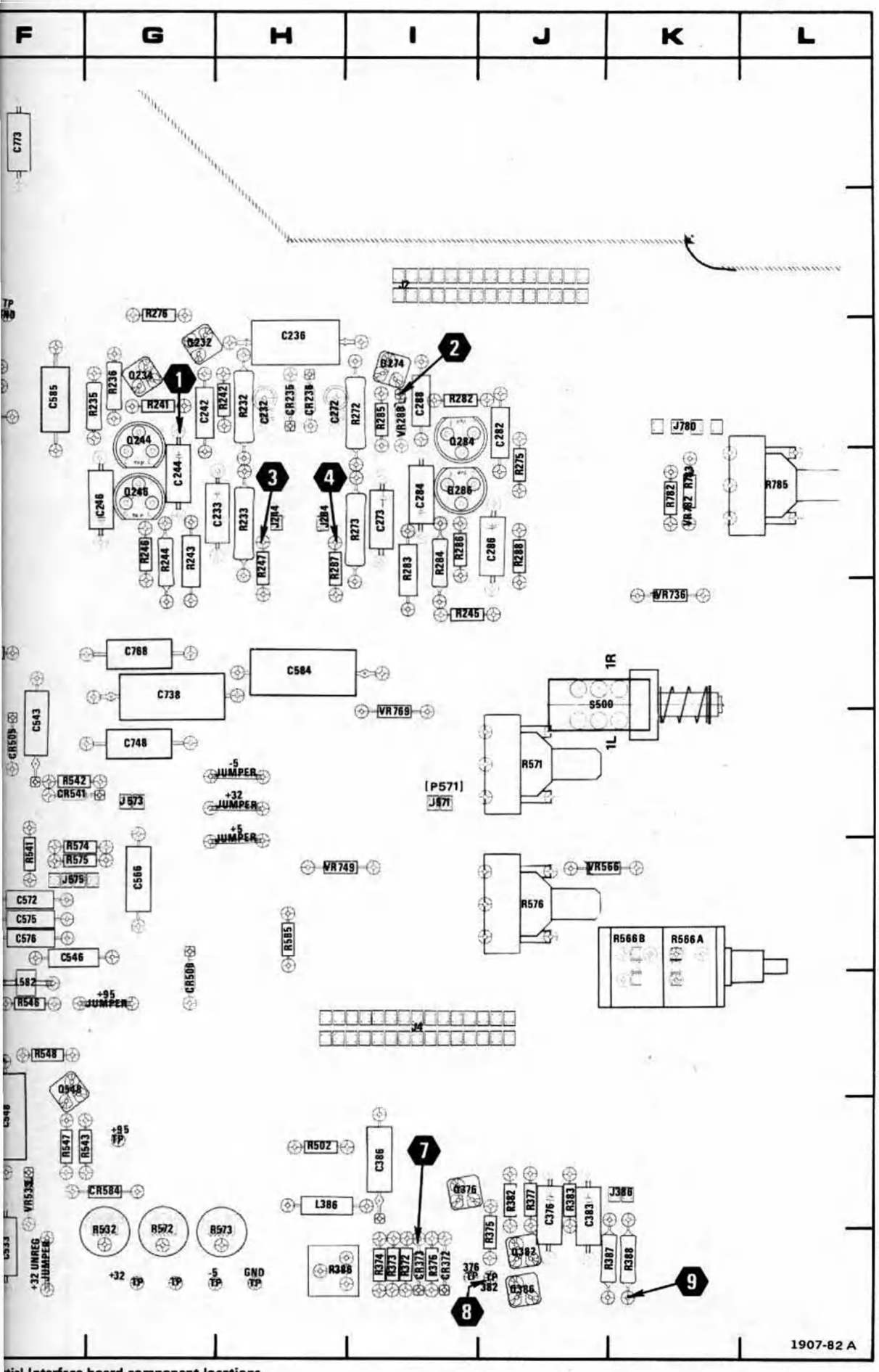
1907-98
REV. B, NOV. 1977

A2 VERTICAL MODULE BLOCK DIAGRAM



REV. B NOV 1977

Fig. 9-2. A1—Partial Interface board compo



*See Parts List for serial number ranges.

tial Interface board component locations.

CKT NO	GRID LOC
C232	3H
C233	4G
C236	3H
C242	3G
C244	4G
C246	4G
C272	3H
C273	4I
C282	3J
C284	4I
C286	4J
C288	3I
C354	4A
C376	9J
C383	9J
C386	9I
C503	5B
C515	6B
C516	6B
C518	5B
C522	6A
C523	6B
C524	5A
C528	6C
C543	6F
C546	7F
C548	9F
C553	10F
C558	9D
C564	6D
C566	7G
C572	7F
C575	7F
C576	7F
C577	5D

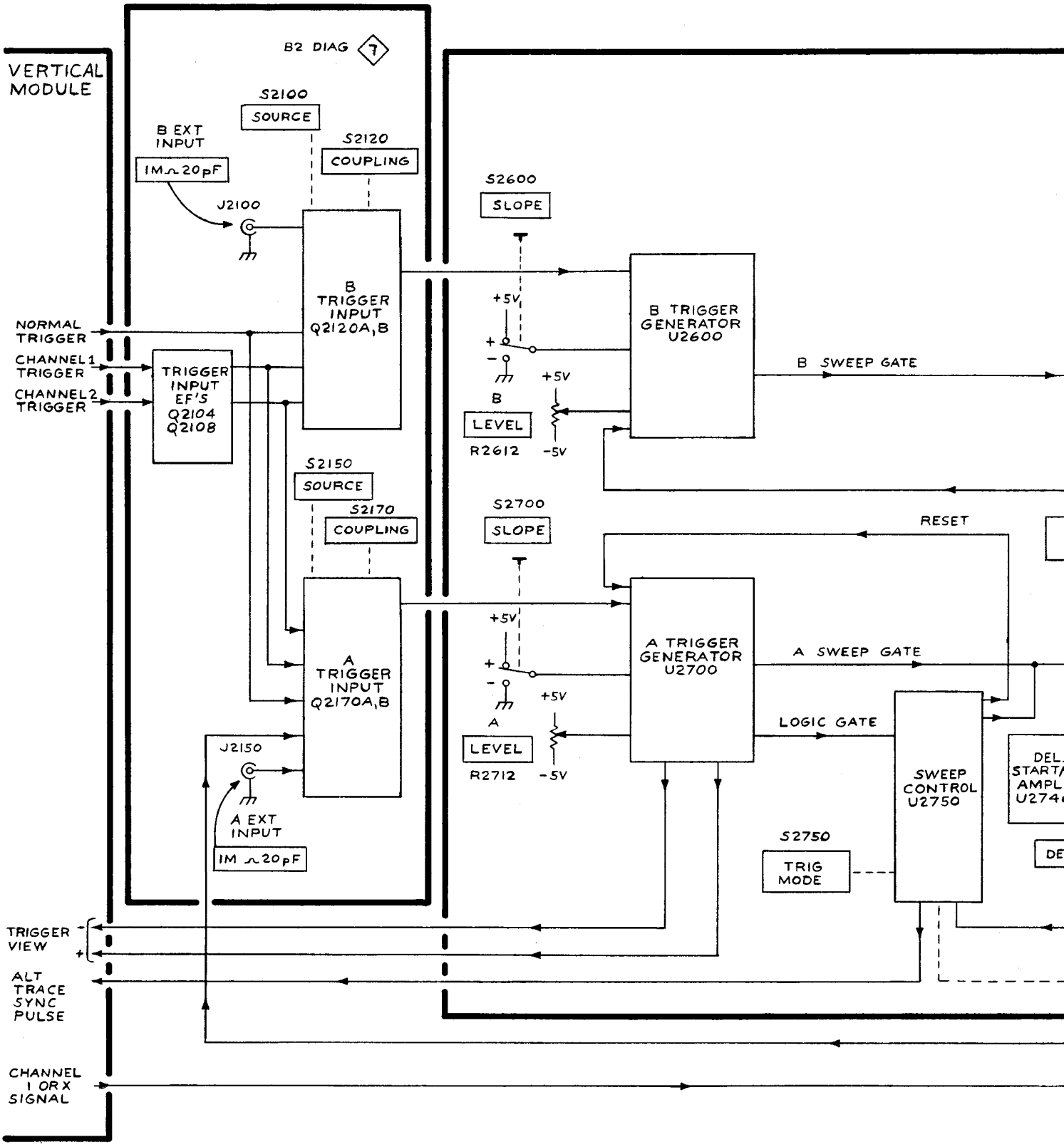
CKT NO	GRID LOC
C582	8E
C584	5H
C585	3F
CR235	3H
CR236	3H
CR351	4B
CR352	4B
CR353	4B
CR358	4C
CR372	10I
CR373	10I
CR504	5C
CR505	6F
CR506	8G
CR507*	5C
CR512	5B
CR513	5C
CR514	5B
CR518	5B
CR524	6A
CR525	5B
CR528	6C
CR541	6F
CR552	9C
CR553	10C
CR554	10C
CR555	10C
CR556	10B
CR557	10D
CR582	9E
CR584	9G
DS563	7C
DS564	7C

CKT NO	GRID LOC
J2	2I
J4	8I
J244	4H
J284	4H
J358	5A
J386	9K
J503	5A
J571	6I
J573	6G
J574	6I
J575	7F
L386	9H
L554	10C
L558	9E
L582	8F
P571	6I
Q232	3G
Q234	3G
Q244	3G
Q246	4G
Q274	3I
Q284	3I
Q286	4I
Q356	4B
Q358	4A
Q376	9I
Q382	10J
Q386	10J
Q514	5B
Q518	5B
Q524	6A
Q526	6B
Q544	5D

CKT NO	GRID LOC
Q548	8F
Q552	10D
Q556	10B
R232	3H
R233	4H
R235	3G
R236	3G
R241	3G
R242	3H
R243	4G
R244	4G
R245	5I
R246	4G
R247	4H
R272	3I
R273	4I
R275	4J
R276	2G
R282	3I
R283	4I
R284	4I
R285	3I
R286	4I
R287	4H
R288	4J
R352	4B
R353	4B
R354	4B
R356	3C
R358	4A
R372	10I
R373	10I
R374	10I
R375	10J

CKT NO	GRID LOC
R376	9J
R377	9J
R382	10I
R383	9J
R386	10H
R387	10K
R388	10K
R502	9H
R503	5C
R504	5F
R505	5B
R506	5C
R512	5B
R513	5C
R514	5B
R515	6B
R516	6B
R517	5B
R521	6A
R522	7A
R523	6B
R524	6B
R525	5B
R526	7B
R532	10G
R533	7B
R541	7F
R542	6F
R543	9F
R544	6D
R546	8F
R547	9F
R548	8F
R553	10C
R554	10D

CKT NO	GRID LOC
R556	10C
R563	6C
R564	7D
R566A	7K
R566B	7K
R571	6J
R572	10G
R573	10G
R574	7F
R575	7F
R576	7J
R577	5D
R585	7H
S500	5J
T550	8D
TP376	10I
TP382	10J
TP526	7A
TP527	7A
TP552	10D
U550	9B
VR288	3I
VR353	4B
VR524	5A
VR533*	9F
VR552	8C
VR553	9C
VR566	7J



455/A2/B2
(B2 HORIZONTAL MODULE)

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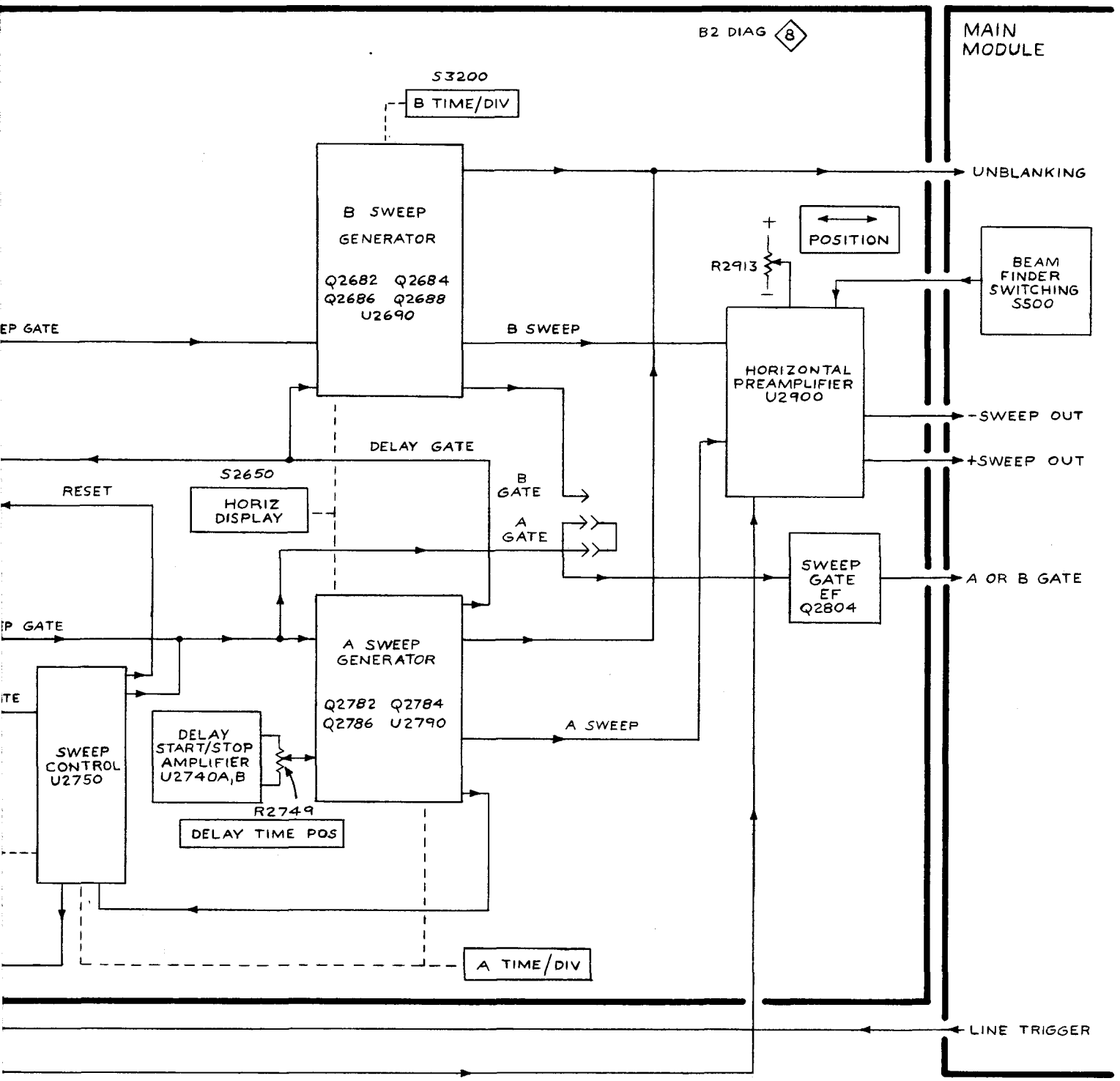


V. 1977

B2 HORIZONTAL MODULE BLOCK DIAGRAM

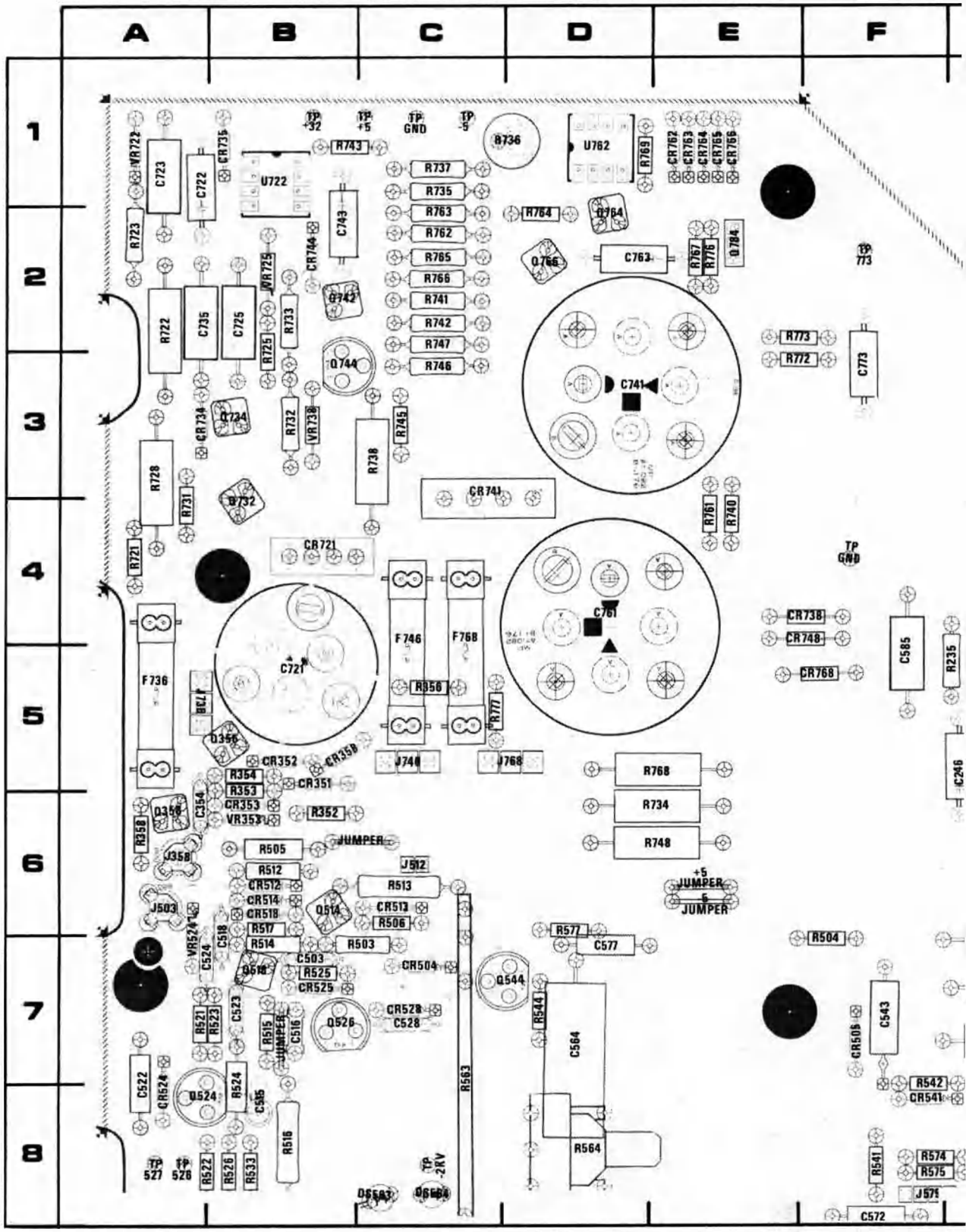
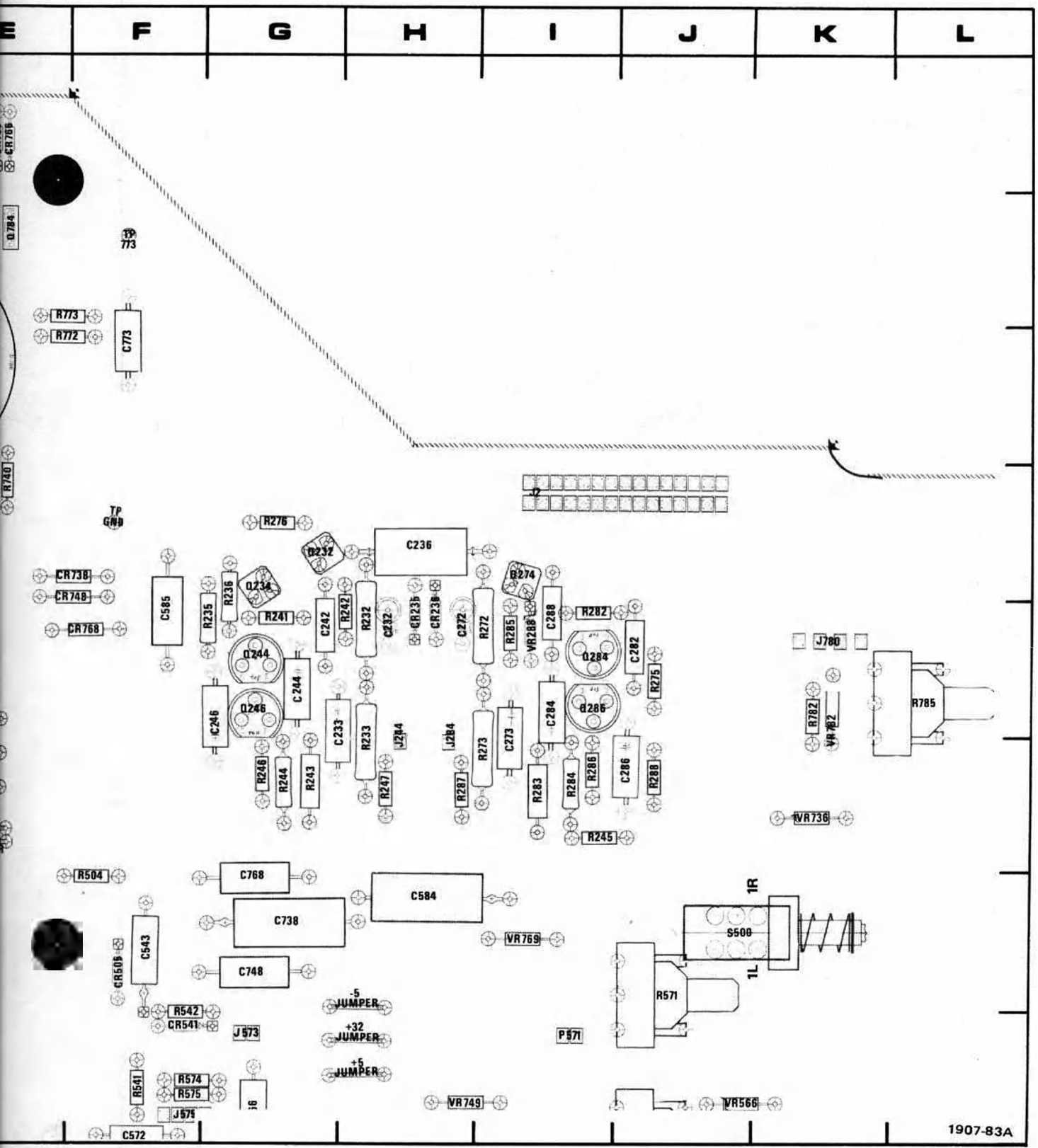


Fig. 9-3. A1—Partial Interface board component locations.


E
F
G
H
I
J
K
L
TP 773
R773
R772
C773
TP GND
R276
C236
Q232
Q234
CR738
CR748
CR768
C585
R235
R236
R241
Q244
Q246
C244
C246
C242
R242
R232
C232
CR235
CR238
C272
R272
R285
VR288
C288
R282
Q274
Q284
Q286
C282
R275
C284
C273
R273
C233
R233
J284
R246
R244
R243
R247
R287
R283
R284
R286
C286
R288
R245
J780
R782
VR782
R785
VR736
R504
C768
C738
C748
C584
VR769
C543
CR505
R542
CR541
J573
-5 JUMPER
+32 JUMPER
+5 JUMPER
P571
R571
S500
1R
1L
R541
R574
R575
J575
C572
VR749
VR566
1907-83A

ns.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C721	5B	CR721	4B	F736	5A	Q744	3B	R734	6E	R764	2D	R782	5K
C722	1A	CR734	3A	F746	4C	Q764	2D	R735	1C	R765	2C	R785	5L
C723	1A	CR735	1B	F768	4C	Q766	2D	R736	1D	R766	2C	TP773	3F
C725	2B	CR738	4F	J2	4I	Q784	2E	R737	1C	R761	4E	U722	1B
C735	2A	CR741	3C	J4	*			R738	3C	R762	2C	U762	1D
C738	7G	CR744	2B	J736	5A	R721	4A	R740	4E	R763	2C		
C741	3D	CR748	4F	J746	5C	R722	2A	R741	2C	R767	2E	VR722	1A
C743	2B	CR762	1E	J768	5D	R723	2A	R742	2C	R768	5E	VR725	2B
C748	7G	CR763	1E	J780	5K	R725	2B	R743	1B	R769	1D	VR736	6K
C761	4D	CR764	1E			R728	3A	R745	3C	R772	3E	VR738	3B
C763	2D	CR765	1E	Q732	3B	R731	4A	R746	3C	R773	2E	VR749	8H
C768	6G	CR766	1E	Q734	3B	R732	3B	R747	2C	R776	2E	VR769	7I
C773	3F	CR768	5F	Q742	2B	R733	2B	R748	6E	R777	5C	VR782	5K

*See Fig. 9-2 for location.

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

No signals were applied to the Vertical or Horizontal modules. The 455 INTENSITY control was set to midrange with the Horizontal module in the X-Y mode. The Horizontal POSITION control was set so that the horizontal deflection plates were at the same voltage level. The upper voltages shown on the + Gate circuit were measured with pin 13 of the (A) sweep IC (in horizontal module) grounded. Calibrator circuit voltages were measured with Q382 removed.

WAVEFORM CONDITIONS

Waveforms below were taken from a Tektronix 7000-series oscilloscope equipped with readout, 7B series Time-Base, 7A13 Diffential Comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

The 455 INTENSITY control was set to midrange. The Horizontal Module (A) sweep was free-running.

Waveforms 7, 8 and 9 were taken using calibrator signal to externally trigger the test oscilloscope.

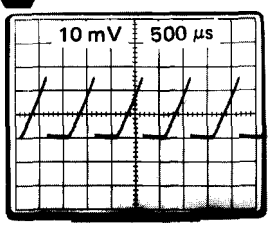
Remove rear panel assembly to reach points 5 and 6. See Maintenance section for removal instructions.

-SWEEP FROM P2200-10 DIAG 8

+SWEEP FROM P2200-9 DIAG 8

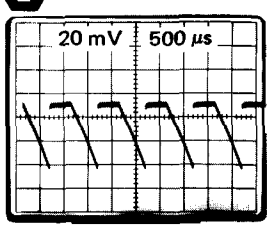
A OR B G FROM CR2804 DIAG 8

1



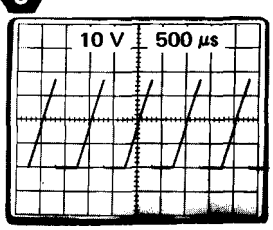
−0.5 V

2



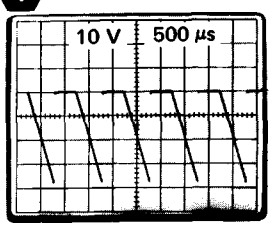
14.2 V

3



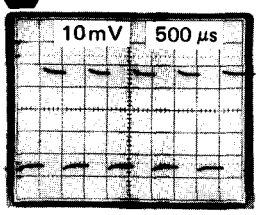
51.0 V

4



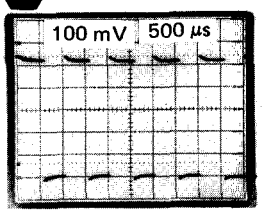
55.0 V

5



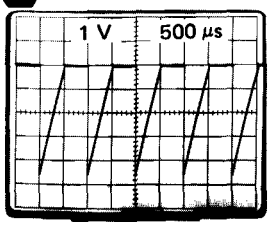
.45V

6



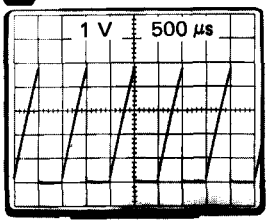
.3 V

7



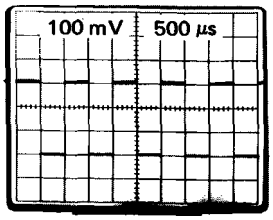
11.6 V

8



10.8 V

9



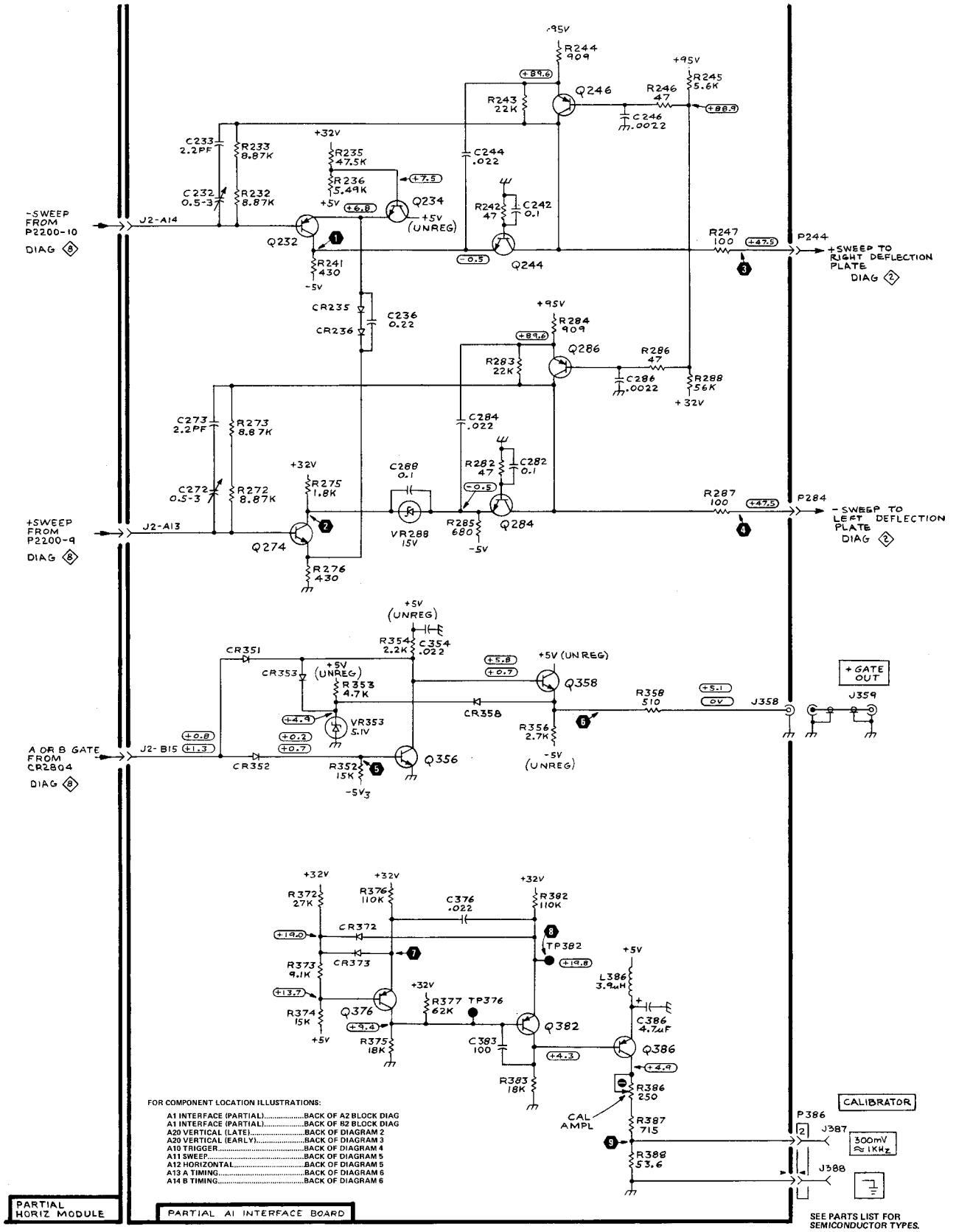
.2 V

1907-100

PARTIAL HORIZ MOD

455/A

(455 MA



455/A2/B2

(455 MAIN MODULE)

1907-101
REV. B, NOV. 1977

HORIZONTAL AMPLIFIER, + GATE & CALIBRATOR ◇1

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

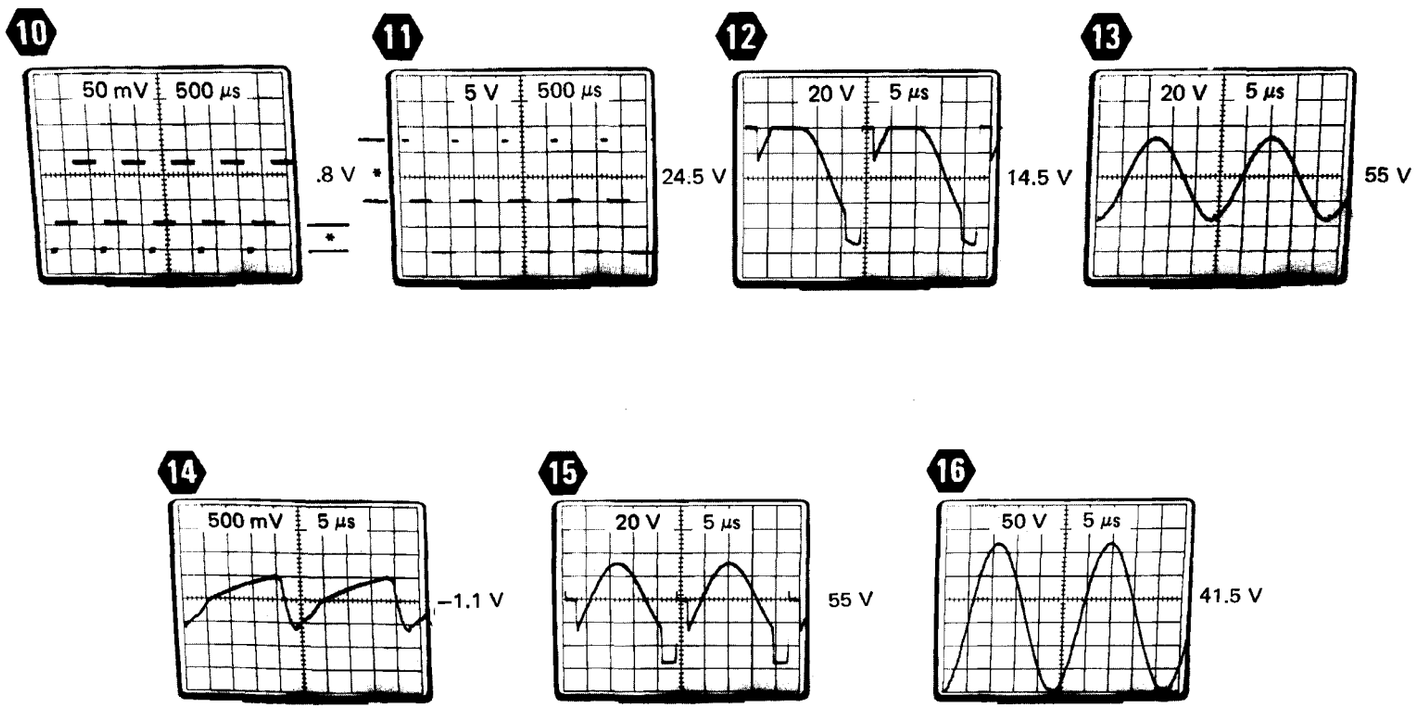
No signals were applied to the Vertical or Horizontal modules. The 455 INTENSITY control was set to midrange.

WAVEFORM CONDITIONS

Waveforms below were taken from a Tektronix 7000-Series oscilloscope equipped with readout, 7B series Time-Base, 7A13 Differential Comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

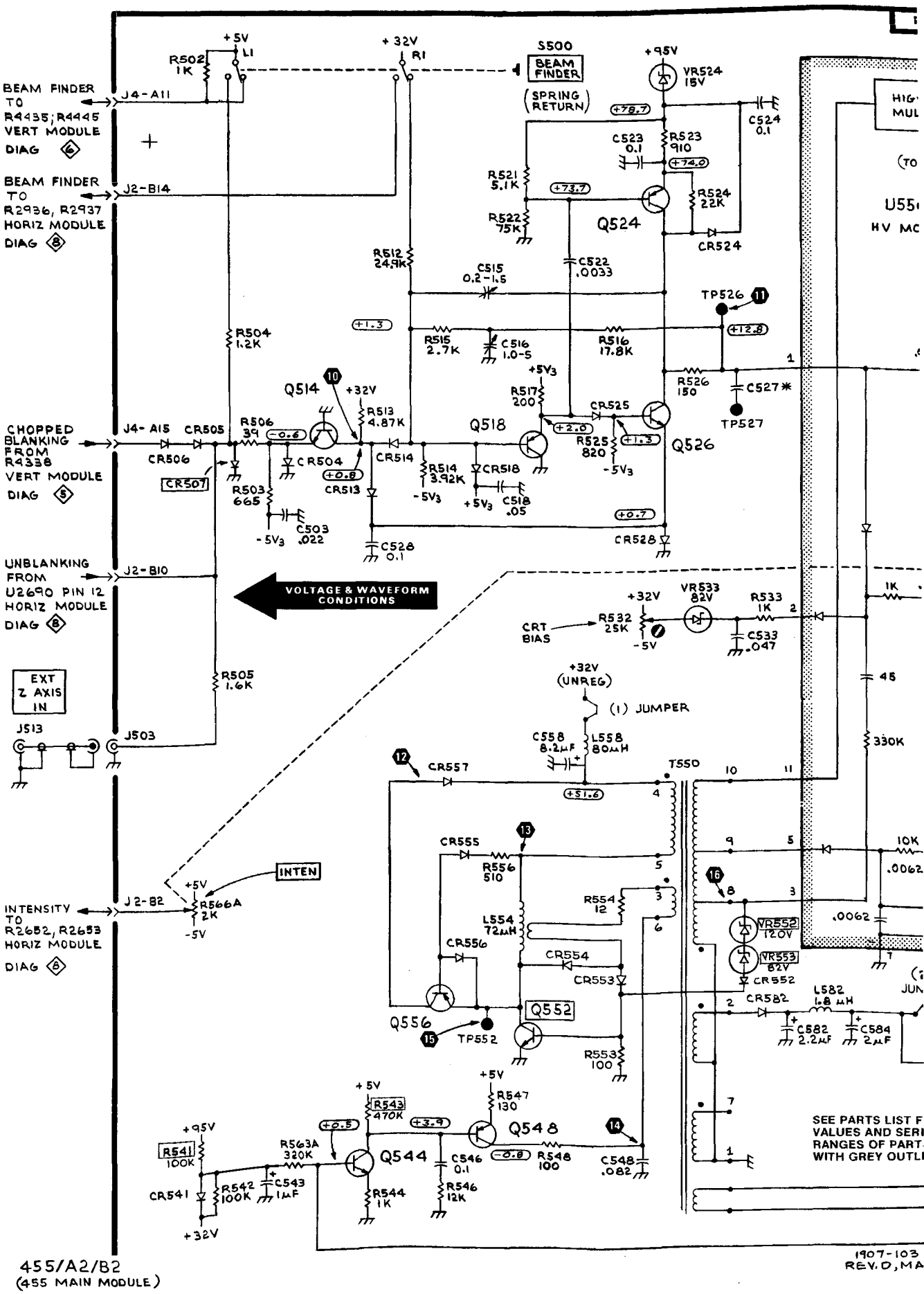
The 455 INTENSITY control was set to midrange. The Horizontal Module (A) sweep was free-running. A INTEN mode was used with delaying sweep module (B2). See note on waveforms.

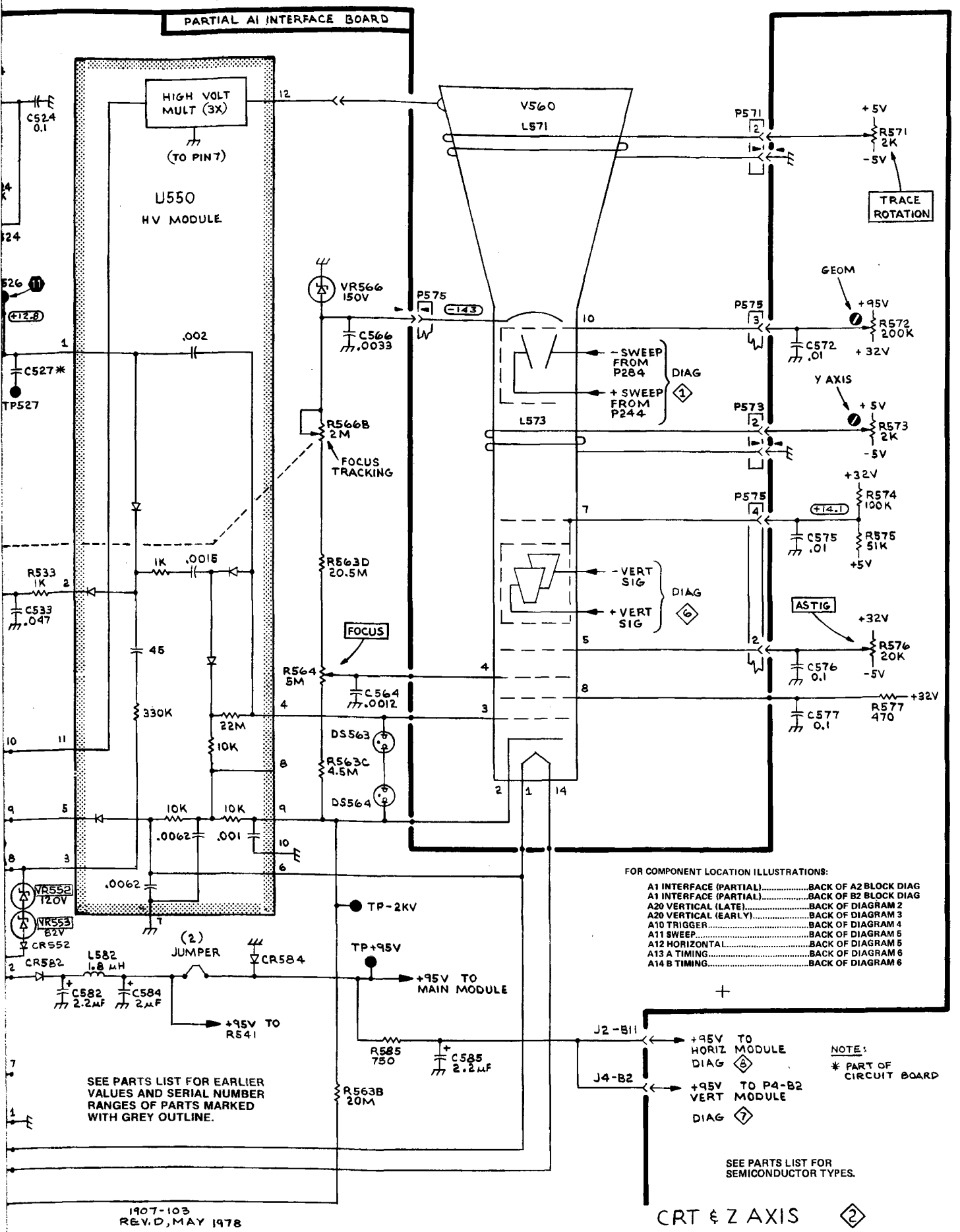
Waveforms 3, 4, 5, 6 and 7 were taken using waveform at TP522 to externally trigger the test oscilloscope.



* THIS PORTION PRESENT ONLY WITH HORIZONTAL MODULE IN A INTEN MODE.

1907-102


BEAM FINDER TO R4435; R4445 VERT MODULE DIAG 4
BEAM FINDER TO R2936, R2937 HORIZ MODULE DIAG 8
CHOPPED BLANKING FROM R4338 VERT MODULE DIAG 5
UNBLANKING FROM U2690 PIN 12 HORIZ MODULE DIAG 8
EXT Z AXIS IN
INTENSITY TO R2652, R2653 HORIZ MODULE DIAG 8
J4-A11
J2-B14
J4-A15
J2-B10
J513
J503
J2-B2
+5V
+32V
+95V
S500
BEAM FINDER
(SPRING RETURN)
L1
R1
R502 1K
VR524 15V
C524 0.1
C523 0.1
R523 910
R521 5.1K
R522 75K
R524 22K
Q524
CR524
R512 24.9K
C515 0.2-1.5
C522 .0033
TP526
R504 1.2K
R515 2.7K
C516 1.0-5
R516 17.8K
R526 150
C527*
TP527
Q514
R513 4.87K
R517 200
CR525
Q518
Q526
R525 820
R506 39
CR505
CR506
CR507
CR504
CR513
CR514
R514 3.92K
CR518
C518 .05
R503 665
C503 .022
C528 0.1
CR528
VOLTAGE & WAVEFORM CONDITIONS
VR533 82V
R533 1K
R532 25K
C533 .047
CRT BIAS
R505 1.6K
(UNREG)
(1) JUMPER
C558 8.2μF
L558 80μH
T550
CR557
CR555
R556 510
R554 12
L554 72μH
CR556
CR554
CR553
Q552
Q556
TP552
R553 100
INTEN
R566A 2K
VR552 12.0V
VR553 82V
CR552
CR582
L582 1.8 μH
C582 2.2μF
C584 2μF
R543 470K
R547 130
Q548
R548 100
C548 .082
R541 100K
R563A 320K
Q544
C546 0.1
R546 12K
R544 1K
CR541
R542 100K
C543 1μF
330K
10K
.0062
SEE PARTS LIST F
VALUES AND SERI
RANGES OF PART
WITH GREY OUTLI
455/A2/B2
(455 MAIN MODULE)
1907-103
REV.D, MA


PARTIAL AI INTERFACE BOARD
HIGH VOLT MULT (3X)
(TO PIN 7)
U550
HV MODULE
V560
L571
L573
P571
P573
P575
+5V
R571 2K
-5V
TRACE ROTATION
GEOM
+95V
R572 200K
C572 .01
+32V
Y AXIS
+5V
R573 2K
-5V
+32V
R574 100K
C575 .01
R575 51K
+5V
ASTIG
+32V
R576 20K
C576 0.1
-5V
+32V
R577 470
C577 0.1
VR566 150V
C566 .0033
C524 0.1
C527*
TP527
.002
R566B 2M
FOCUS TRACKING
R563D 20.5M
FOCUS
R564 5M
C564 .0012
R533 1K
C533 .047
1K
.0015
45
330K
22M
10K
DS563
R563C 4.5M
DS564
10K
10K
.0062
.001
.0062
VR552 120V
VR553 82V
CR552
CR582
L582 1.8 μH
C582 2.2μF
C584 2μF
(2) JUMPER
CR584
TP-2KV
TP+95V
+95V TO MAIN MODULE
+95V TO R541
R585 750
C585 2.2μF
R563B 20M
- SWEEP FROM P284
+ SWEEP FROM P244
DIAG 1
- VERT SIG
+ VERT SIG
DIAG 6
J2-B11
+95V TO HORIZ MODULE DIAG 8
J4-B2
+95V TO P4-B2 VERT MODULE DIAG 7
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH GREY OUTLINE.
FOR COMPONENT LOCATION ILLUSTRATIONS:
A1 INTERFACE (PARTIAL)....BACK OF A2 BLOCK DIAG
A1 INTERFACE (PARTIAL)....BACK OF B2 BLOCK DIAG
A20 VERTICAL (LATE)....BACK OF DIAGRAM 2
A20 VERTICAL (EARLY)....BACK OF DIAGRAM 3
A10 TRIGGER....BACK OF DIAGRAM 4
A11 SWEEP....BACK OF DIAGRAM 5
A12 HORIZONTAL....BACK OF DIAGRAM 5
A13 A TIMING....BACK OF DIAGRAM 6
A14 B TIMING....BACK OF DIAGRAM 6
NOTE:
* PART OF CIRCUIT BOARD
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
1907-103
REV. D, MAY 1978
CRT & Z AXIS 2

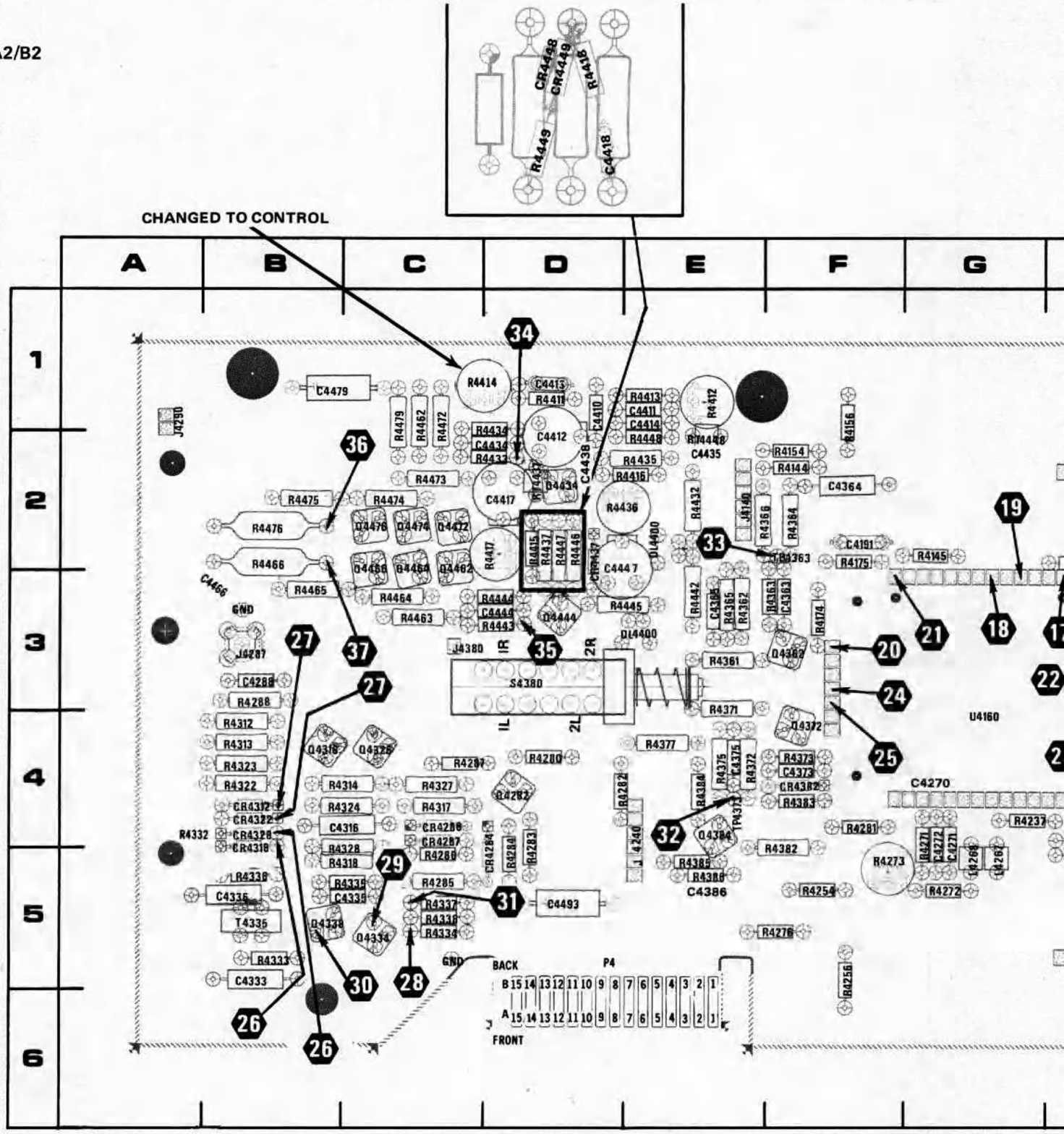
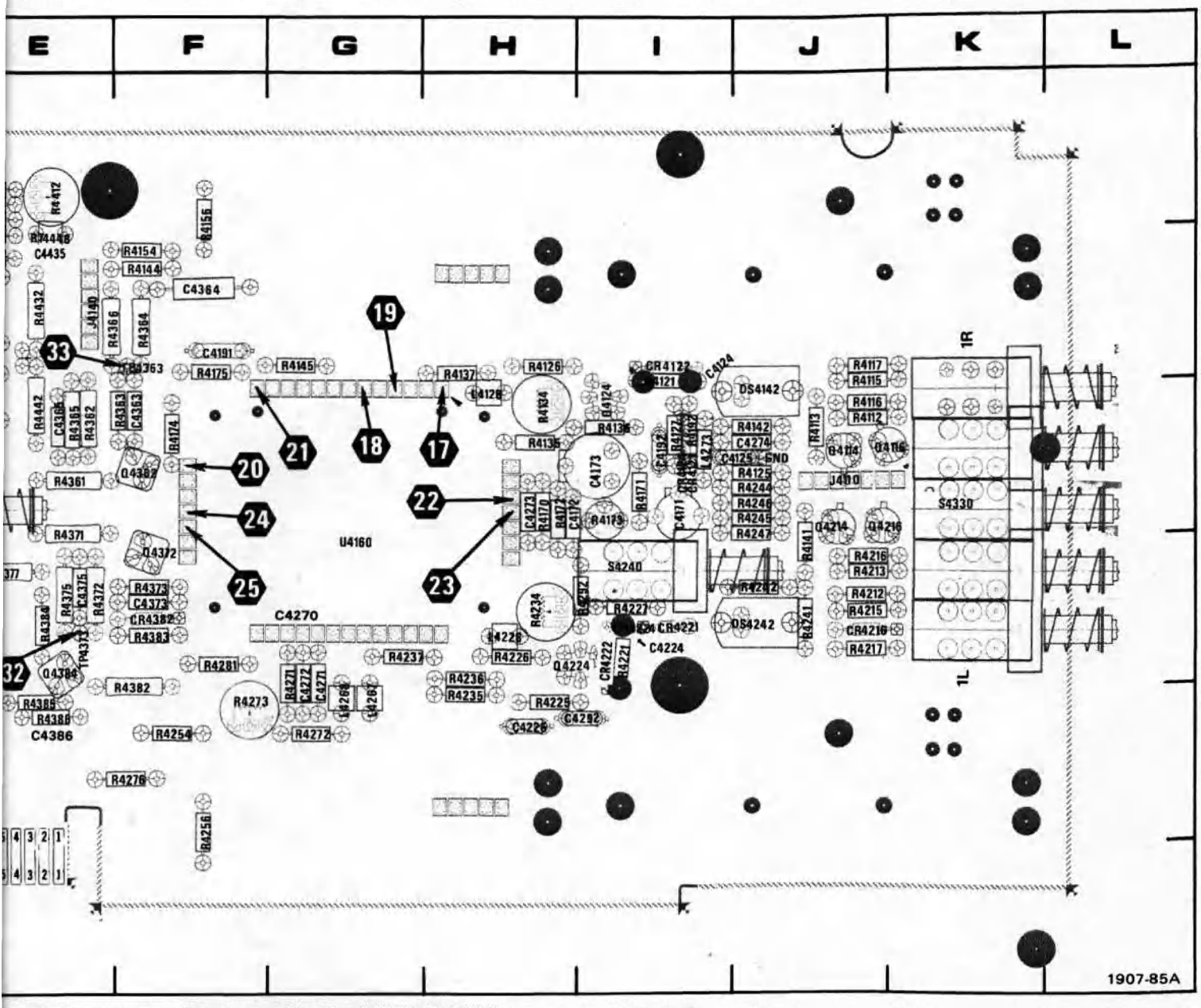


Fig. 9-4. A20—Vertical board component locations SN B0110



9-4. A20—Vertical board component locations SN B011030-UP.

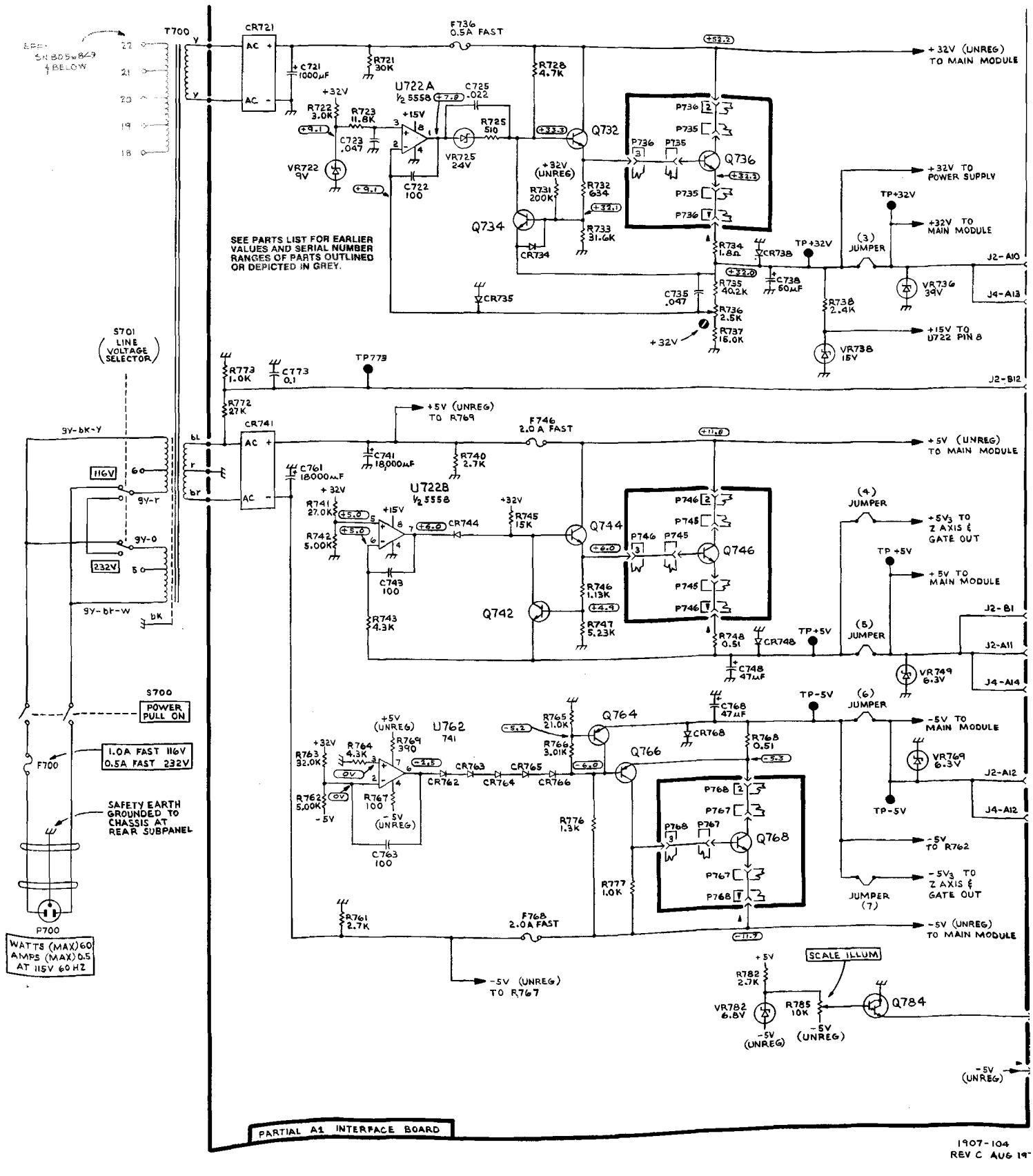
*See Parts List for serial number ranges.

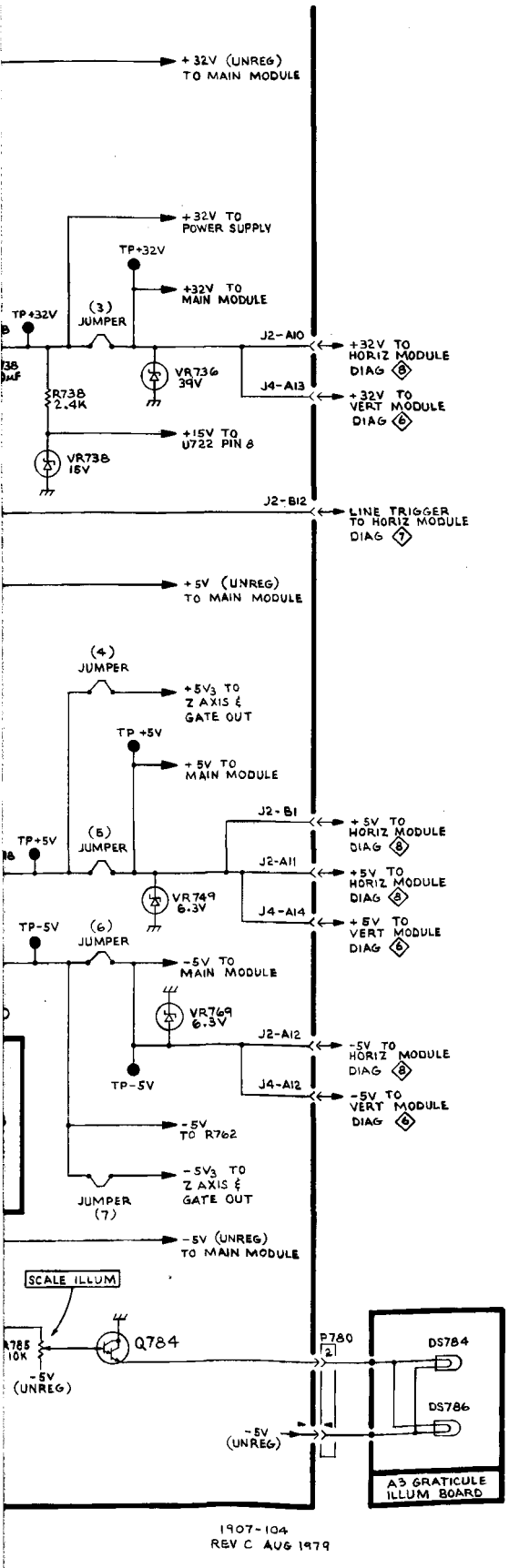
† On back of board

1 Shown on exploded view.

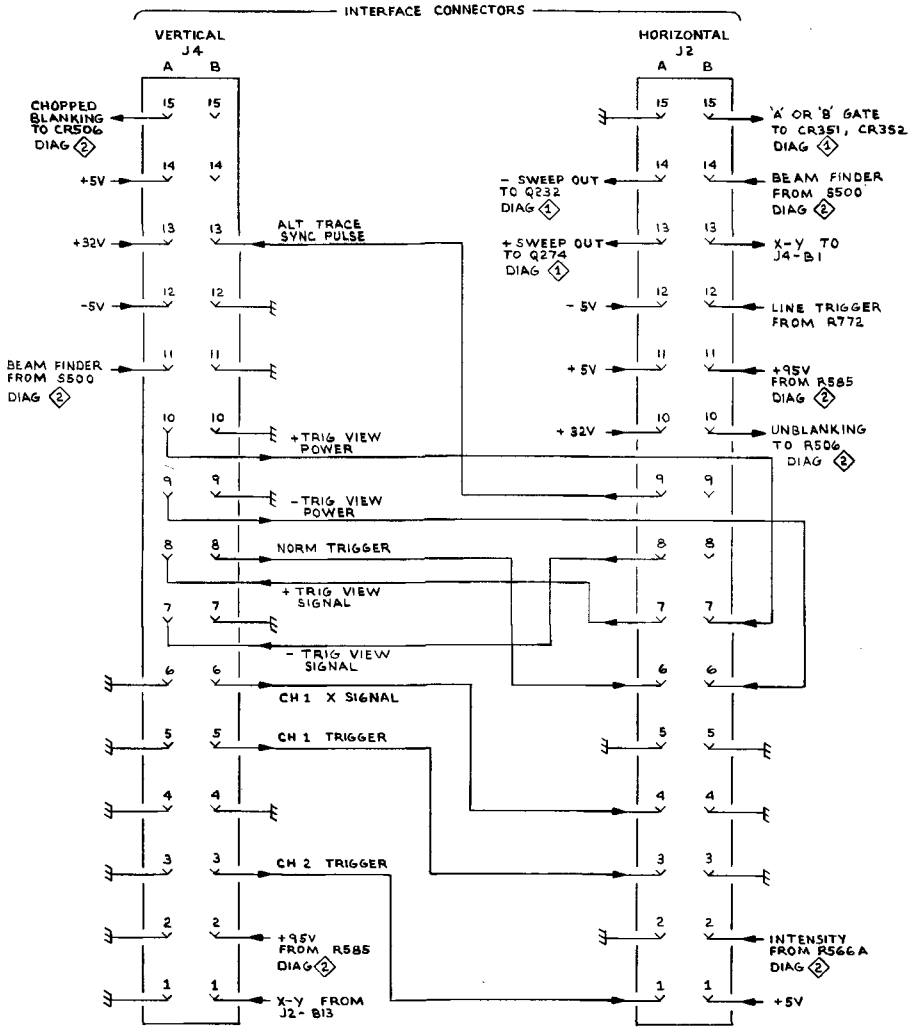
CKT NO	GRID LOC
C4123†	
C4124	1E
C4125	3J
C4162†	
C4171	3I
C4172	3H
C4173	3I
C4191	2F
C4192	3I
C4223†	
C4224	4I
C4225	5H
C4262†	
C4270*	4G
C4271	4G
C4272	4G
C4273	3H
C4274	3J
C4288	3B
C4292	5I
C4316	4C
C4333	5B
C4335	5C
C4336	5B
C4363	3F
C4364	2F
C4365	3E
C4373	4F
C4375	4E
C4386*	5E
C4410	1D
C4411	1E
C4412	2D
C4413	1D
C4414	1E
C4417[1]	2D
C4418[1]	2D
C4434	2D
C4435*	2E
C4438*	2D
C4444	3D
C4466*	3B
C4447	2D
C4479	1B
C4493	5D
CR4121	3I
CR4122	1E
CR4124	3I
CR4129†*	
CR4216	4J
CR4221	4I
CR4222	4I
CR4224	4I
CR4229†*	
CR4284	5D
CR4286	4C
CR4287	4C
CR4312	4B
CR4318	4B
CR4322	4B
CR4328	4B
CR4382	4F
CR4437	2D
CR4448[1]	2D
CR4449[1]	2D
DL4400	2E
DL4400	3E
DS4142	3J
DS4242	4J
J4110	3J
J4140	2E
J4240	4E
J4287	3B
J4290	1A
J4380	3C
L4128	3H
L4228	4H
L4267	5G
L4268	5G
L4273	3I
Q4114	3J
Q4116	3J
Q4124	3I
Q4160	4G
Q4214	3J
Q4216	3J
Q4224	4H
Q4282	4D
Q4316	4B
Q4326	4C
Q4334	5C
Q4338	5B
Q4362	3F
Q4372	4F
Q4384	4E
Q4434	2D
Q4444	3D
Q4462	2C
Q4464	2C
Q4466	2C
Q4472	2C
Q4474	2C
Q4476	2C
R4112	3J
R4113	3J
R4115	2J
R4116	3J
R4117	2J
R4121	1E
R4122†	
R4123†	
R4125	3J
R4126	2H
R4127	3I
R4129†*	
R4134	3H
R4135	3H
R4136	3I
R4137	2H
R4141	4J
R4142	3J
R4144	2F
R4145	2G
R4154	2F
R4156	1F
R4170	3H
R4171	3I
R4172	3H
R4173	3I
R4174	3F
R4175	2F
R4192	3I
R4212	4J
R4213	4J
R4215	4J
R4216	4J
R4217	4J
R4221	4I
R4222†	
R4223†	
R4225	5H
R4226	4H
R4227	4I
R4229†*	
R4234	4H
R4235	5H
R4236	4H
R4237	4G
R4238	5C
R4241	4J
R4242	4J
R4244	3J
R4245	3J
R4246	3J
R4247	3J
R4254	5F
R4256	5F
R4271	4G
R4272	5G
R4273	5F
R4276	5F
R4280	4D
R4281	4F
R4282	4E
R4283	5D
R4284	5D
R4285	5C
R4286	5C
R4287	4C
R4288	3B
R4292	4I
R4312	4B
R4313	4B
R4314	4C
R4317	4C
R4318	5C
R4322	4B
R4323	4B
R4324	4C
R4327	4C
R4328	5C
R4332*	4A
R4333	5B
R4334	5C
R4335	5C
R4336	5B
R4337	5C
R4361	3E
R4362	3E
R4363	3F
R4364	2F
R4365	3E
R4366	2F
R4371	3E
R4372	4E
R4373	4F
R4375	4E
R4377	4E
R4382	4F
R4383	4F
R4384	4E
R4385	5E
R4386	5E
R4400†	
R4411	1D
R4412	1E
R4413	1E
R4414*	1D
R4415	2D
R4416	2E
R4417	2D
R4418[1]	2D
R4432	2E
R4433	2D
R4434	1D
R4435	2E
R4436	2E
R4437	2D
R4442	3E
R4443	3D
R4444	3D
R4445	3E
R4446	2D
R4447	2D
R4448	2E
R4449[1]	2D
R4462	1C
R4463	3C
R4464	3C
R4465	3B
R4466	2B
R4472	1C
R4473	2C
R4474	2C
R4475	2B
R4476	2B
R4479	1C
RT4437	2D
RT4448	2E
S4240	4I
S4330	3K
S4380	3D
T4335	5B
TP4363	2F
TP4373	4E

iew.


T700
CR721
F736 0.5A FAST
+32V (UNREG) TO MAIN MODULE
U722A
Q732
Q734
Q736
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
+32V TO POWER SUPPLY
+32V TO MAIN MODULE
TP+32V
(3) JUMPER
J2-A10
J4-A13
VR736 39V
+15V TO U722 PIN 8
VR738 15V
S701 LINE VOLTAGE SELECTOR
TP773
J2-B12
CR741
F746 2.0A FAST
+5V (UNREG) TO R769
+5V (UNREG) TO MAIN MODULE
U722B
Q742
Q744
Q746
(4) JUMPER
+5V3 TO Z AXIS & GATE OUT
TP+5V
+5V TO MAIN MODULE
(5) JUMPER
J2-B1
J2-A11
J4-A14
VR749 6.3V
S700 POWER PULL ON
F700
1.0A FAST 116V
0.5A FAST 232V
SAFETY EARTH GROUNDED TO CHASSIS AT REAR SUBPANEL
P700
WATTS (MAX) 60
AMPS (MAX) 0.5
AT 115V 60 HZ
U762 741
Q764
Q766
Q768
TP-5V
(6) JUMPER
-5V TO MAIN MODULE
VR769 6.3V
J2-A12
J4-A12
-5V TO R762
-5V3 TO Z AXIS & GATE OUT
JUMPER (7)
F768 2.0A FAST
-5V (UNREG) TO MAIN MODULE
-5V (UNREG) TO R767
SCALE ILLUM
Q784
VR782 6.8V
PARTIAL A1 INTERFACE BOARD
1907-104
REV C AUG 19



1907-104
REV C AUG 1979



VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a TEKTRONIX DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the Vertical or Horizontal module.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

POWER SUPPLY & INTERFACE CONNECTORS ◇3

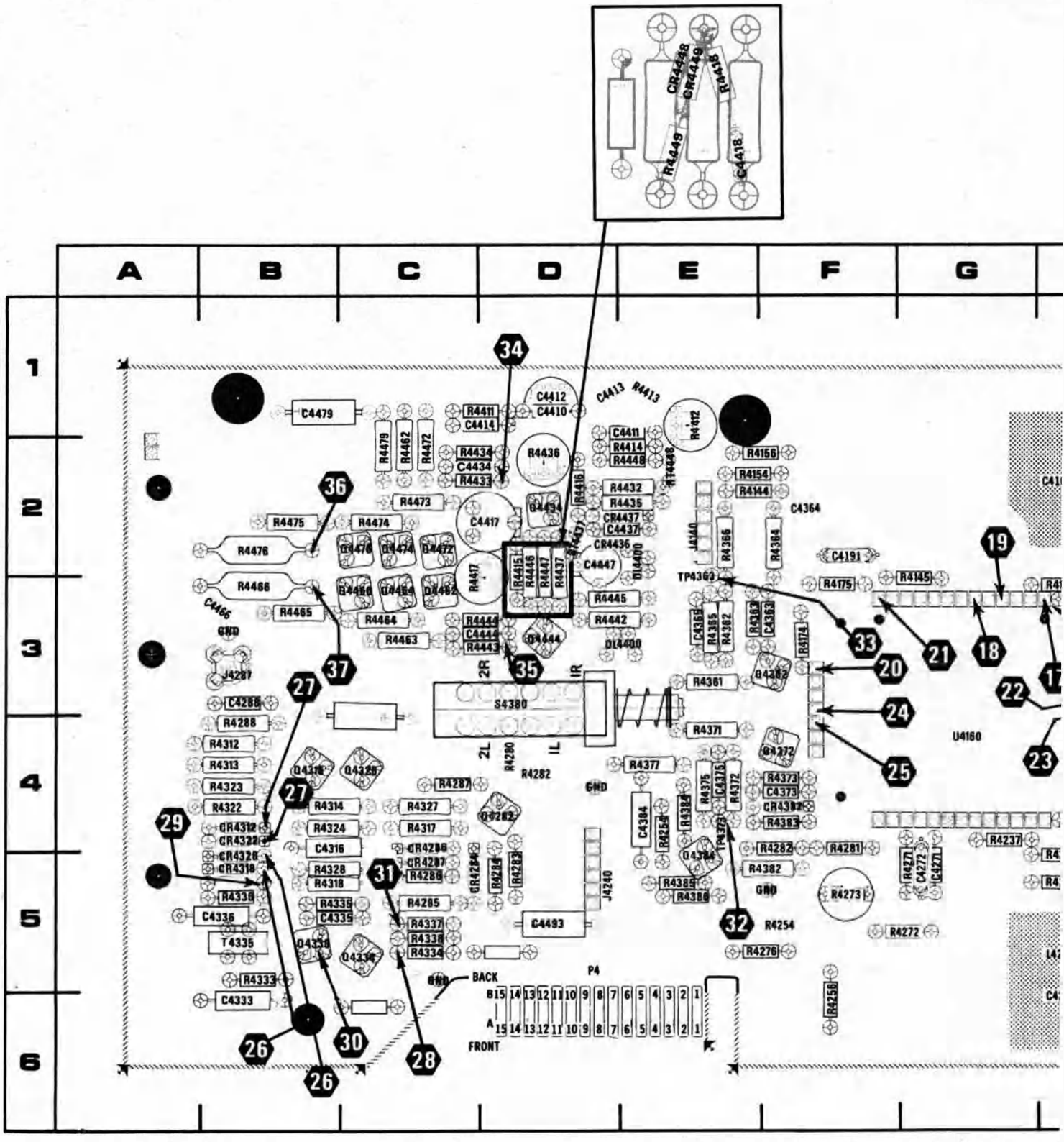
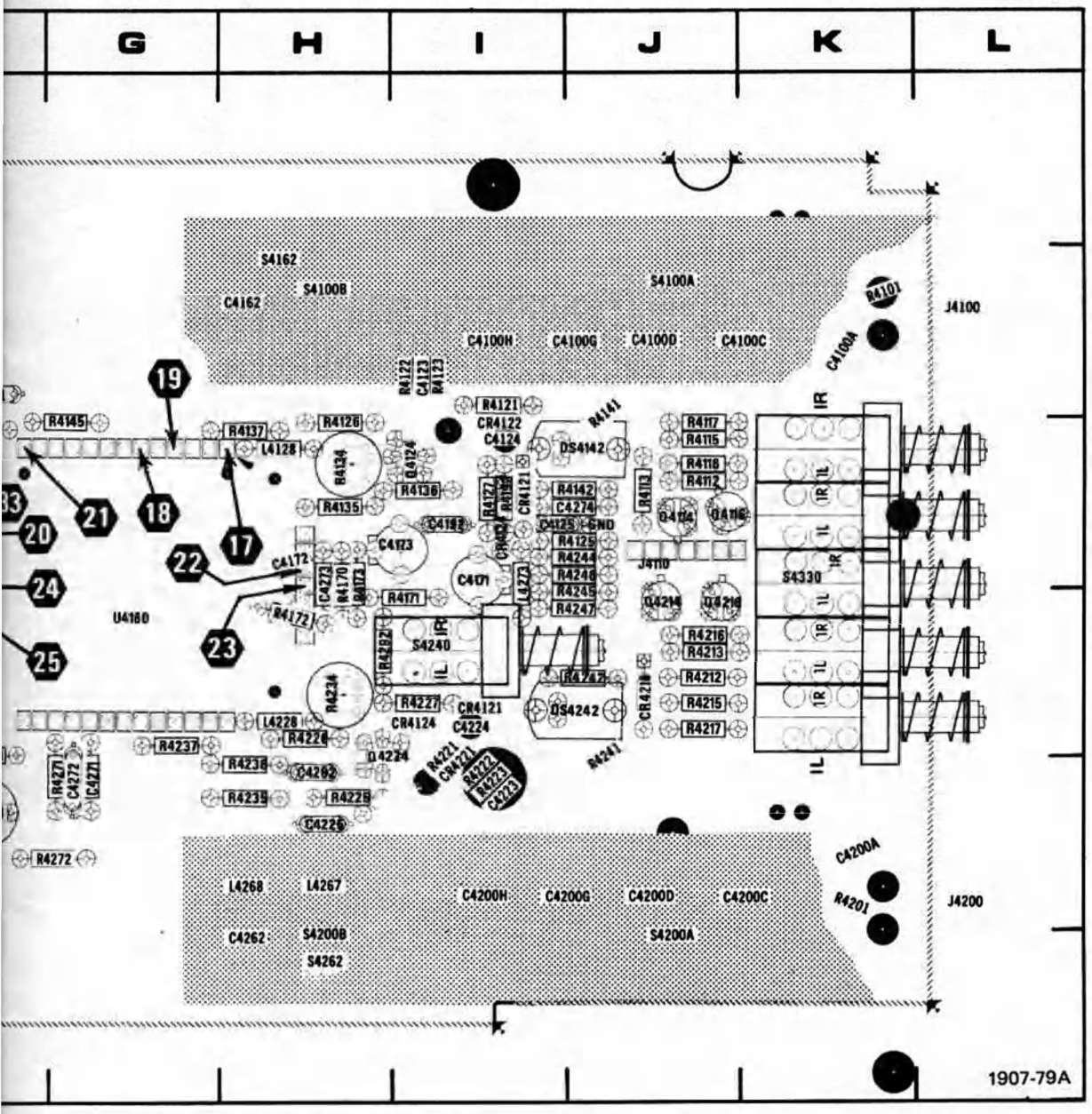


Fig. 9-5. A20—Vertical board component location, SN B010100-B



ent location, SN B010100-B011029.

*See Parts List for serial number ranges.

CKT NO	GRID LOC
C4100A	2K
C4100C	2K
C4100D	2J
C4100G	2J
C4100H	2I
C4123†	
C4124	3I
C4125	3J
C4162†	
C4171	3I
C4172	3H
C4173	3I
C4191	2F
C4192	3I
C4200A	5K
C4200C	5K
C4200D	5J
C4200G	5J
C4200H	5I
C4223†	
C4224	4I
C4225	5H
C4262†	
C4271	5G
C4272	5G
C4273	3H
C4274	3J
C4288	3B
C4292	5H
C4316	4B
C4333	6B
C4335	5B
C4336	5B
C4363	3F
C4364*	2F
C4365	3E
C4373	4F
C4375	4E
C4384*	4E
C4410	1D
C4411	1E
C4412	1D
C4413	1D
C4414	1D
C4417	2D
C4418[4]*	2D
C4434	2C
C4437[1]*	2E
C4444	3D
C4447	2D
C4479	1B
C4493	5D
CR4121	3I

CKT NO	GRID LOC
CR4122*	2I
CR4124	4I
CR4124	3I
CR4216	4J
CR4221	5I
CR4222*	4I
CR4224	4J
CR4284	5C
CR4286	4C
CR4287	5C
CR4312	4B
CR4318	5B
CR4322	4B
CR4328	5B
CR4382	4F
CR4436[1]*	2E
CR4437	2E
CR4448[4]*	2D
CR4449[4]*	2D
DL4400	2E
DL4400	3E
DS4142	3J
DS4242	4J
J4100	2L
J4110	3J
J4140	2E
J4200	5L
J4240	5D
J4287	3B
L4128	3H
L4228	4H
L4267†	
L4268†	
L4273	3I
Q4114	3J
Q4116	3K
Q4124	3I
Q4214	4J
Q4216	4J
Q4224	4I
Q4282	4D
Q4316	4B
Q4326	4C
Q4328	4C
Q4334	5C
Q4338	5B
Q4362	3F
Q4372	4F
Q4384	5E
Q4434	2D
Q4444	3D

CKT NO	GRID LOC
Q4462	3C
Q4464	3C
Q4466	3C
Q4472	2C
Q4474	2C
Q4476	2C
R4101	2K
R4112	3J
R4113	3J
R4115	3J
R4116	3J
R4117	3J
R4121	3I
R4122†	
R4123†	
R4125	3J
R4126	3H
R4127	3I
R4134	3H
R4135	3H
R4136	3I
R4137	3H
R4141†	
R4142	3J
R4144	2F
R4145	3G
R4154	2E
R4156	2F
R4170	3H
R4171	4I
R4172	4H
R4173	3H
R4174	3F
R4175	3F
R4192	3I
R4201	5K
R4212	4J
R4213	4J
R4215	4J
R4216	4J
R4217	4J
R4221	5I
R4222†	
R4223†	
R4225	5H
R4226	4H
R4227	4I
R4234	4H
R4235	5H
R4236	5H
R4237	4G
R4241†	
R4242	4J
R4244	3J
R4245	3J
R4246	3J

CKT NO	GRID LOC
R4247	4J
R4254[2]	4E
R4256	6F
R4271	5G
R4272	5G
R4273	5F
R4276	5F
R4280*	4D
R4281	4F
R4282[3]	4D
R4283	5D
R4284	5D
R4285	5C
R4286	5C
R4287	4C
R4288	4B
R4292	4H
R4312	4B
R4313	4B
R4314	4B
R4317	4C
R4318	5B
R4322	4B
R4323	4B
R4324	4B
R4327	4C
R4328	5B
R4332	5B
R4333	5B
R4334	5C
R4335	5B
R4336	5B
R4337	5C
R4338	5C
R4361	3E
R4362	3E
R4363	3E
R4364	2F
R4365	3E
R4366	2E
R4371	4E
R4372	4E
R4373	4F
R4375	4E
R4377	4E
R4382	5F
R4383	4F
R4384	4E
R4385	5E
R4386	5E
R4411	1D
R4412	1E
R4413	1E
R4414	2E
R4415	2D

CKT NO	GRID LOC
R4416	2D
R4417	2D
R4418[4]*	2D
R4432	2E
R4433	2D
R4434	2D
R4435	2E
R4436	2D
R4437	2D
R4442	3E
R4443	3D
R4444	3D
R4445	3E
R4446	2D
R4447	2D
R4448	2E
R4449[4]*	2D
R4462	2C
R4463	3C
R4464	3C
R4465	3B
R4466	3B
R4472	2C
R4473	2C
R4474	2C
R4475	2B
R4476	2B
R4479	2C
RT4437	2D
RT4448	2E
S4100A	2J
S4100B	2H
S4160	2H
S4162	1H
S4200A	6J
S4200B	6H
S4262	6H
S4240	4I
S4260	6H
S4330	3K
S4380	3D
T4335	5B
TP4363	2E
TP4373	4E
U4160	4G

[1] C4437 change to CR4436 SN B011030.
[2] R4254 may be located at 5F.
[3] R4282 may be located at 4F.
[4] Shown on exploded view.

† On back of board.

VOLTAGE CONDITIONS

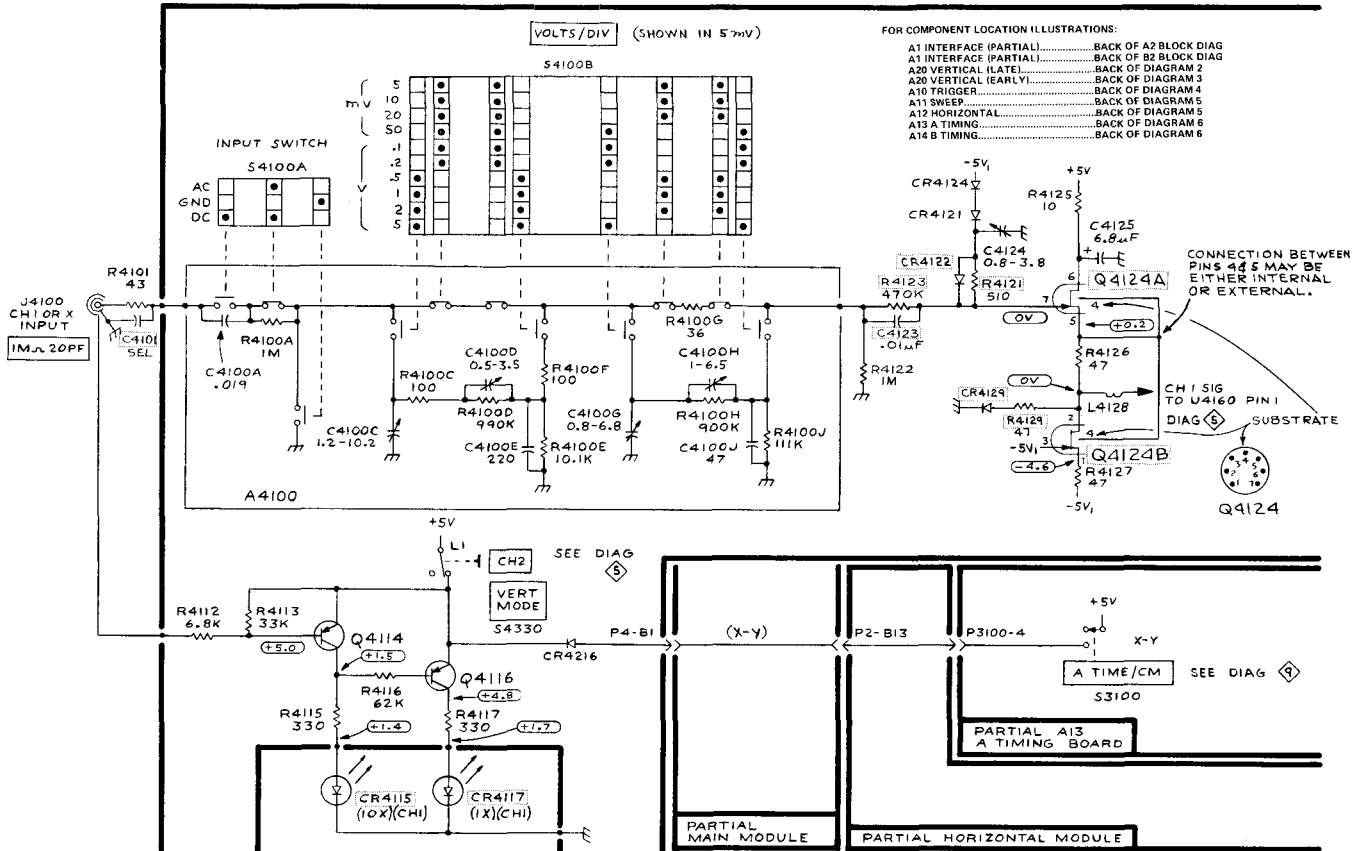
Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ± 20%.

A2 controls were set as follows:	VERT MODE	CH 1
	CH 1 & CH 2 AC-GND-DC	GND
	CH 1 POSITION	Trace or spot centered

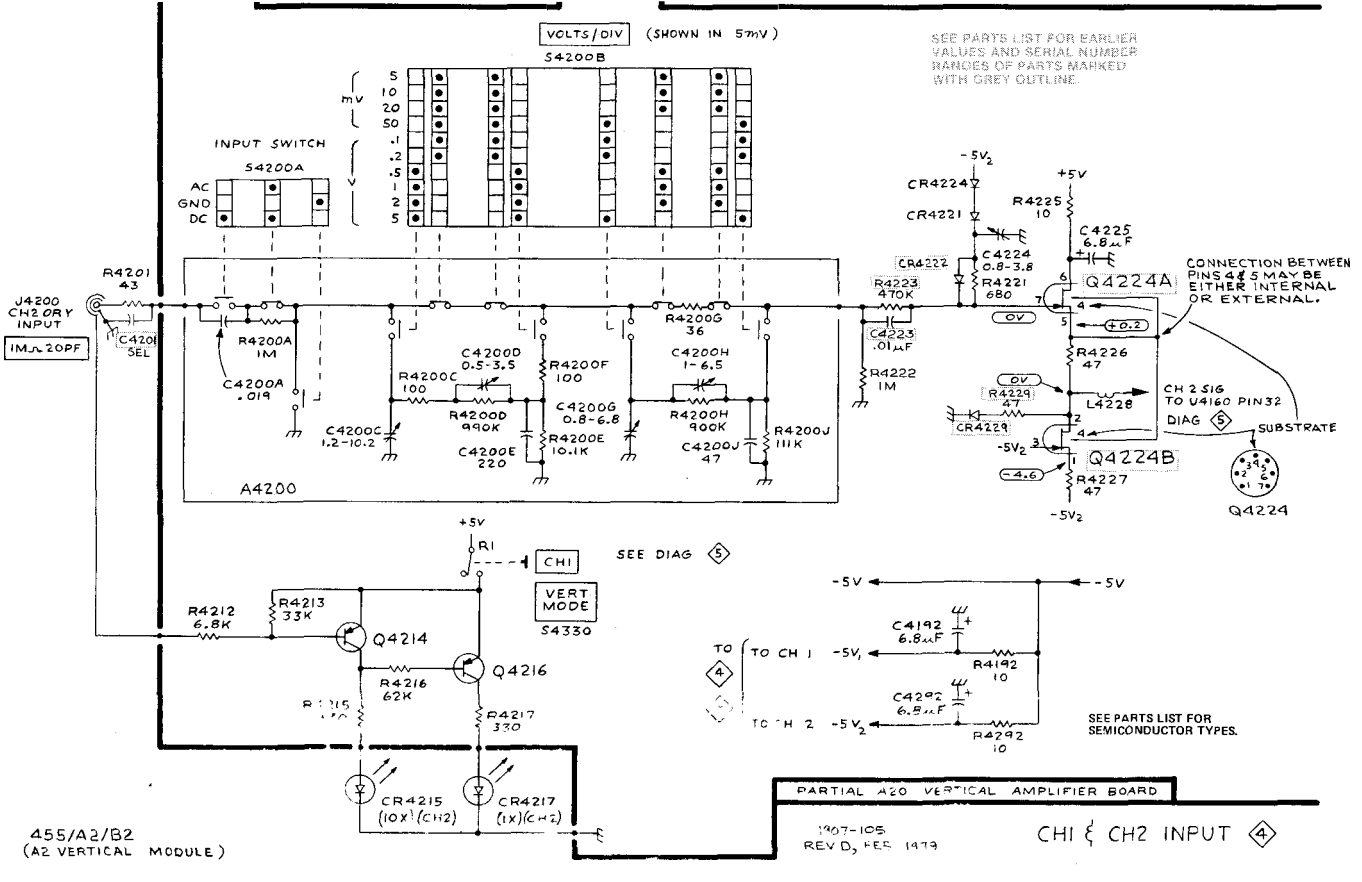
J4100
CH1 OR X
INPUT
1MΩ 20PF

J4200
CH2 OR Y
INPUT
1MΩ 20PF

455/A
(A2 VER


VOLTS/DIV
(SHOWN IN 5 mV)
S4100B
INPUT SWITCH
S4100A
AC
GND
DC
mV
V
5
10
20
50
.1
.2
.5
1
2
5
FOR COMPONENT LOCATION ILLUSTRATIONS:
A1 INTERFACE (PARTIAL)....BACK OF A2 BLOCK DIAG
A1 INTERFACE (PARTIAL)....BACK OF B2 BLOCK DIAG
A20 VERTICAL (LATE)....BACK OF DIAGRAM 2
A20 VERTICAL (EARLY)....BACK OF DIAGRAM 3
A10 TRIGGER....BACK OF DIAGRAM 4
A11 SWEEP....BACK OF DIAGRAM 5
A12 HORIZONTAL....BACK OF DIAGRAM 5
A13 A TIMING....BACK OF DIAGRAM 6
A14 B TIMING....BACK OF DIAGRAM 6
J4100
CH 1 OR X INPUT
1MΩ 20PF
R4101
43
C4101
SEL
R4100A
1M
C4100A
.019
C4100C
1.2-10.2
R4100C
100
C4100D
0.5-3.5
R4100D
990K
C4100E
220
R4100F
100
C4100G
0.8-6.8
R4100E
10.1K
R4100G
36
C4100H
1-6.5
R4100H
900K
C4100J
47
R4100J
111K
A4100
R4122
1M
C4123
.01μF
R4123
470K
CR4122
C4124
0.8-3.8
R4121
510
CR4124
CR4121
-5V
+5V
R4125
10
C4125
6.8μF
CONNECTION BETWEEN PINS 4 & 5 MAY BE EITHER INTERNAL OR EXTERNAL.
Q4124A
OV
+0.2
R4126
47
CR4129
L4128
CH 1 SIG TO U4160 PIN 1
DIAG 5 SUBSTRATE
R4129
47
-5V
-4.6
Q4124B
R4127
47
Q4124
+5V
L1
CH2
VERT MODE
S4330
SEE DIAG 5
R4112
6.8K
R4113
33K
+5.0
Q4114
+1.5
Q4116
+4.8
R4116
62K
R4115
330
+1.4
R4117
330
+1.7
CR4115
(10X)(CH1)
CR4117
(1X)(CH1)
CR4216
P4-B1
(X-Y)
P2-B13
P3100-4
+5V
X-Y
A TIME/CM
S3100
SEE DIAG 9
PARTIAL A13
A TIMING BOARD
PARTIAL
MAIN MODULE
PARTIAL HORIZONTAL MODULE

can vary


VOLTS/DIV (SHOWN IN 5mV)
S4200B
mV
5
10
20
50
.1
.2
.5
1
2
5
V
INPUT SWITCH
S4200A
AC
GND
DC
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH GREY OUTLINE.
J4200 CH2 ORY INPUT
1MΩ 20PF
R4201 43
C4201 SEL
C4200A .019
R4200A 1M
C4200C 1.2-10.2
R4200C 100
C4200D 0.5-3.5
R4200D 990K
C4200E 220
R4200E 10.1K
R4200F 100
C4200G 0.8-6.8
R4200G 36
C4200H 1-6.5
R4200H 900K
C4200J 47
R4200J 111K
A4200
R4222 1M
C4223 .01μF
R4223 470K
CR4222
C4224 0.8-3.8
R4221 680
CR4224
CR4221
-5V2
+5V
R4225 10
C4225 6.8μF
Q4224A
CONNECTION BETWEEN PINS 4 & 5 MAY BE EITHER INTERNAL OR EXTERNAL.
OV
+0.2
R4226 47
L4228
CH 2 SIG TO U4160 PIN 32
DIAG 5
SUBSTRATE
R4229 47
CR4229
-5V2
-4.6
Q4224B
R4227 47
-5V2
Q4224
+5V
R1
CH1
VERT MODE
S4330
SEE DIAG 5
R4212 6.8K
R4213 33K
Q4214
Q4216
R4216 62K
R4217 330
CR4215 (10X)(CH2)
CR4217 (1X)(CH2)
-5V
-5V
C4192 6.8μF
R4192 10
TO 4 TO CH 1 -5V1
C4292 6.8μF
TO CH 2 -5V2
R4292 10
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
PARTIAL A20 VERTICAL AMPLIFIER BOARD
1907-105
REV D, FEB 1979
CH1 & CH2 INPUT 4
455/A2/B2
(A2 VERTICAL MODULE)

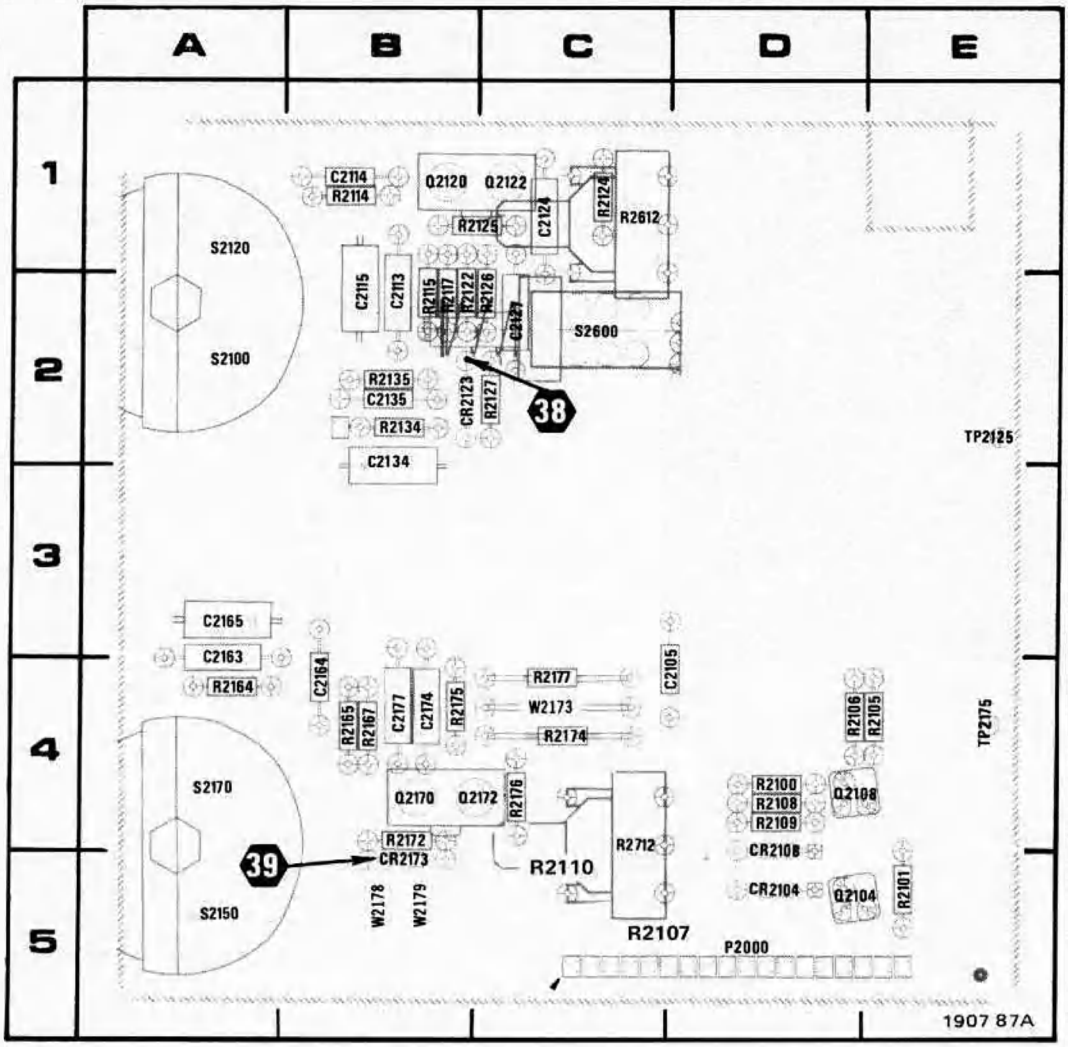
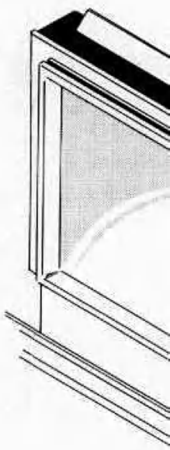


Fig. 9-6. A10—Trigger board component locations.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C2105	4C	C2174	4B	Q2108	5D	R2108	4D	R2135	2B	R2712	1C
C2113	2B	C2177	4B	Q2120	1B	R2109	4D	R2164	4A		
C2114	1B			Q2120	1B	R2110	5C	R2165	4B	S2100	2A
C2115	2B	CR2104	5D	Q2122	1C	R2114	1B	R2167	4B	S2120	1A
C2124	1C	CR2108	4D	Q2170	4B	R2115	2B	R2172	4B	S2150	5A
C2127	2C	CR2123	2B	Q2172	4C	R2117	2B	R2174	4C	S2170	4A
C2134	2B	CR2173	5B			R2122	2B	R2175	4B	S2600	2C
C2135	2B			R2100	4D	R2124	1C	R2176	4C	TP2125	2E
C2163	3A	P2000	5D	R2101	5E	R2125	1B	R2177	4C	TP2175	4E
C2164	4B			R2105	4E	R2126	2C	R2212	3B		
C2165	3A	Q2104	5D	R2106	4D	R2127	2C	R2612	1C	W2173	4C
				R2107	5C	R2134	2B			W2178	5B
										W2179	5B



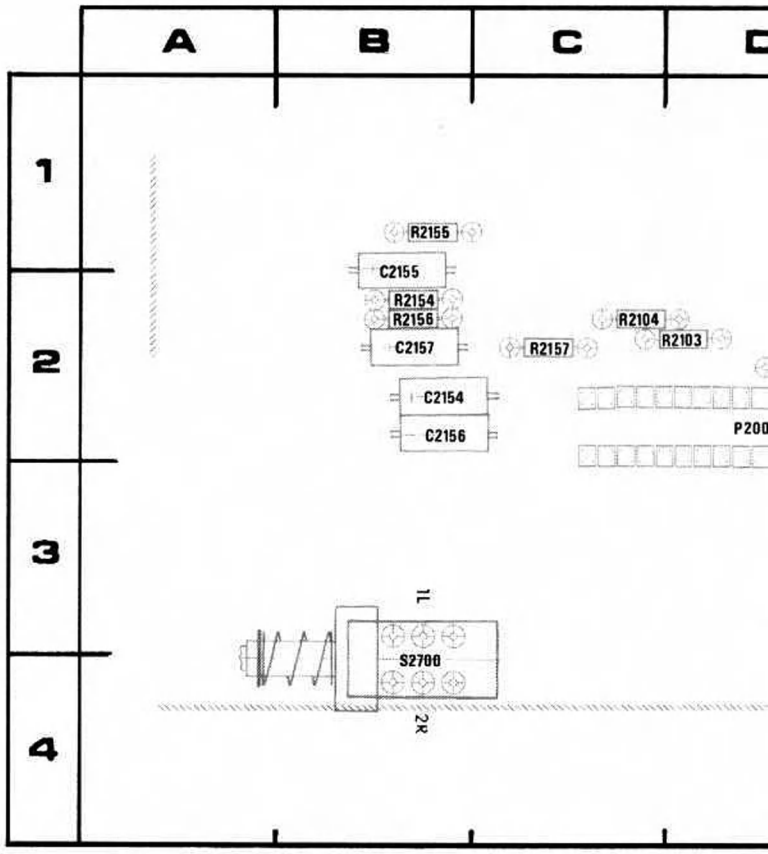
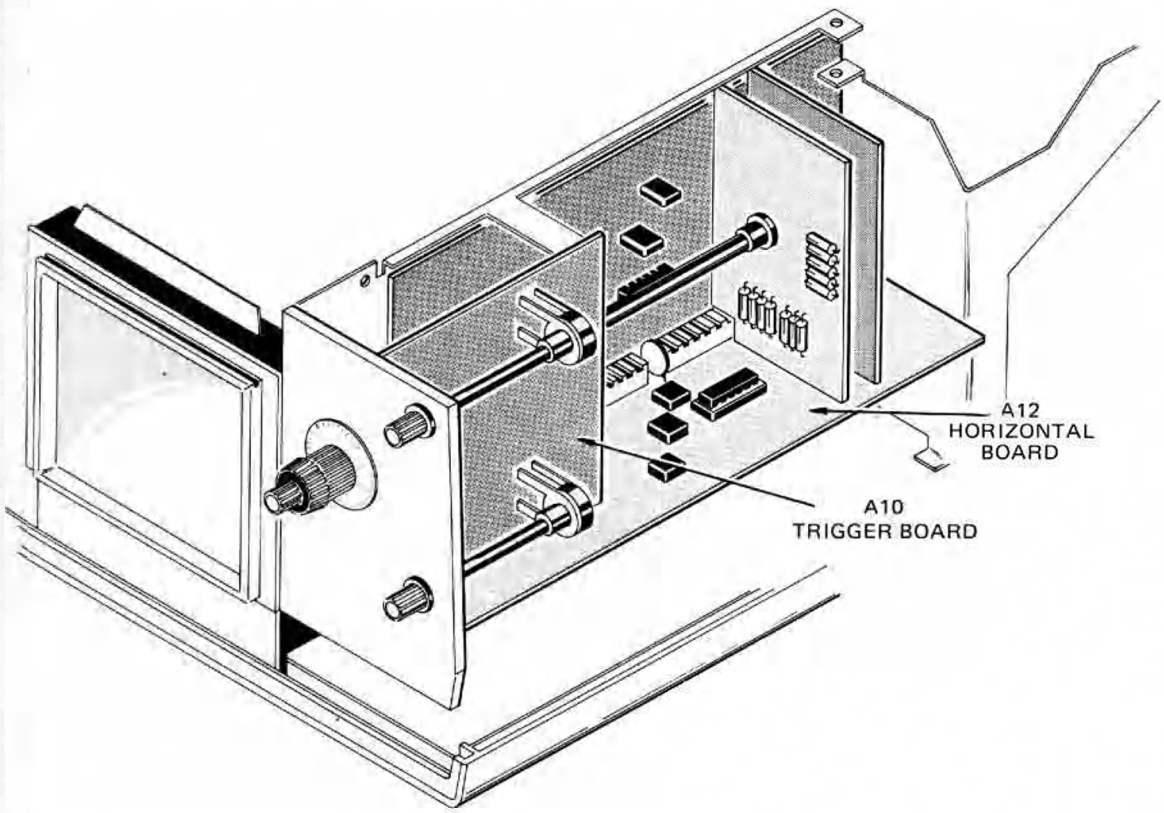


Fig. 9-7A. A12



CKT NO	GRID LOC
C2154	2B
C2155	2B
C2156	2B
C2157	2B
C2911	2H
C2913	1H
C2917*	2G
C2919	2H
C2941	2H
P2000	2D

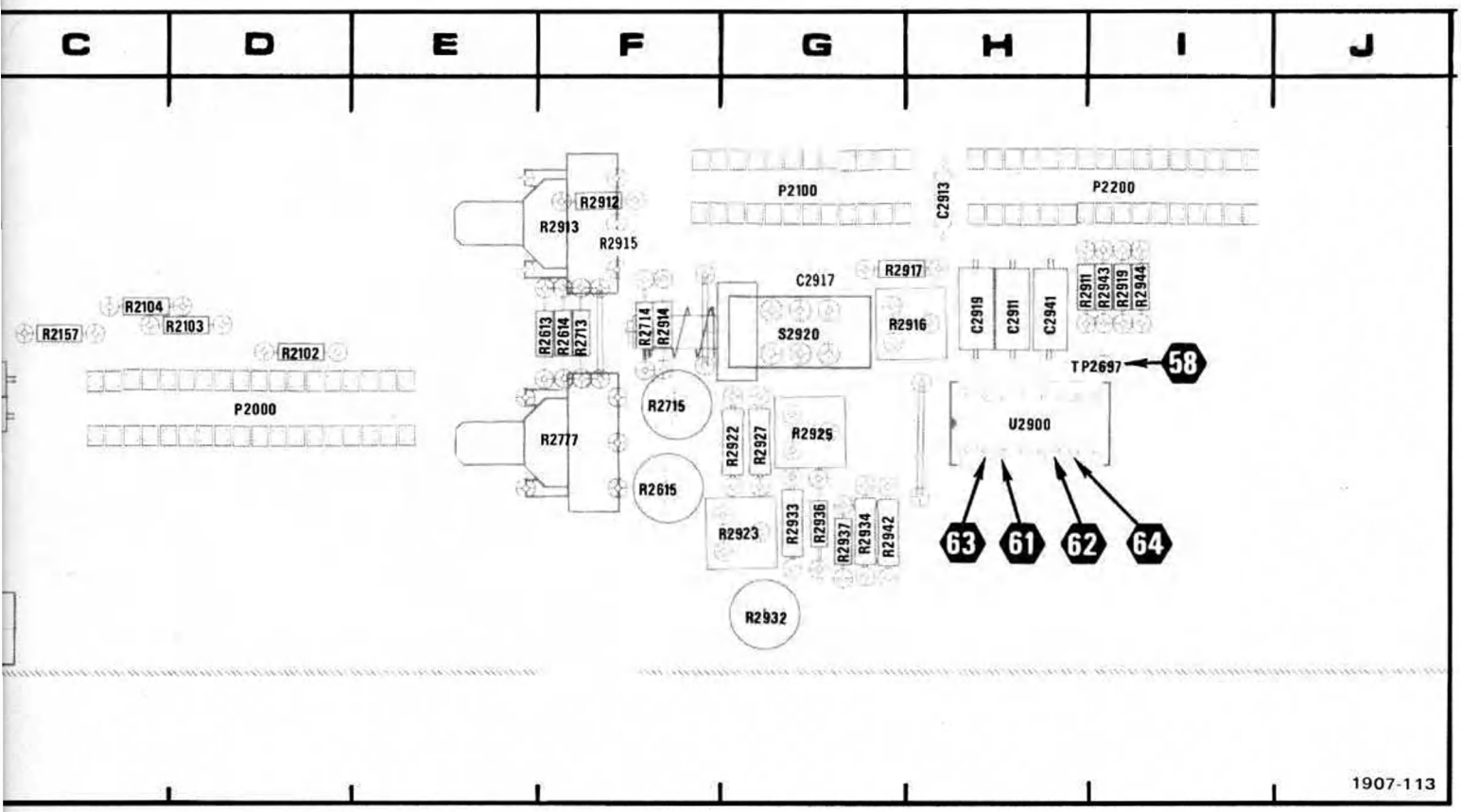


Fig. 9-7A. A12 – Horizontal board component locations SN B010100 – B044419.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C2154	2B	P2100	1G	R2614	2F	R2917	2H	R2942	3G
C2155	2B	P2200	1I	R2615	3F	R2919	2I	R2943	2I
C2156	2B			R2713	2F	R2922	3G	R2944	2I
C2157	2B	R2102	2D	R2714	2F	R2923	3G		
C2911	2H	R2103	2D	R2715	2F	R2927	3G	S2700	4B
C2913	1H	R2104	2C	R2777†		R2925	2G	S2920†	
C2917*	2G	R2154	2B	R2911	2I	R2932	3G		
C2919	2H	R2155	1B	R2912	1F	R2933	3G	TP2697	2I
C2941	2H	R2156	2B	R2913†		R2934	3G		
		R2157	2C	R2914	2F	R2936	3G	U2900	2H
P2000	2D	R2613	2F	R2915*	1F	R2937	3G		
				R2916	2H				

* See Parts List for serial number ranges.
† On back of board.

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

Controls were set as follows:

VERT MODE	CH 1
CH 1 and CH 2 AC-GND-DC	GND
CH 1 POSITION	Trace or spot centered

WAVEFORM CONDITIONS

Waveforms below were taken from a Tektronix 7000-series oscilloscope equipped with readout, 7B series Time-Base, 7A13 Differential Comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

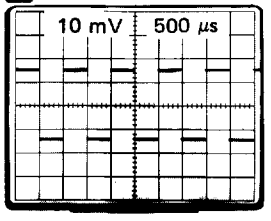
The Main Module calibrator signal was applied to the CH 1 input through a compensated 10X probe. The test oscilloscope was triggered externally on the + slope from the calibrator signal.

A2 controls were set as follows: (except as noted below)

VERT MODE	CH 1
CH 1 VOLTS/DIV	5 mV
CH 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND
CH 1 POSITION	Trace or spot centered

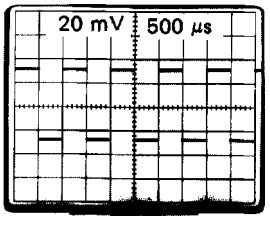
For waveforms 10 through 15, the CH 1 and CH 2 AC-GND-DC switches were both in the GND position and the VERT MODE switch was in either the CHOP or ALT position as noted on the waveforms.

17



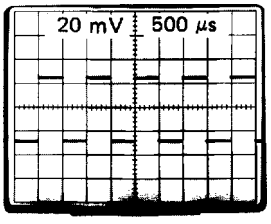
20 mV

18



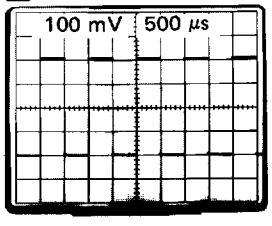
1.6 V

19



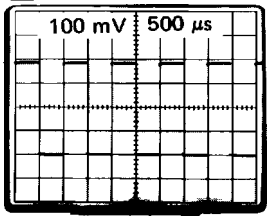
1.6 V

20



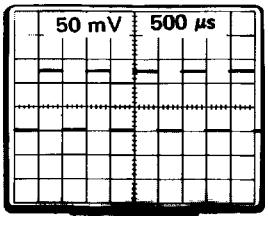
.1 V

21



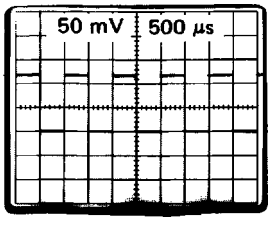
0 V

22



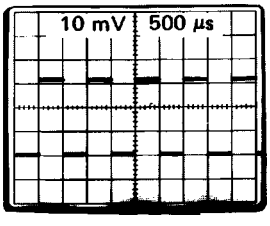
−.8 V

23



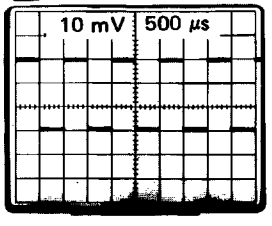
−.8 V

24



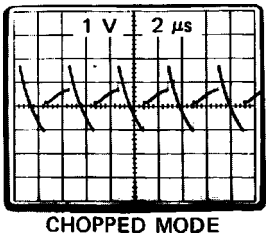
3 V

25



3 V

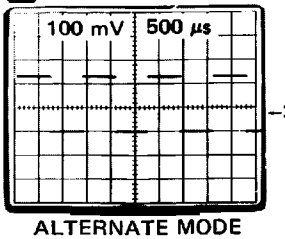
26



−2.7 V

CHOPPED MODE

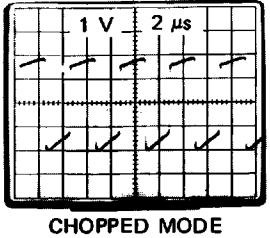
26



−3.1 V

ALTERNATE MODE

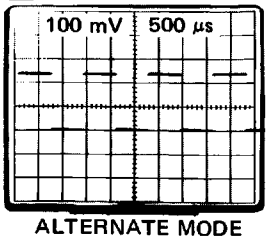
27



−.6 V

CHOPPED MODE

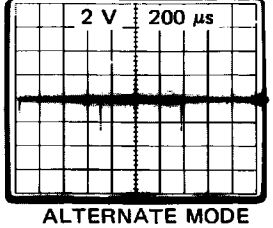
27



−3.1

ALTERNATE MODE

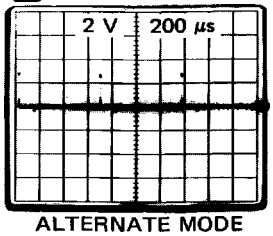
28



−4.0 V

ALTERNATE MODE

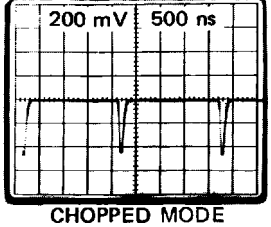
29



−4.4 V

ALTERNATE MODE

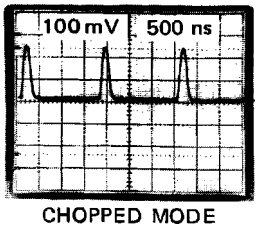
30



+.7 V

CHOPPED MODE

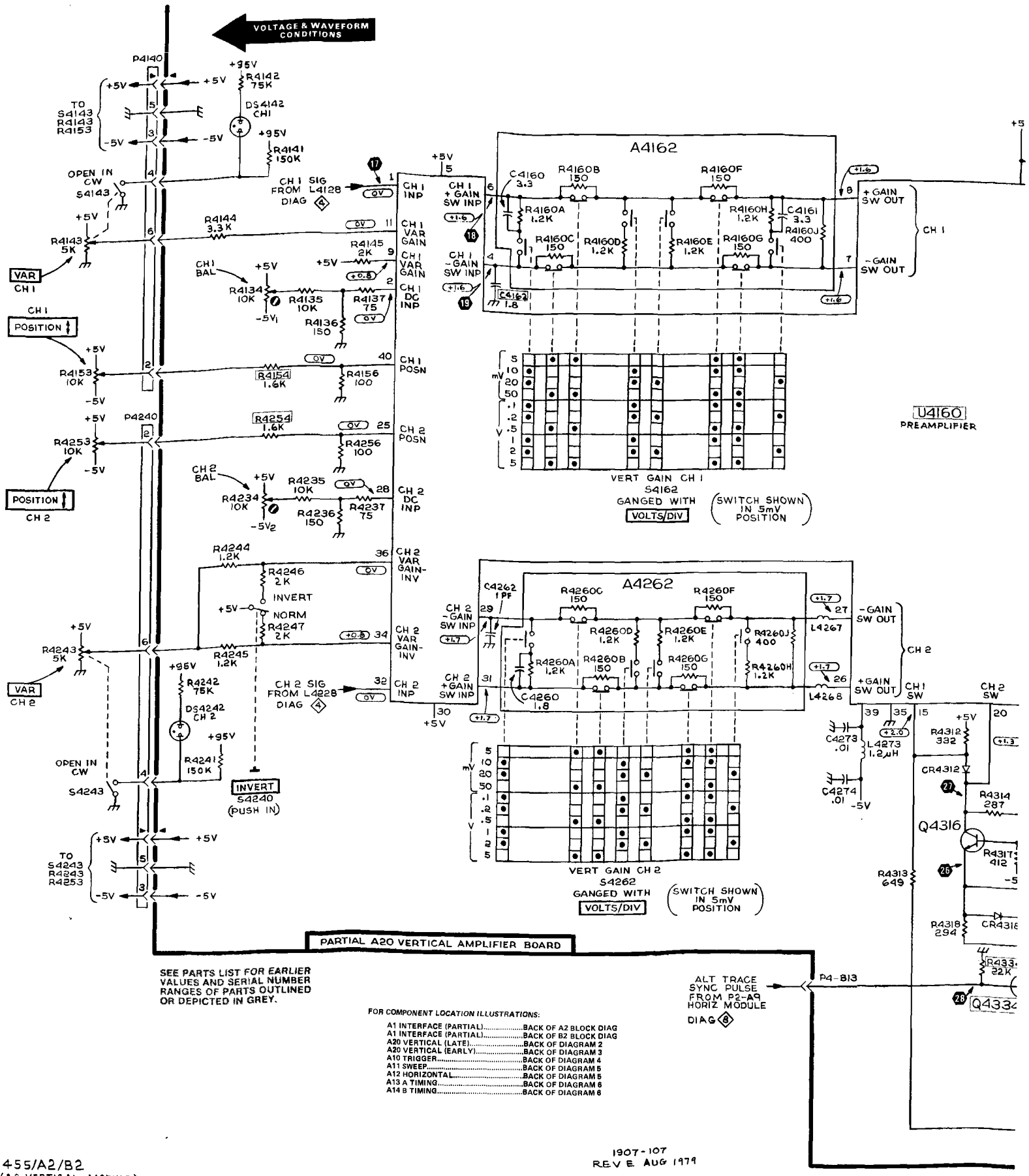
31



0V

CHOPPED MODE

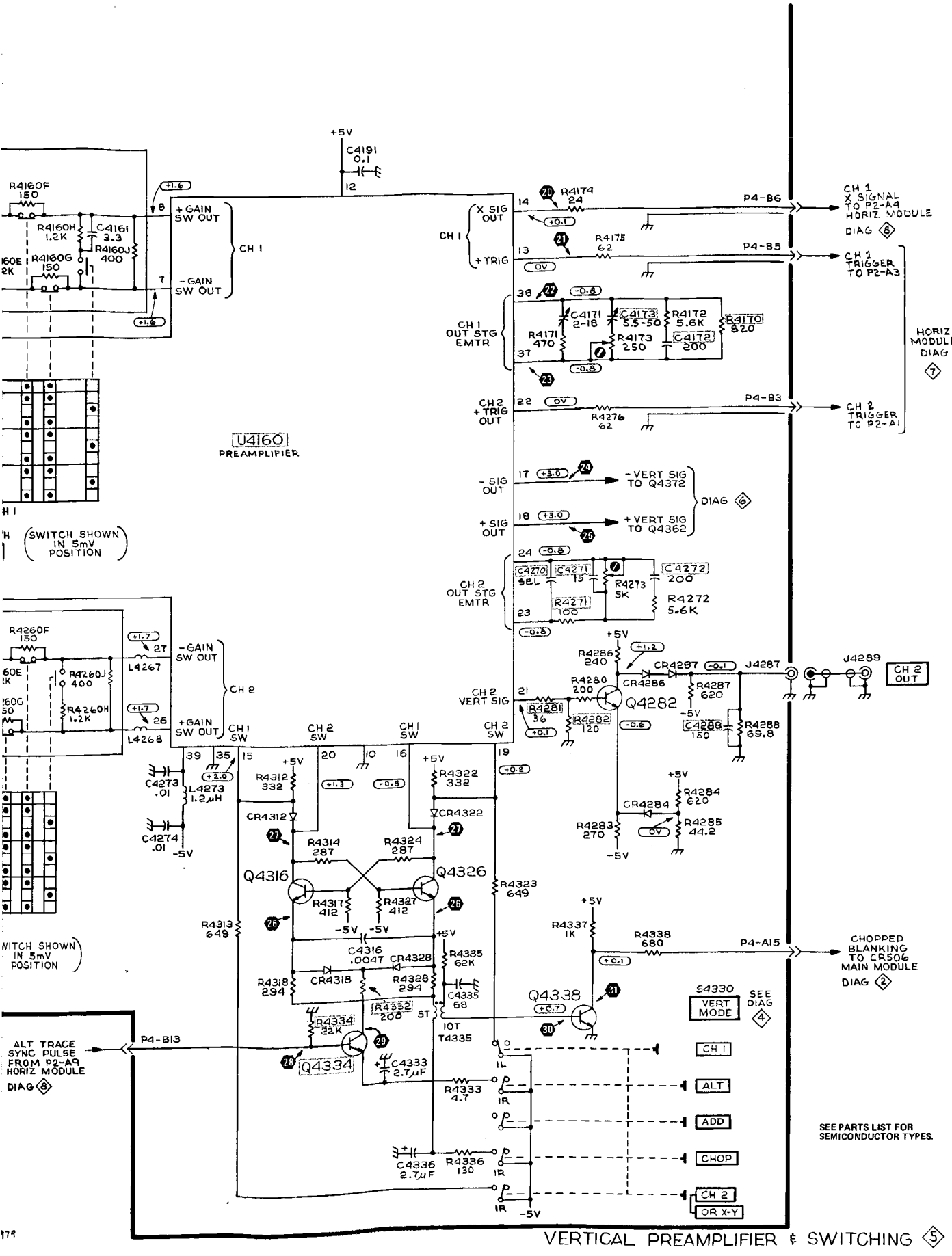
1907-106



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

FOR COMPONENT LOCATION ILLUSTRATIONS:

A1 INTERFACE (PARTIAL)	BACK OF A2 BLOCK DIAG
A1 INTERFACE (PARTIAL)	BACK OF B2 BLOCK DIAG
A20 VERTICAL (LATE)	BACK OF DIAGRAM 2
A20 VERTICAL (EARLY)	BACK OF DIAGRAM 3
A10 TRIGGER	BACK OF DIAGRAM 4
A11 SWEEP	BACK OF DIAGRAM 5
A12 HORIZONTAL	BACK OF DIAGRAM 5
A13 A TIMING	BACK OF DIAGRAM 6
A14 B TIMING	BACK OF DIAGRAM 6



VERTICAL PREAMPLIFIER & SWITCHING 5

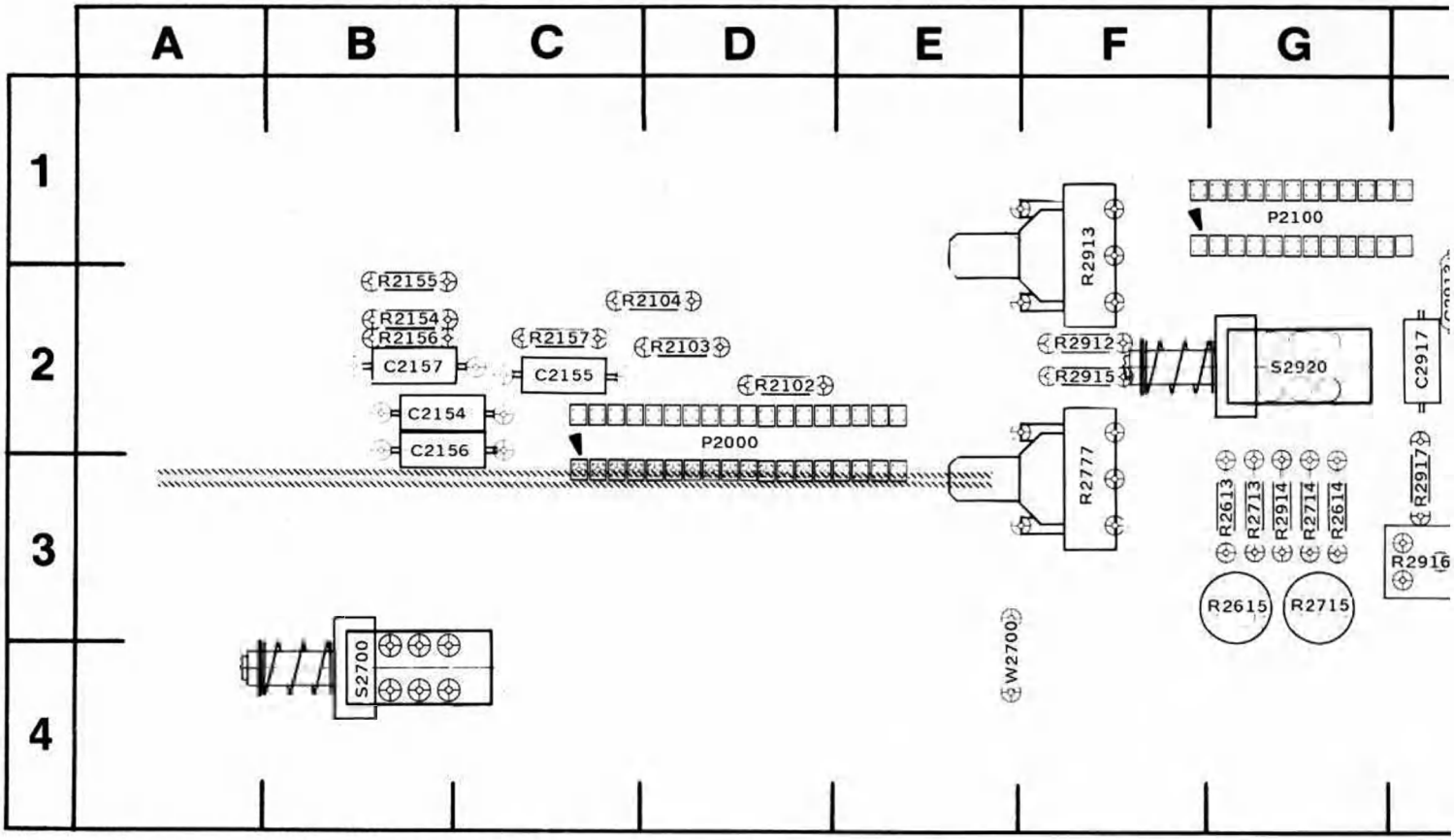
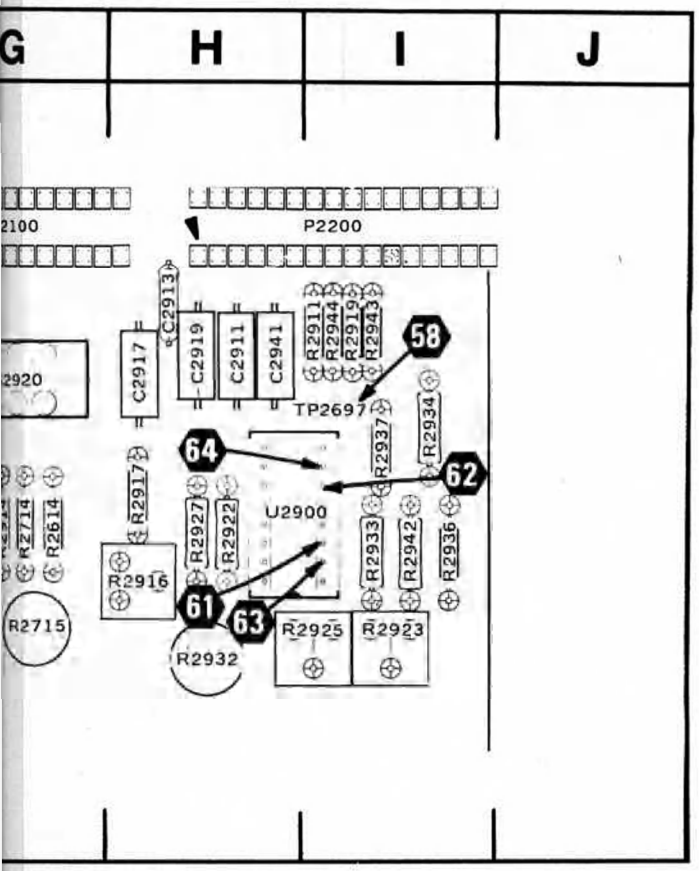


Fig. 9-7B. A12 — Horizontal board component locations SN B044420 — up.

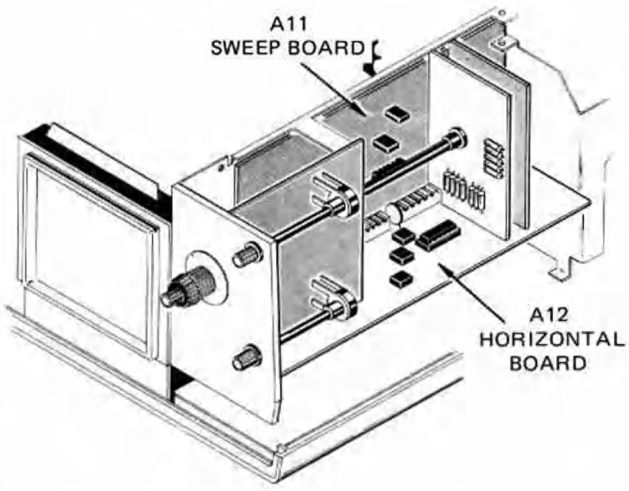
FOR A12 BOARD BELOW SN B044420 SEE BACK OF DIAGRAM 4

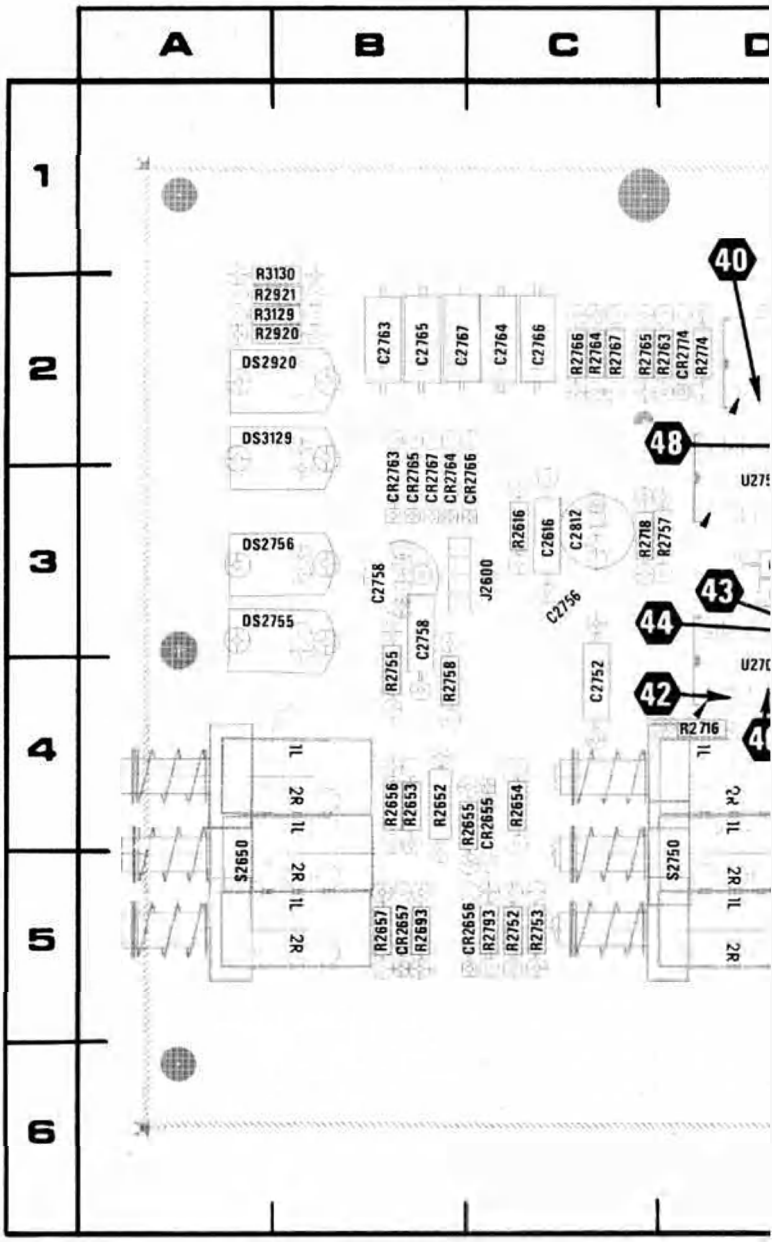
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C2154	2B	R2102	2D	R2777†		R2932	3H	U2900	3H
C2155	2C	R2103	2D	R2911	2I	R2933	3I		
C2156	2B	R2104	2D	R2912	2F	R2934	2I	W2700	4E
C2157	2B	R2154	2B	R2913†		R2936	3I		
C2911	2H	R2155	2B	R2914	3G	R2937	2I		
C2913	2H	R2156	2B	R2915	2F	R2942	3I		
C2917	2H	R2157	2C	R2916	3H	R2943	2I		
C2919	2H	R2613	3G	R2917	3H	R2944	2I		
C2941	2H	R2614	3G	R2919	2I				
		R2615	3G	R2922	3H	S2700	4B		
P2000	2D	R2713	3G	R2923	3I	S2920†			
P2100	1G	R2714	3G	R2925	3I				
P2200	1I	R2715	3G	R2927	3H	TP2697	2I		



– up.

	GRID LOC
)	3H
)	4E





CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	C
C2616	3C	C2762	3E	CR2688	2I	CR2791	
C2618	5H	C2763	2B	CR2689	2I	CR2793	
C2681	4H	C2764	2C	CR2690	3E	CR2795	
C2683	2I	C2765	2B	CR2691†		CR2804	
C2684	2I	C2766	2C	CR2692	3F		
C2685	5I	C2767	2B	CR2694	3F	DS2755	
C2686	3I	C2781	4G	CR2695	3F	DS2756	
C2687†*		C2783	4F	CR2741	3G	DS2920	
C2688	4I	C2784	4E	CR2742	3F	DS3129	
C2697*	3I	C2785	4G	CR2743	2F		
C2698	6H	C2786	4G	CR2756[2]	4E	J2100	
C2716	4D	C2788	4G	CR2757	4E	J2200	
C2717	3E	C2791[2]*	3G	CR2759*	4E	J2600	
C2718	3D	C2797†*		CR2763	3B	J2740	
C2722	4E	C2812	3C	CR2764	3B	J3000	
C2744	3G	C2814	2H	CR2765	3B	J3100	
C2752	4C			CR2766	3B	J3200	
C2756[2]	3E	CR2655	4C	CR2767	3B		
C2757	3D	CR2656	5C	CR2774	3C	L2688	
C2758[1]	3B	CR2657	5B	CR2786	4G	L2788	
C2759	3E	CR2686	3I	CR2788	4F	L2812	

* See Parts List for serial number ranges.

† On back of board.

[1] C2758 is one of two types shown.

[2] Components located on back of board before SN B010325.

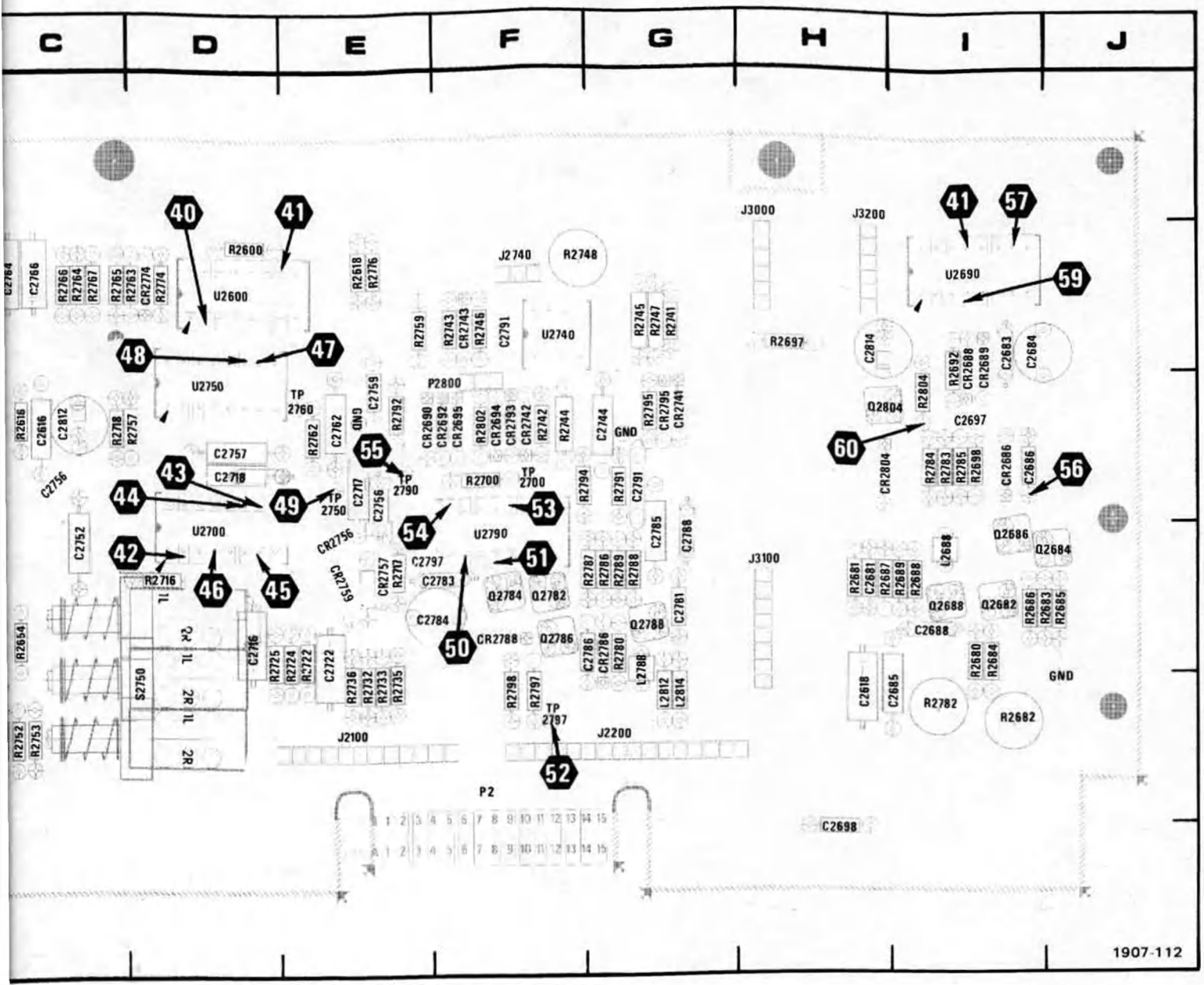


Fig. 9-8. A11 – Sweep board component locations.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
CR2688	2I	CR2791†		L2814	5G	R2655	4C	R2722	4E	R2762	3E	R2795	3G	U2700	4D
CR2689	2I	CR2793	3F			R2656	4B	R2724	4E	R2763	2D	R2797	5F	U2740	2F
CR2690	3E	CR2795	3G	P2	5F	R2657	5B	R2725	4D	R2764	2C	R2798	5F	U2750	3D
CR2691†		CR2804	3H	P2800	3F	R2680	4I	R2732	5E	R2765	2C	R2802	3F	U2790	4F
CR2692	3F					R2681	4H	R2733	5E	R2766	2C	R2804	3I		
CR2694	3F	DS2755	3B	Q2682	4I	R2682	5I	R2735	5E	R2767	2C	R2920	2A		
CR2695	3F	DS2756	3B	Q2684	4J	R2683	4J	R2736	5E	R2774	3C	R2921	2A		
CR2741	3G	DS2920	2A	Q2686	4I	R2684	4I	R2741	2G	R2776	2E	R3129	2A		
CR2742	3F	DS3129	2A	Q2688	4I	R2685	4J	R2742	3F	R2780	4G	R3130	1A		
CR2743	2F			Q2782	4F	R2686	4I	R2743	2F	R2782	5I				
CR2756	4E	J2100	5E	Q2784	4F	R2687	4H	R2744	3F	R2783	3I	S2650	5A		
CR2757	4E	J2200	5G	Q2786	4F	R2688	4I	R2745	2G	R2784	3I	S2750	5D		
CR2759*	4E	J2600	3C	Q2788	4G	R2689	4I	R2746	2F	R2785	3I				
CR2763	3B	J2740	2F	Q2804	3H	R2692	2I	R2747	2G	R2786	4G	TP2600	3F		
CR2764	3B	J3000	1H			R2693	5B	R2748	2F	R2785	4G	TP2750	3E		
CR2765	3B	J3100	4H	R2600	2D	R2697	2H	R2752	5C	R2788	4G	TP2760	3E		
CR2766	3B	J3200	1H	R2616	3C	R2698	3I	R2753	5C	R2789	4G	TP2790	3E		
CR2767	3B			R2618	2E	R2700	3F	R2755	4B	R2791	3G	TP2797	5F		
CR2774	3C	L2688	4I	R2652	4B	R2716	4D	R2757	3D	R2792	3E				
CR2786	4G	L2788	4G	R2653	4B	R2717	4E	R2758	4B	R2793	5C	U2600	2D		
CR2788	4F	L2812	5G	R2654	4C	R2718	3C	R2759	2E	R2794	3G	U2690	2I		

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

Controls were set as follows:

VERT MODE	CH 1
CH 1 and CH 2 AC-GND-DC	GND
CH 1 POSITION	Trace or spot centered

WAVEFORM CONDITIONS

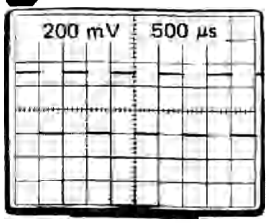
Waveforms below were taken from a Tektronix 7000-series oscilloscope equipped with readout, 7B series Time-Base, 7A13 Differential Comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

The Main Module calibrator signal was applied to the CH 1 input through a compensated 10X probe. The test oscilloscope was triggered externally on the + slope from the calibrator signal.

A2 controls were set as follows: (except as noted below)

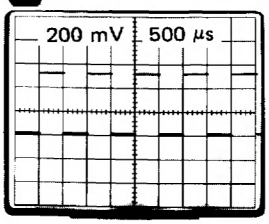
VERT MODE	CH 1
CH 1 VOLTS/DIV	5 mV
CH 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND
CH 1 POSITION	Trace or spot centered

32



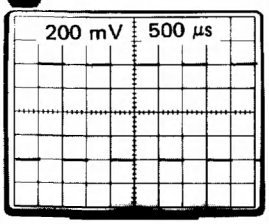
0 V

33



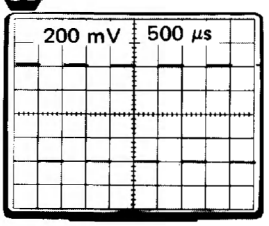
0 V

34



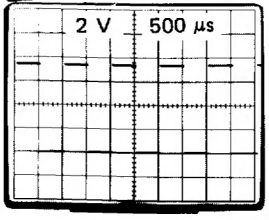
−1.7 V

35



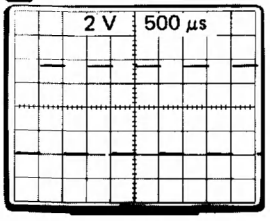
−1.7 V

36



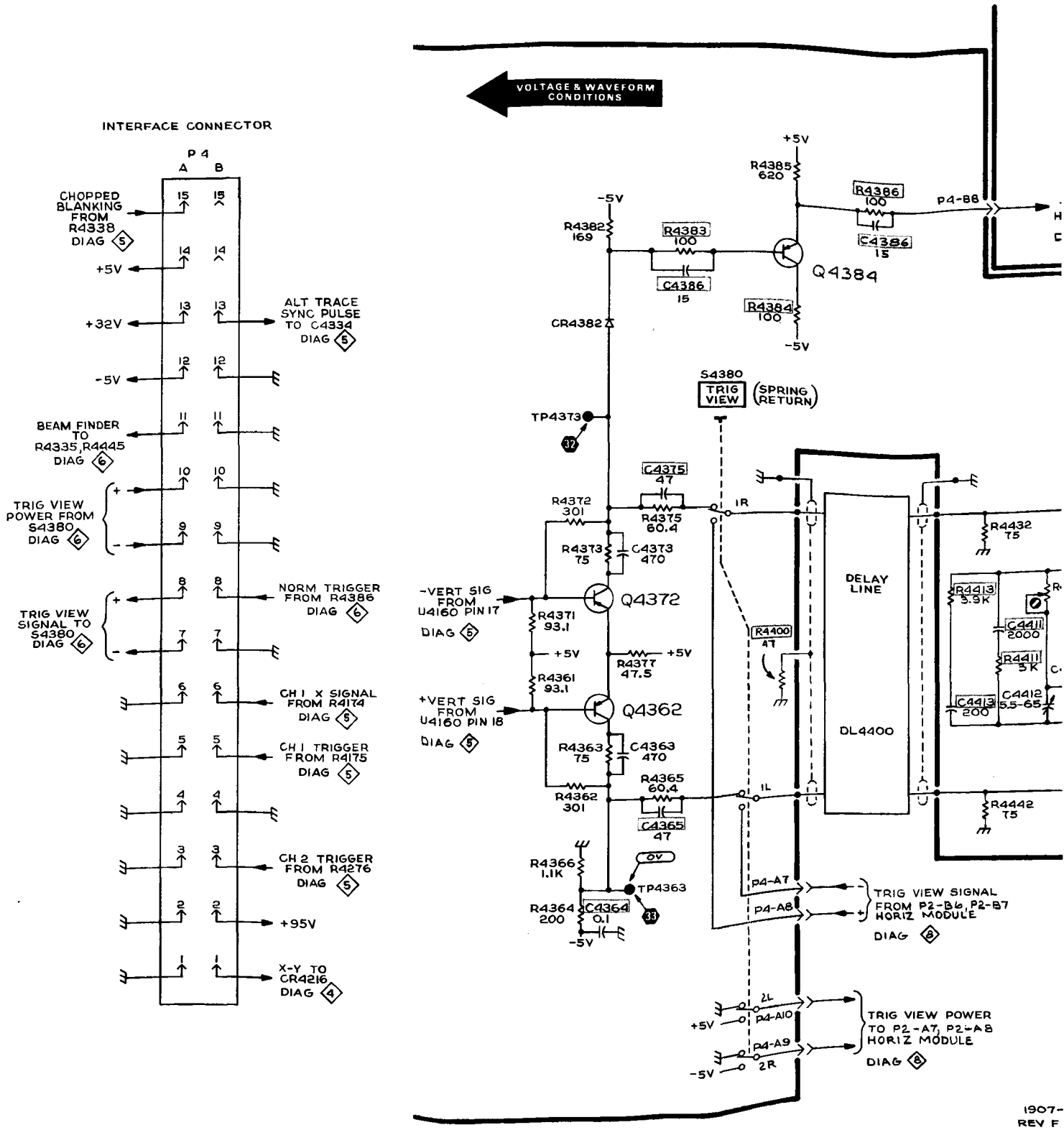
AC COUPLED

37

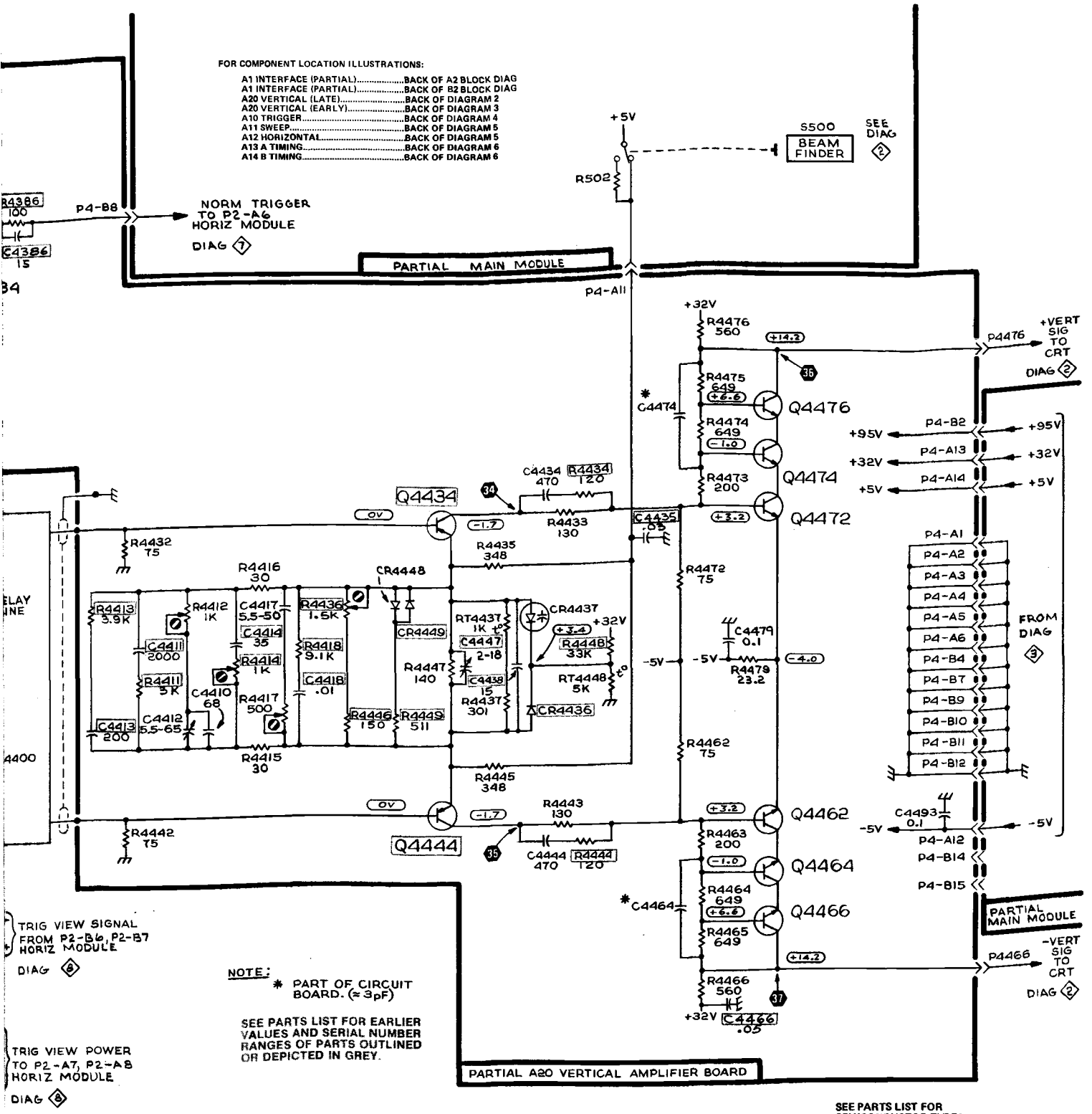


AC COUPLED

1907-108



455/A2/B2
(A2 VERTICAL MODULE)



1907-109
REV F AUG 1979

VERTICAL OUTPUT AMPLIFIER & INTERFACE CONNECTOR 6

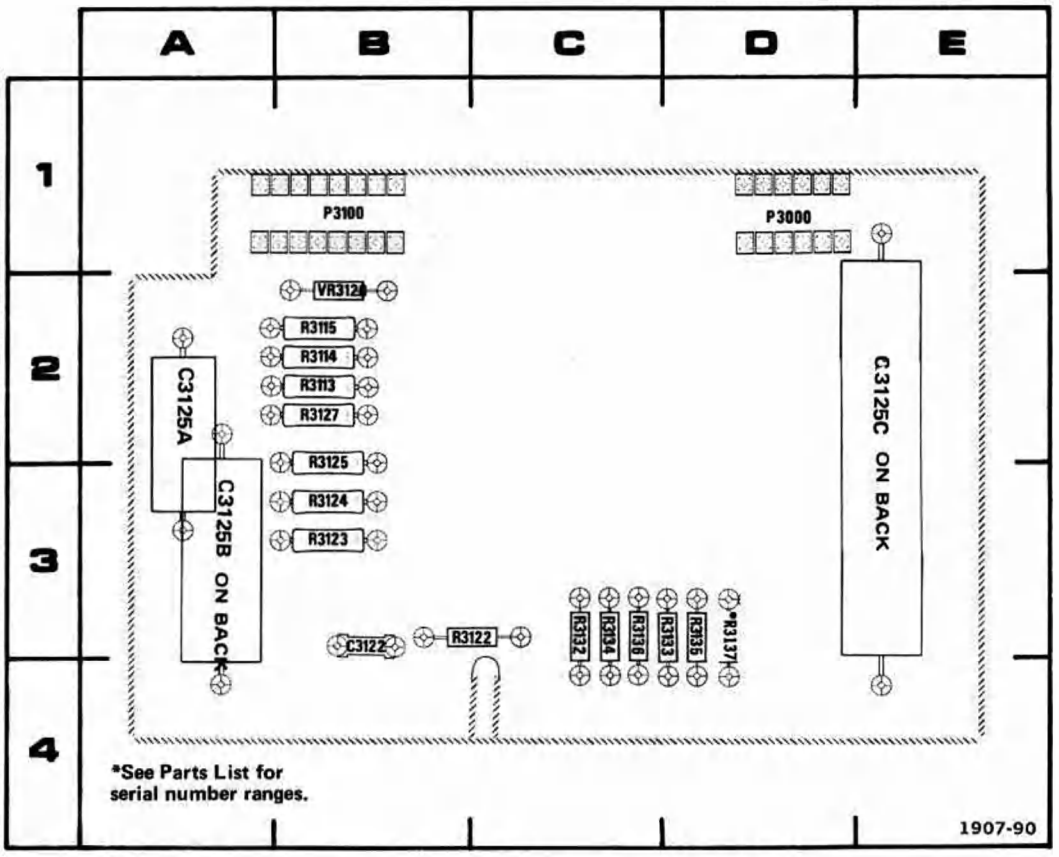


Fig. 9-9. A13—A Timing Switch board component locations.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C3122	3B	R3114	2B	R3134	3C
C3125A	2A	R3115	2B	R3135	3D
C3125B	3A	R3122	3C	R3136	3C
C3125C	2E	R3123	3B	R3137*	3D
		R3124	3B		
P3000	1D	R3125	2B	VR3128	2B
P3100	1B	R3127	2B		
		R3132	3C		
R3113	2B	R3133	3D		

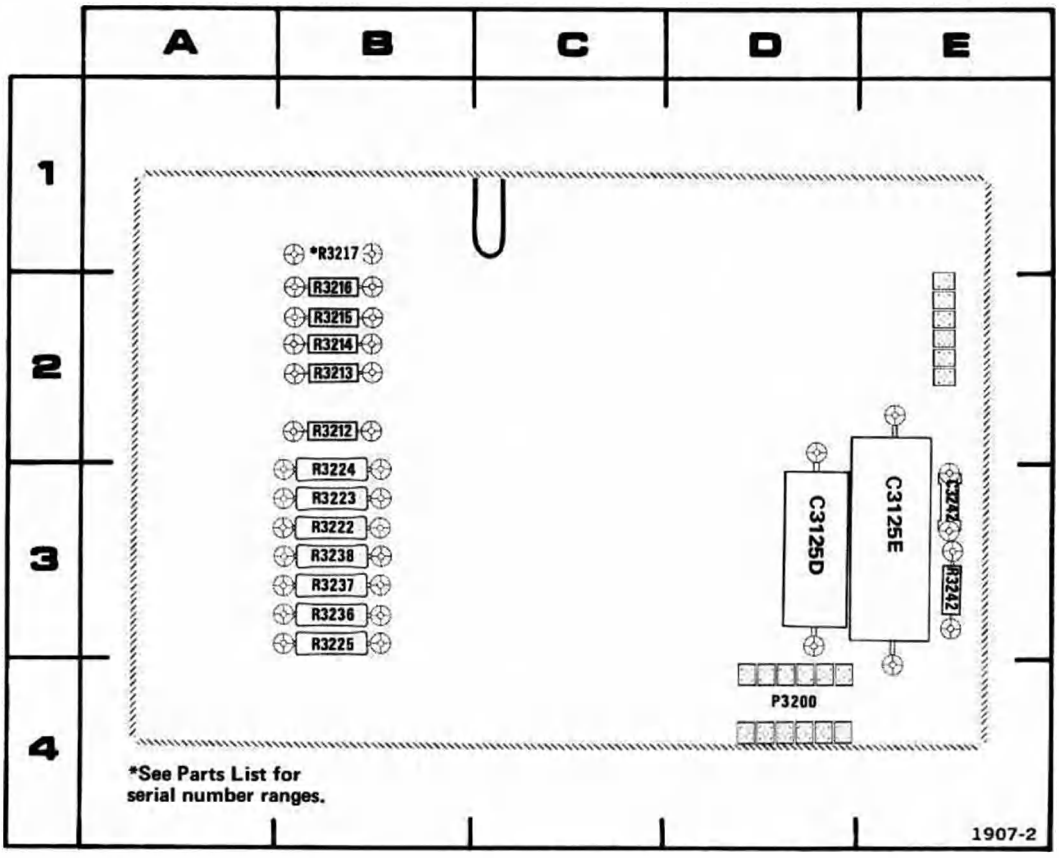
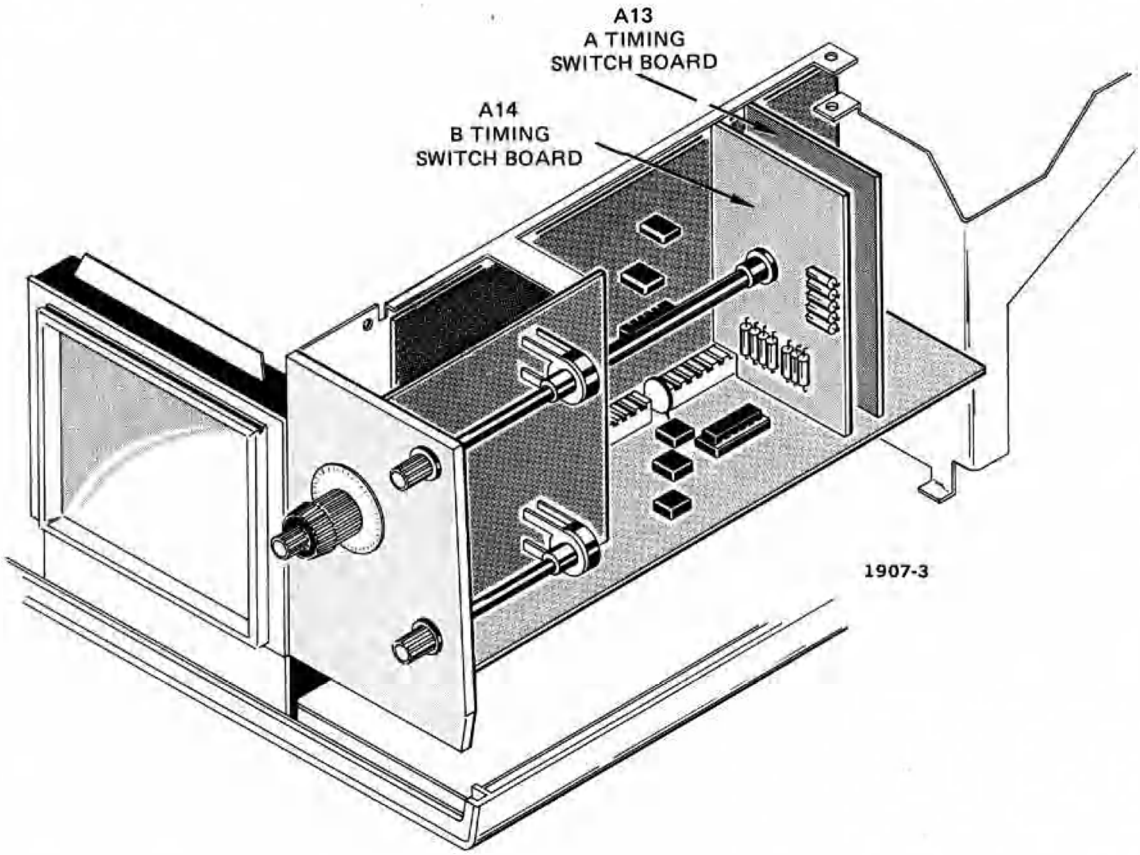


Fig. 9-10. A14—B Timing Switch board component locations.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C3242	3E	R3213	2B	R3224	3B
C3125D	3D	R3214	2B	R3225	3B
C3125E	3E	R3215	2B	R3236	3B
		R3216	2B	R3237	3B
P3200	4D	R3217*	1B	R3238	3B
		R3222	3B	R3242	3E
R3212	2B	R3223	3B		


A13
A TIMING
SWITCH BOARD
A14
B TIMING
SWITCH BOARD
1907-3

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

No signal was applied to the vertical input. The Main Module INTENSITY control was set to midrange. The B2 HORIZ DISPLAY was set to A INTEN and the B SOURCE switch to NORM.

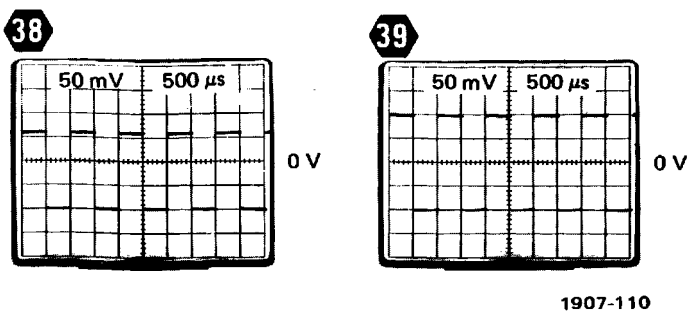
WAVEFORM CONDITIONS

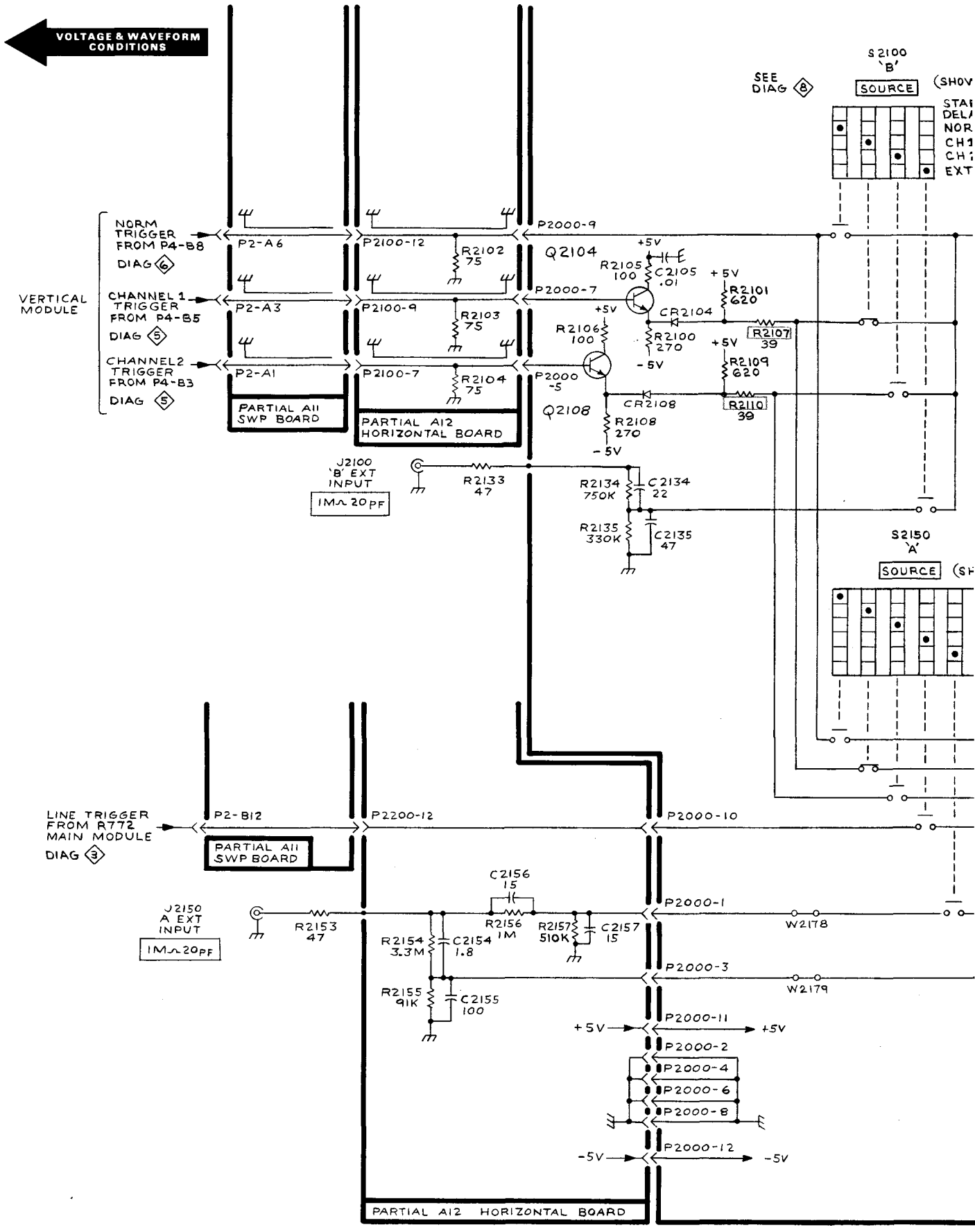
Waveforms below were taken from a Tektronix 7000-series oscilloscope equipped with readout, 7B series time-base, 7A13 Differential Comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

The Main Module calibrator signal was applied to the CH 1 vertical input through a compensated 10X probe. The Vertical Module CH 1 VOLTS/DIV switch was set to 5 mV. The test oscilloscope was triggered externally on the + slope from the (A) + GATE OUT connector at the rear of the Main Module.

The B2 controls were set as follows:

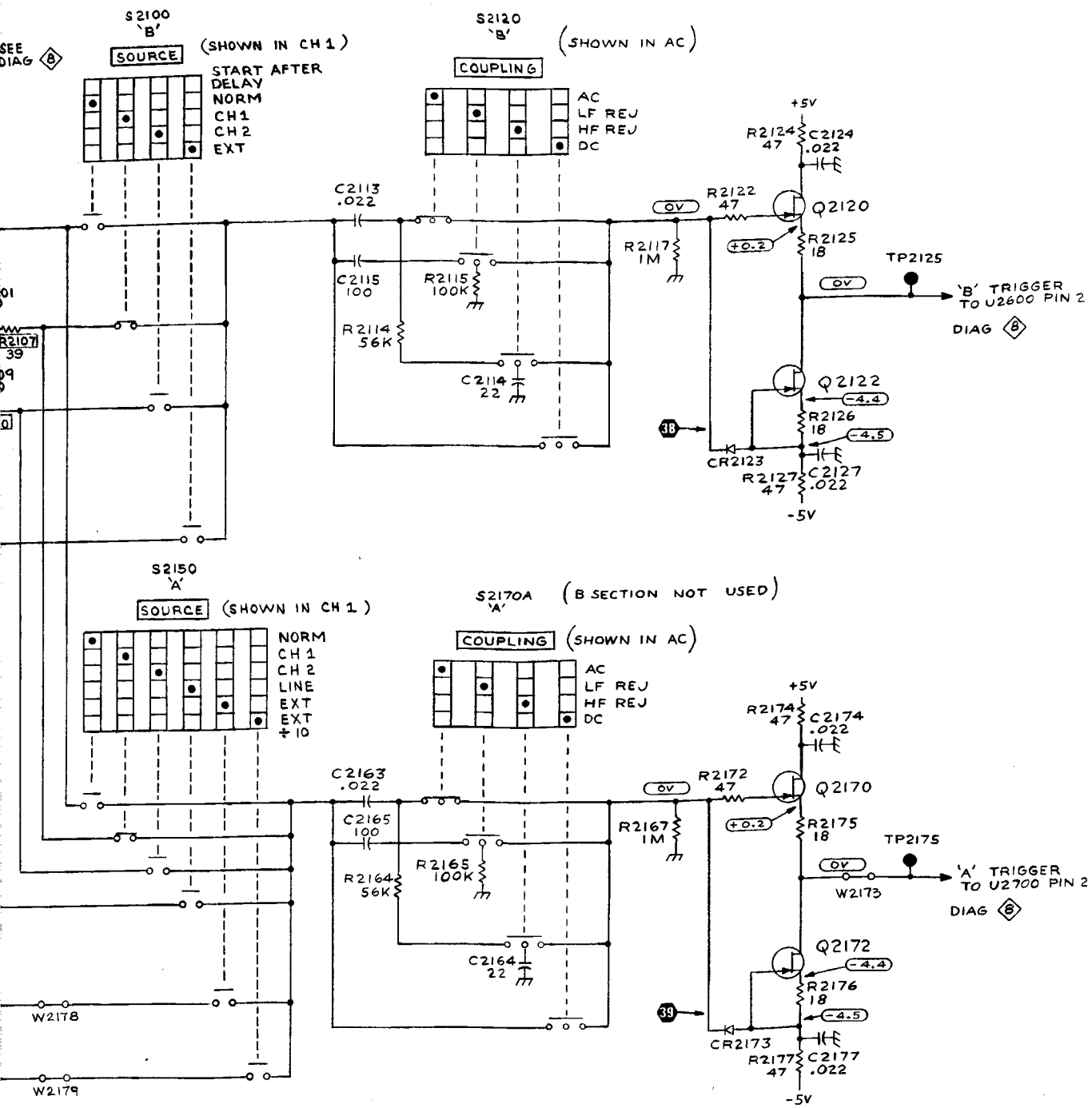
A SOURCE	NORM
B SOURCE	CH 1
A and B COUPLING	DC





455/A2/B2
(B2 HORIZONTAL MODULE)

1907-111
REV. C, NOV. 1977



FOR COMPONENT LOCATION ILLUSTRATIONS:

A1 INTERFACE (PARTIAL)	BACK OF A2 BLOCK DIAG
A1 INTERFACE (PARTIAL)	BACK OF B2 BLOCK DIAG
A20 VERTICAL (LATE)	BACK OF DIAGRAM 2
A20 VERTICAL (EARLY)	BACK OF DIAGRAM 3
A10 TRIGGER	BACK OF DIAGRAM 4
A11 SWEEP	BACK OF DIAGRAM 5
A12 HORIZONTAL	BACK OF DIAGRAM 5
A13 A TIMING	BACK OF DIAGRAM 6
A14 B TIMING	BACK OF DIAGRAM 6

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

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

PARTIAL A10 TRIGGER BOARD

1907-111
REV. C, NOV. 1977

TRIGGER INPUT 7

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%.

No signal was applied to the vertical input. The Main Module INTENSITY control was set to midrange. The B2 HORIZ DISPLAY was set to midrange. The B2 HORIZ DISPLAY was set to A INTEN and the B SOURCE switch to NORM.

Upper voltages shown on the schematic diagram were measured with pin 13 of U2790 grounded.

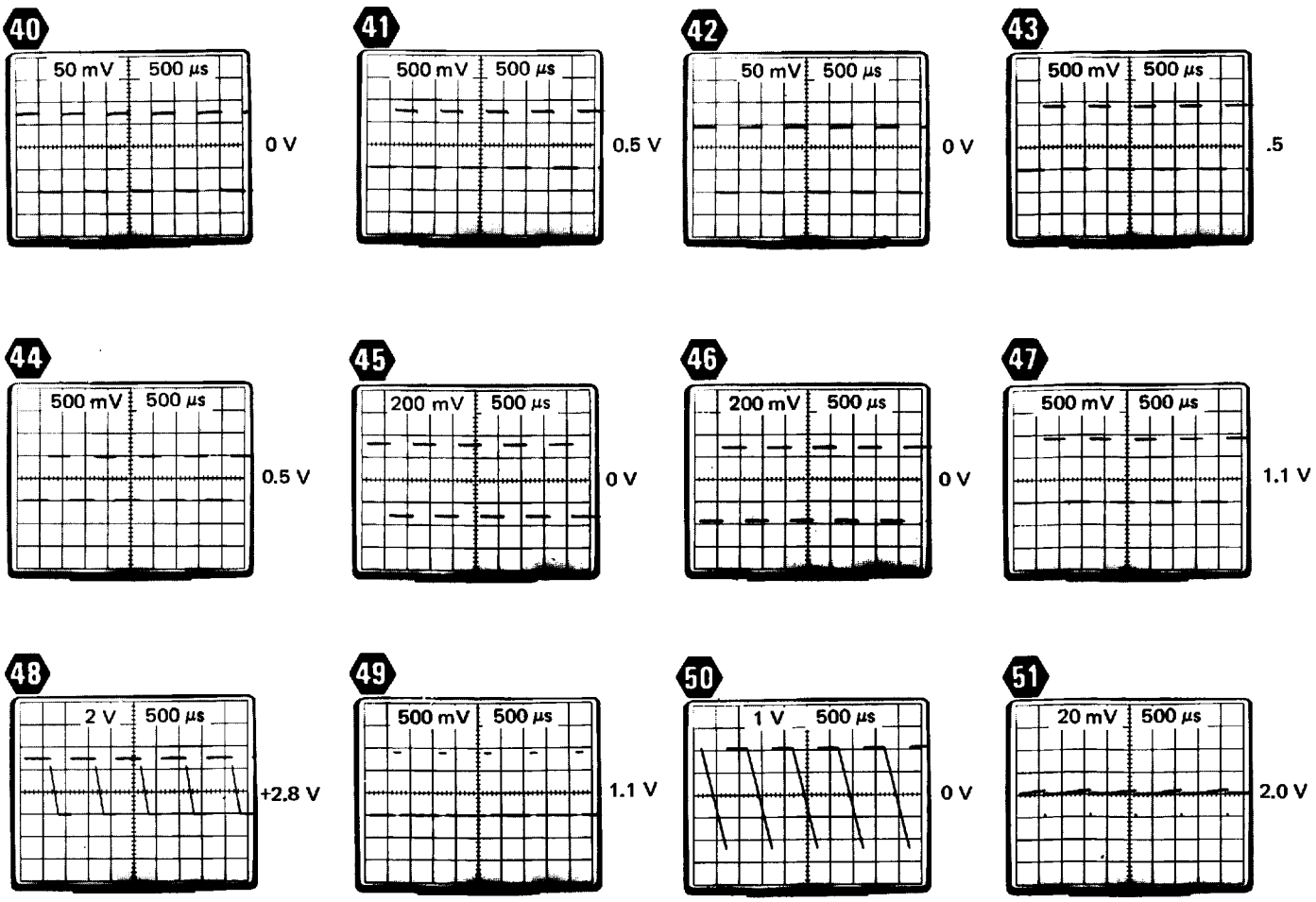
WAVEFORM CONDITIONS

Waveforms below were taken from a Tektronix 7000-series oscilloscope equipped with readout, 7B series time-base, 7A13 Differential Comparator and a 10X probe. The offset voltages were read directly from the 7A13 in the dc coupled mode. If a different test oscilloscope system is used, the ac coupled mode may have to be used due to high dc offset voltages. This can cause some waveforms to appear slightly different. Waveforms may vary as much as ±20%.

The Main Module calibrator signal was applied to the CH 1 vertical input through a compensated 10X probe. The Vertical Module CH 1 VOLTS/DIV switch was set to 5 mV. The test oscilloscope was triggered externally on the + slope from the (A) + GATE OUT connector at the rear of the Main Module.

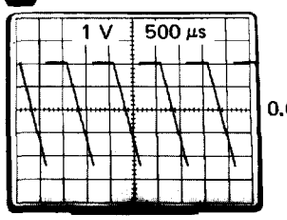
The B2 controls were set as follows:

HORIZ DISPLAY	A INTEN
A TIME/DIV	50 μs
B TIME/DIV	10 μs
A TRIG MODE	AUTO
A SOURCE	NORM
B SOURCE	CH 1
A and B COUPLING	DC
DELAY TIME POS	0.0
A and B LEVEL	For stable display



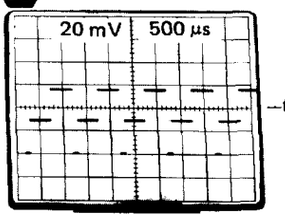
WAVEFORMS 40-51

52



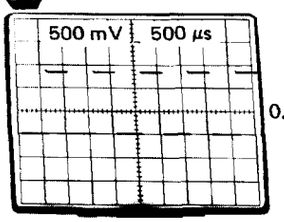
0.0 V

53



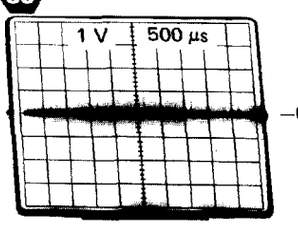
−0.6 V

54



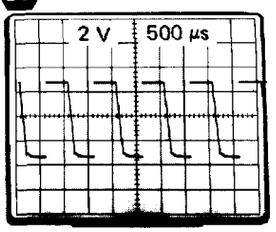
0.4 V

55



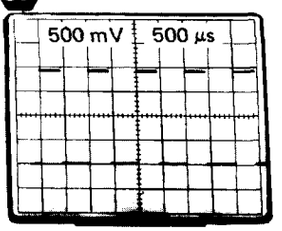
−0.8 V

56



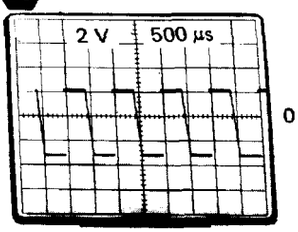
0 V

57



+0.3 V

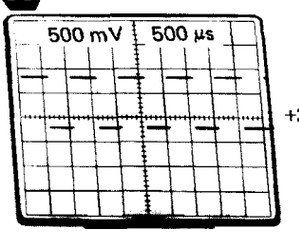
58



0 V

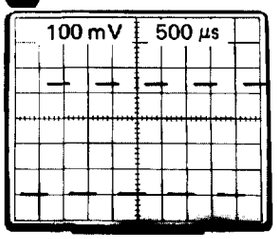
(B DLY'D MODE)

59



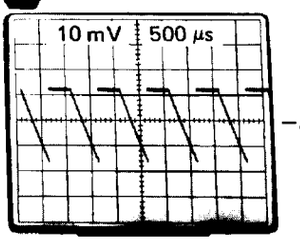
+3.0 V

60



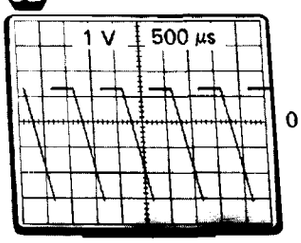
1.1 V

61



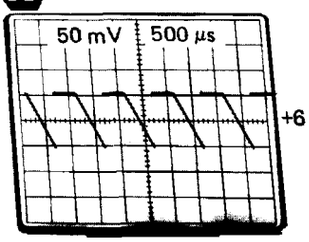
−.7 V

62



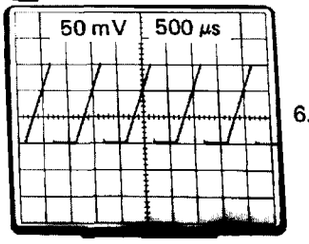
0 V

63



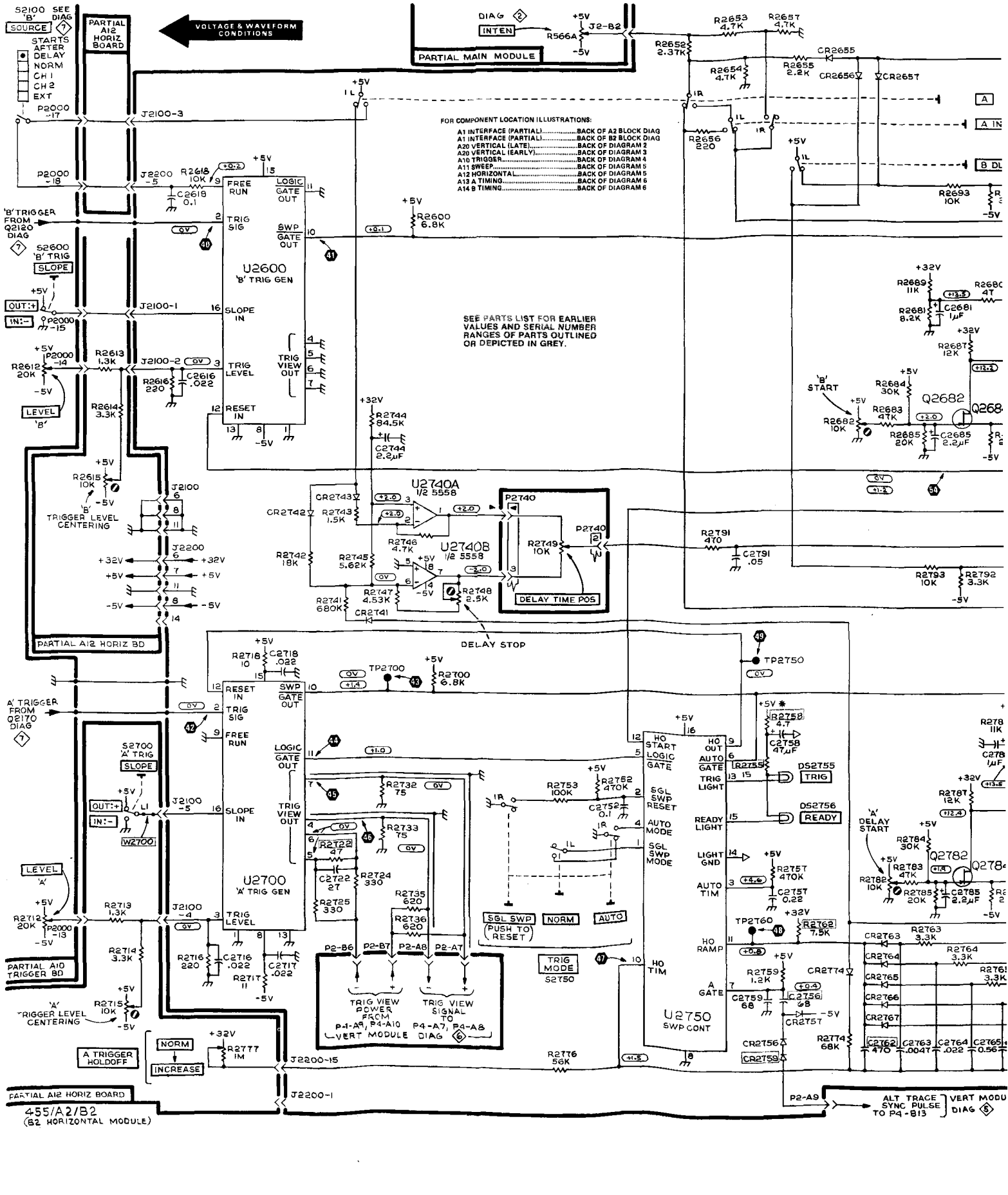
+6 V

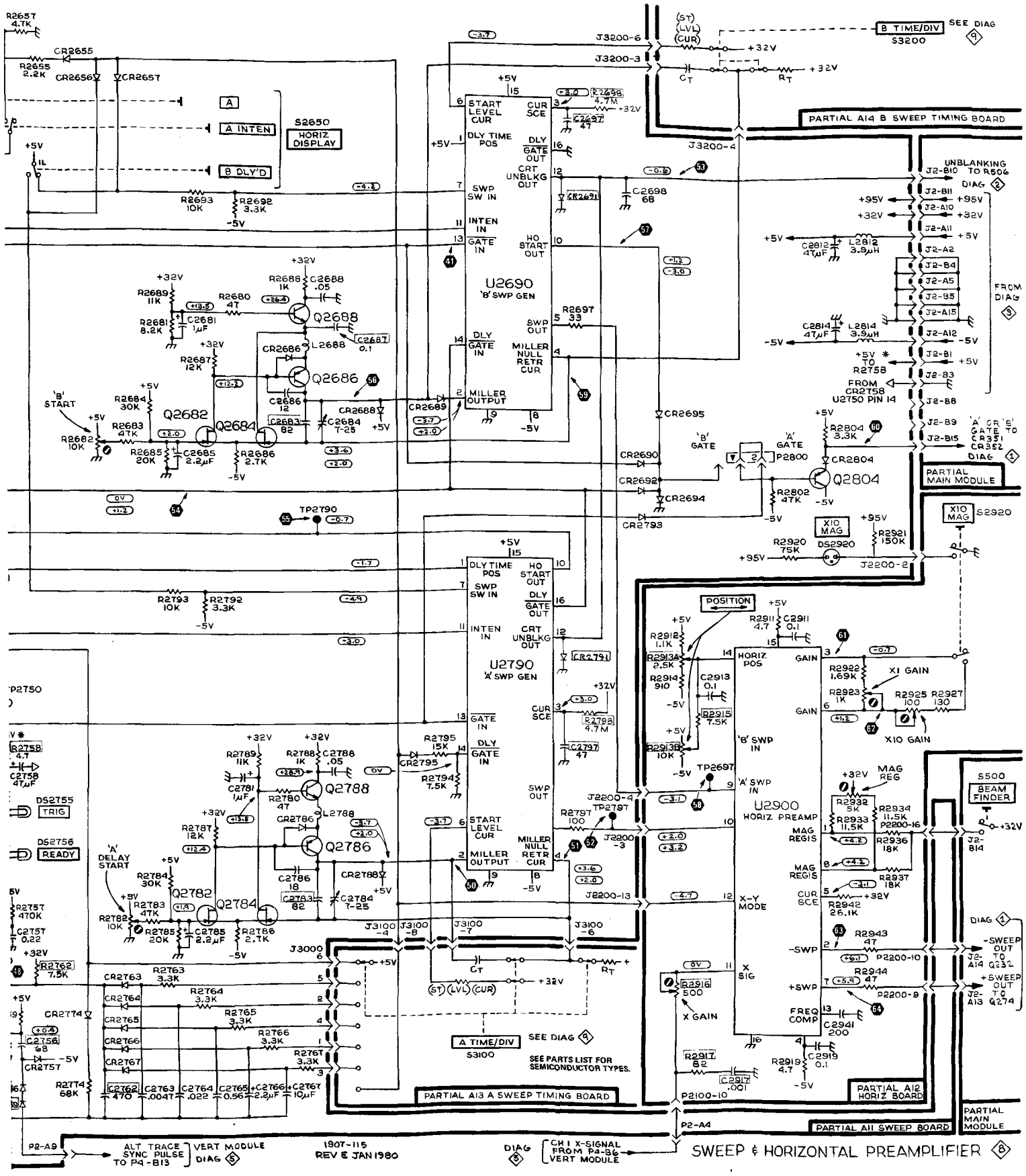
64

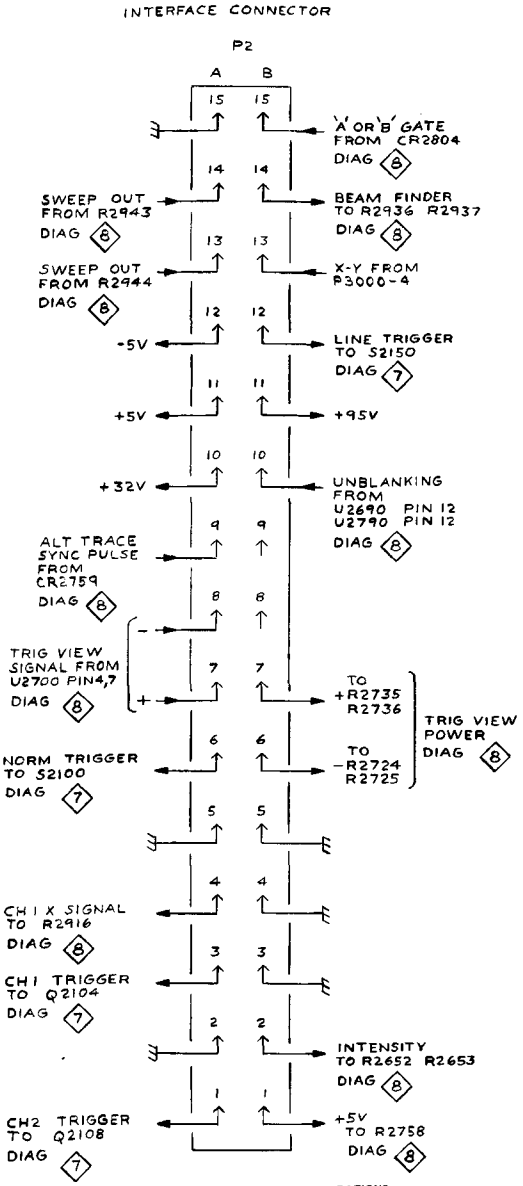


6.0 V

1907-117

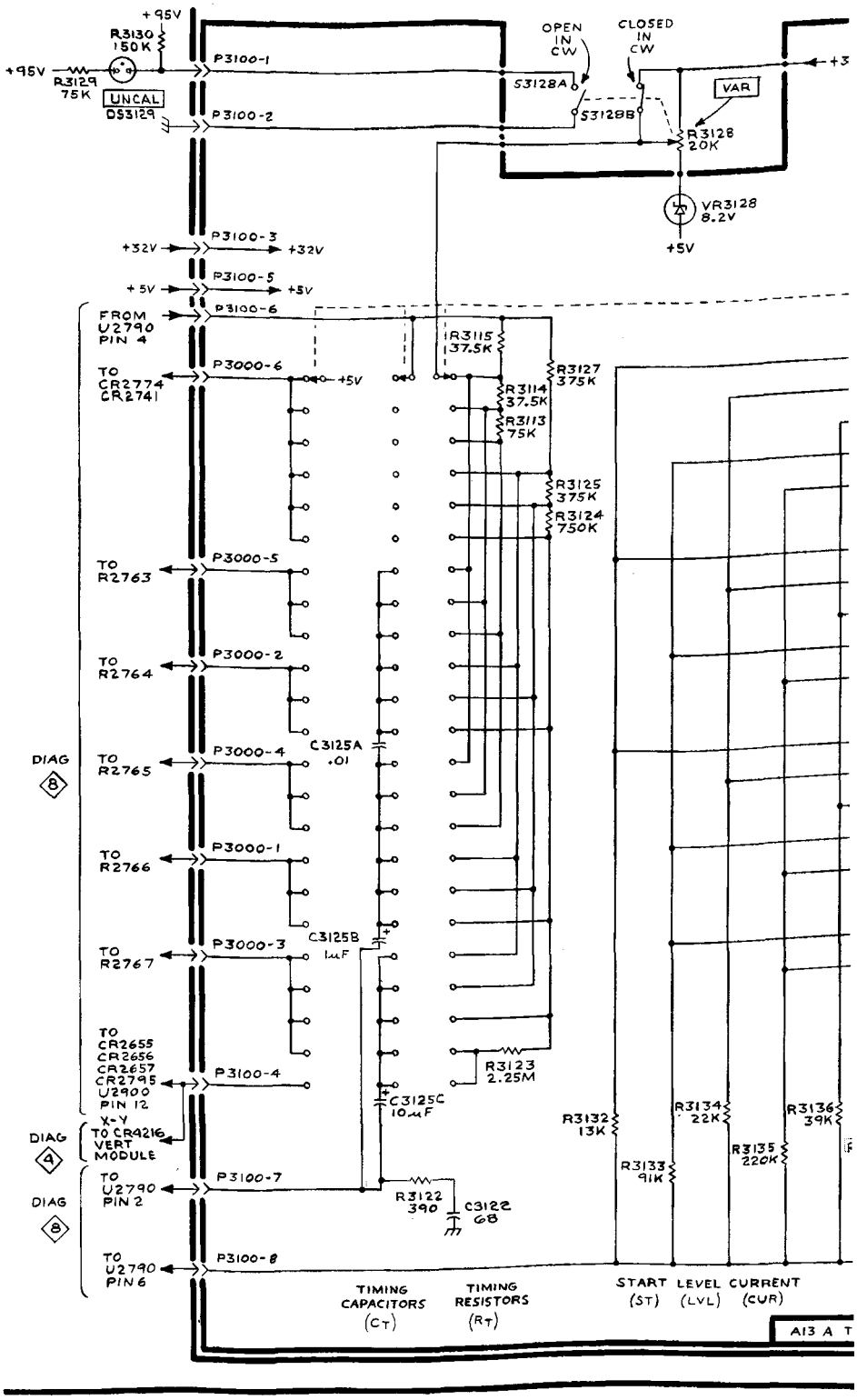

VOLTAGE & WAVEFORM CONDITIONS
PARTIAL MAIN MODULE
PARTIAL A12 HORIZ BOARD
PARTIAL A12 HORIZ BD
PARTIAL A10 TRIGGER BD
U2600 'B' TRIG GEN
U2700 'A' TRIG GEN
U2740A 1/2 5558
U2740B 1/2 5558
U2750 SWP CONT
FOR COMPONENT LOCATION ILLUSTRATIONS:
A1 INTERFACE (PARTIAL).....BACK OF A2 BLOCK DIAG
A1 INTERFACE (PARTIAL).....BACK OF B2 BLOCK DIAG
A20 VERTICAL (LATE).....BACK OF DIAGRAM 2
A20 VERTICAL (EARLY).....BACK OF DIAGRAM 3
A10 TRIGGER.....BACK OF DIAGRAM 4
A11 SWEEP.....BACK OF DIAGRAM 5
A12 HORIZONTAL.....BACK OF DIAGRAM 5
A13 A TIMING.....BACK OF DIAGRAM 6
A14 B TIMING.....BACK OF DIAGRAM 6
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
DELAY TIME POS
DELAY STOP
TRIG VIEW POWER FROM P4-A9, P4-A10
TRIG VIEW SIGNAL TO P4-A7, P4-A8
ALT TRACE SYNC PULSE TO P4-B13
455/A2/B2
(B2 HORIZONTAL MODULE)


SWEEP & HORIZONTAL PREAMPLIFIER
PARTIAL A14 B SWEEP TIMING BOARD
PARTIAL A13 A SWEEP TIMING BOARD
PARTIAL A12 HORIZ BOARD
PARTIAL A11 SWEEP BOARD
PARTIAL MAIN MODULE
U2690 'B' SWP GEN
U2790 'A' SWP GEN
U2900 HORIZ PREAMP
Q2682
Q2684
Q2686
Q2688
Q2782
Q2784
Q2786
Q2788
Q2804
S2650 HORIZ DISPLAY
S3200 B TIME/DIV
S3100 A TIME/DIV
S2920 X10 MAG
S500 BEAM FINDER
DS2755 TRIG
DS2756 READY
P2200-16
P2200-10
P2200-9
P2100-10
P2-A4
P2-A9
1907-115
REV E JAN 1980



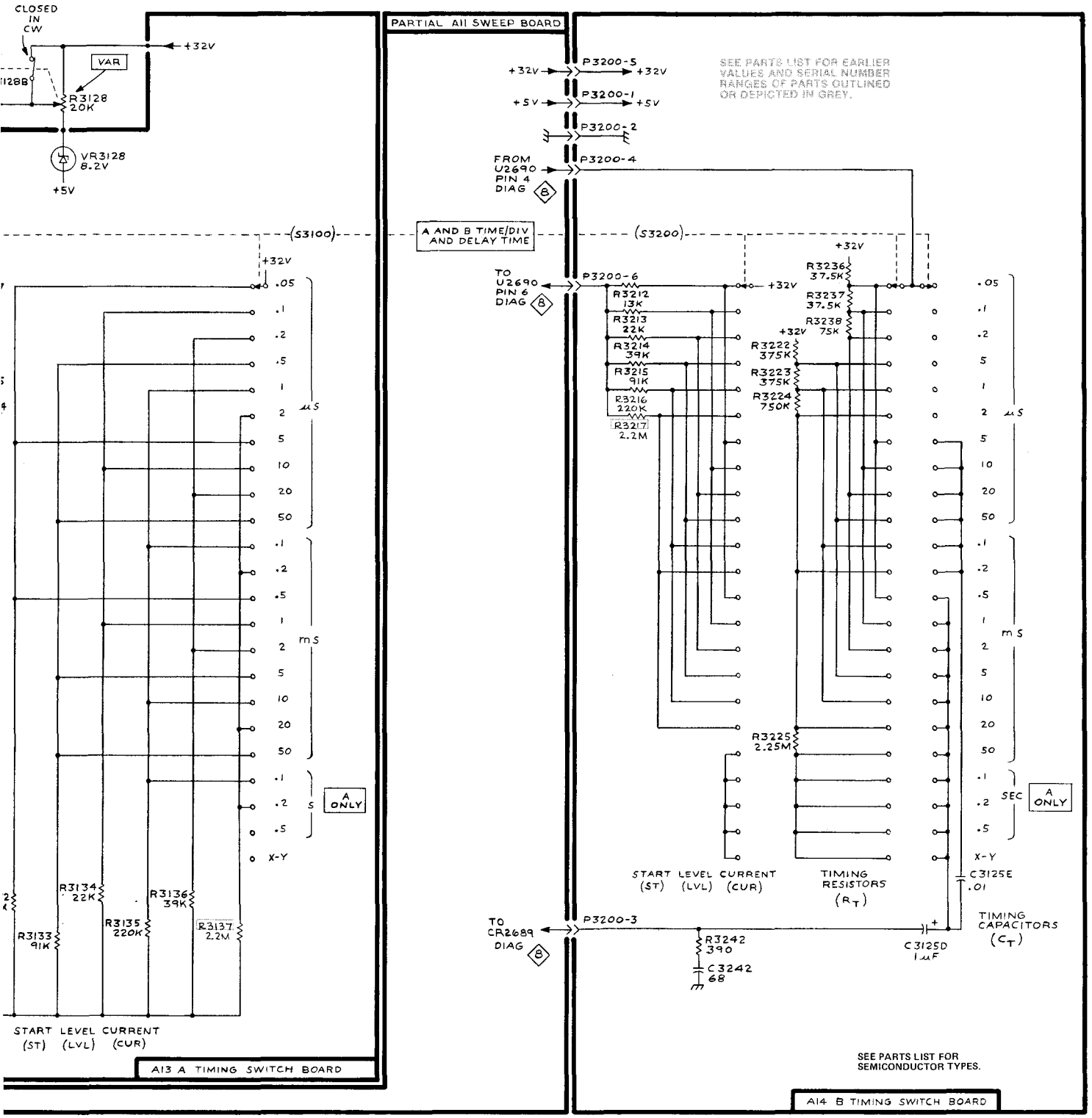
FOR COMPONENT LOCATION ILLUSTRATIONS:

A1 INTERFACE (PARTIAL)	BACK OF A2 BLOCK DIAG
A1 INTERFACE (PARTIAL)	BACK OF B2 BLOCK DIAG
A20 VERTICAL (LATE)	BACK OF DIAGRAM 2
A20 VERTICAL (EARLY)	BACK OF DIAGRAM 3
A10 TRIGGER	BACK OF DIAGRAM 4
A11 SWEEP	BACK OF DIAGRAM 5
A12 HORIZONTAL	BACK OF DIAGRAM 5
A13 A TIMING	BACK OF DIAGRAM 6
A14 B TIMING	BACK OF DIAGRAM 6



455/A2/B2
(B2 HORIZONTAL MODULE)

1907-116
REV E, FEB 1979



1907-116
REV E, FEB 1979

A&B TIMING SWITCH & INTERFACE CONNECTOR 9

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

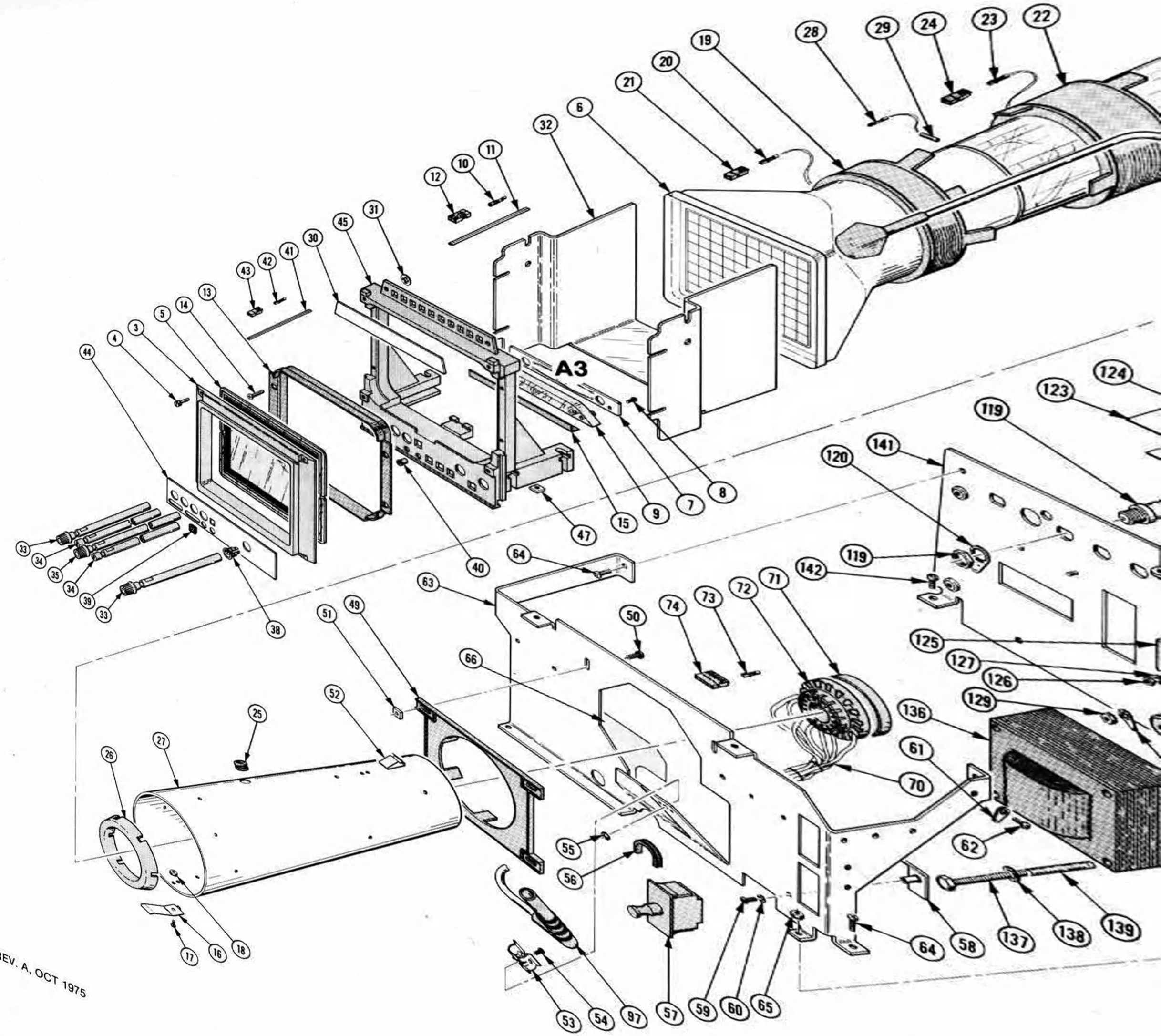
Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05006	TWENTIETH CENTURY PLASTICS, INC.	415 E WASHINGTON BLVD.	LOS ANGELES, CA 90015
05129	KILO ENGINEERING COMPANY	2015 D	LA VERNE, CA 91750
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
07322	MINNESOTA RUBBER CO.	3630 WOODDALE AVENUE	MINNEAPOLIS, MN 55416
07700	TECHNICAL WIRE AND PRODUCTS, INC.	129 DERMODY ST.	CRANFORD, NJ 07016
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
14438	USM CORP., NYLOK FASTERNER DIV.	3730 W. MORSE	LINCOLNWOOD, IL 60645
16428	BELDEN CORP.	P. O. BOX 1331	RICHMOND, IN 47374
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22670	G.M. NAMEPLATE, INC.	2040 15TH AVENUE WEST	SEATTLE, WA 98119
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
59730	THOMAS AND BETTS COMPANY	36 BUTLER ST.	ELIZABETH, NJ 07207
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80033	PRESTOLE EVERLOCK, INC.	P. O. BOX 278,1345 MIAMI ST.	TOLEDO, OH 43605
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544
99742	PERMACEL DIV. OF JOHNSON AND JOHNSON	U. S. HIGHWAY 1	NEW BRUNSWICK, NJ 08901

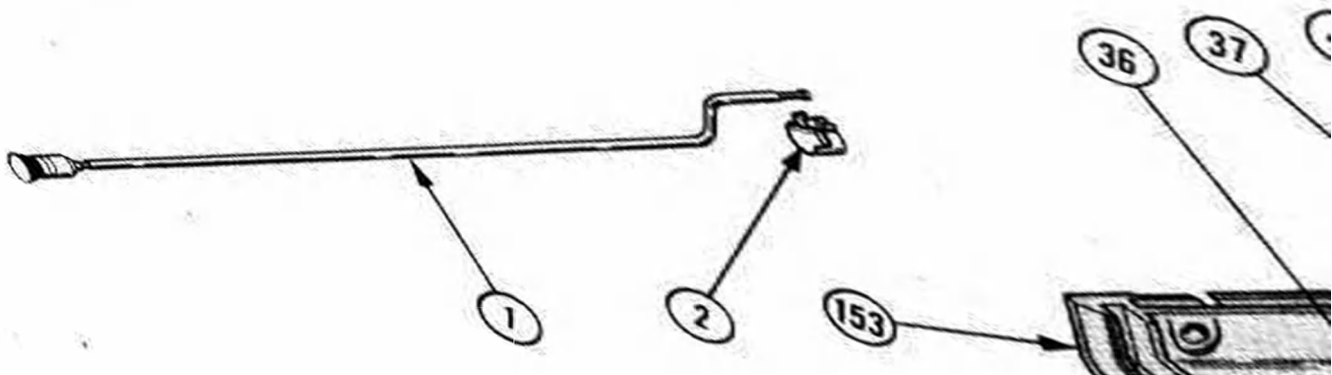
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	384-1311-01			1		EXTENSION SHAFT:0.125 D X 11.835" L,W/KNOB	80009	384-1311-01
						(ATTACHING PARTS)		
-2	376-0127-00			1		COUPLER,SHAFT:PLASTIC	80009	376-0127-00
						- - - * - - -		
-3	343-0523-00			1		RTNR,IMPLOSION:5.65 X 4.705 INCH,PLASTIC	80009	343-0523-00
-4	213-0313-00			4		THUMBSCREW:4-40 X 0.45 INCH,KNURLED	80009	213-0313-00
-5	337-2122-00			1		SHLD,IMPLOSION:BLUE	80009	337-2122-00
-6	----- -----			1		ELECTRON TUBE:ASSY,W/ANODE(SEE V560 EPL)		
-7	----- -----			1		CKT BOARD ASSY:SCALE ILLUM(SEE A3 EPL)		
						(ATTACHING PARTS)		
-8	211-0001-00			2		SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-9	378-0614-00			1		REFLECTOR,LIGHT:MOLDED PLASTIC	80009	378-0614-00
-10	175-0825-00			FT		WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-11	131-0621-00			2		CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-12	352-0198-00			1		HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-13	386-3336-00			1		SUPPORT,CRT:FRONT	80009	386-3336-00
						(ATTACHING PARTS)		
-14	213-0183-00			4		SCR,TPG,THD FOR:6-20 X 0.5 TYPE B,PNH,STL	83385	OBD
						- - - * - - -		
-15	337-2262-00			1		SHIELD,LIGHT:CRT SCALE	80009	337-2262-00
-16	214-2270-00			1		SPRING,GROUND:CRT TO SHIELD	80009	214-2270-00
						(ATTACHING PARTS)		
-17	211-0007-00			1		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-18	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	211-041800-00
						- - - * - - -		
-19	----- -----			1		COIL,TUBE DEFL:TRACE ROTATION(SEE L571 EPL)		
-20	131-0707-00			2		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-21	352-0169-01			1		. HLDR TERM CONN:2 WIRE,BROWN	80009	352-0169-01
-22	----- -----			1		COIL,TUBE DEFL:X-Y ALIGNMENT(SEE L573 EPL)		
-23	131-0707-00			2		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-24	352-0169-00			1		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-25	348-0004-00			1		GROMMET,RUBBER:0.281 ID X 0.563 INCH OD	70485	763
-26	386-3305-00			1		SUPPORT,CRT:REAR	80009	386-3305-00
	334-1951-01			1		MARKER,IDENT:MARKED WARNING	80009	334-1951-01
-27	337-2124-00	B010100	B057959	1		SHIELD,CRT:	80009	337-2124-00
	337-2124-03	B057960		1		SHIELD,CRT:	80009	337-2124-03
	343-0213-00	XB057960		1		CLAMP,LOOP:PRESS MT,PLASTIC	80009	343-0213-00
	334-2859-00	XB057960		1		MARKER,IDENT:MARKED CAUTION	22670	OBD
-28	131-0707-00			4		CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-29	131-0472-01			4		CONTACT,ELEC:FEMALE	80009	131-0472-01
-30	333-2061-00			1		PANEL,FRONT:	80009	333-2061-00
						(ATTACHING PARTS)		
-31	354-0195-00			2		RING,RETAINING:	97464	6100-12-ST-PA
						- - - * - - -		
-32	337-2207-00			1		SHIELD,ELEC:VERT AND HORIZ SUPPORT	80009	337-2207-00
-33	384-1350-02			2		KNOB:4.515" L X 0.28 OD PLASTIC	80009	384-1350-02
-34	384-1348-00			2		EXTENSION SHAFT:0.25 OD X 6.623 " L,PLSTC	80009	384-1348-00
-35	384-1350-00			1		EXTENSION SHAFT:0.2 OD X 12.215 " L,W/KNOB	80009	384-1350-00
-36	366-1559-00			1		PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-37	384-1129-00			1		EXTENSION SHAFT:5.607 INCH LONG	80009	384-1129-00
-38	358-0550-00			5		BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-39	426-1072-00			1		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-40	136-0387-00			2		JACK,TIP:GRAY	71279	450-4352-01-0318
-41	175-0825-00			FT		WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-42	131-0707-00			2		CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-43	352-0169-00			1		HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-44	333-1994-00			1		PANEL,FRONT:MAINFRAME	80009	333-1994-00
-45	426-1240-00			1		FR SECT,SCOPE:CRT FRONT SUPPORT	80009	426-1240-00
						(ATTACHING PARTS)		
-46	211-0516-00			4		SCREW,MACHINE:6-32 X 0.875 INCH,PNH STL	83385	OBD
-47	220-0419-00			4		NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-48	384-1351-00			1		EXTENSION SHAFT:0.312 OD X 1.0 INCH LONG	80009	384-1351-00
-49	386-3288-00	B010100	B055169	1		SPRT,CRT SHIELD:CRT	80009	386-3288-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-	386-3519-00	B055170		1		SPRT,CRT SHIELD:REAR	80009	386-3519-00
						(ATTACHING PARTS)		
-50	211-0534-00			2		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	OBD
	211-0097-00	XB055170		1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	210-0003-00	XB055170		1		WASHER,LOCK:EXT,0.123 ID X 0.245" OD,STL	78189	1104-00-00-0541C
	211-0116-00	XB055170		1		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-51	220-0419-00	B010100	B055169	2		NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL	83385	OBD
	210-0457-00	B055170		2		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-52	214-2371-00	B010100	B055169X	1		SPRING,GROUND:CRT SHIELD	80009	214-2371-00
	129-0308-00	XB055170		1		POST,ELEC-MECH:HEX.,0.25 X 0.465 INCH LONG	80009	129-0308-00
-53	344-0250-00			1		CLIP,ELECTRICAL:COMPONENT MOUNTING	80033	E50005-007
						(ATTACHING PARTS)		
-54	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-55	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	211-041800-00
						- - - * - - -		
-56	348-0141-00			1		GROMMET,PLASTIC:U-SHP,0.625 X0.658 INCH	80009	348-0141-00
-57	----- -----			1		SWITCH,PUSH:POWER ON(SEE S700 EPL)		
-58	343-0528-00			1		CLAMP,XSTR:SCALE ILLUM	80009	343-0528-00
						(ATTACHING PARTS)		
-59	211-0012-00			1		SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
-60	210-0004-00			1		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
-61	210-0202-00			1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-62	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	343-0002-00	XB043777		1		CLAMP,LOOP:0.188 INCH DIA	95987	3-16-6B
						(ATTACHING PARTS)		
	210-0547-00	XB043777		1		RING,EXT THD:0.562-40 X 0.313,BRS ALBALO	80009	210-0547-00
	210-0863-00	XB043777		1		WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
						- - - * - - -		
-63	441-1260-00			1		CHAS,ELEC EQPT:POWER SUPPLY	80009	441-1260-00
						(ATTACHING PARTS)		
-64	211-0534-00			4		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	OBD
-65	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	211-041800-00
						- - - * - - -		
-66	342-0297-00			1		INSULATOR,FILM:HIGH VOLTAGE POWER SUPPLY	80009	342-0297-00
	210-0994-00	XB030000		1		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
-67	337-2128-00			1		SHIELD,ELEC:HI VOLTAGE	80009	337-2128-00
						(ATTACHING PARTS)		
-68	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-69	348-0141-00			1		GROMMET,PLASTIC:U-SHP,0.625 X0.658 INCH	80009	348-0141-00
-70	136-0624-00	B010100	B056849	1		SKT,PL-IN ELEK:CRT	80009	136-0624-00
	136-0624-01	B056850		1		SKT,PL-IN ELEK:ELCTRN TUBE,14 CONT W/LEADS	80009	136-0624-01
	198-0902-01	XB056850		1		. WIRE SET,ELEC:	80009	198-0902-01
-71	200-0616-00			1		. . COVER,CRT SKT:1.78 DIA X 0.2 D,WHITE	80009	200-0616-00
-72	136-0202-01			1		. . SOCKET,PLUG-IN:14 PIN	80009	136-0202-01
-73	131-0707-00			4		. . CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-74	352-0162-00	B010100	B056849	1		. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
	352-0162-00	B056850		2		. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-75	----- -----			1		CKT BOARD ASSY:INTERFACE(SEE A1 EPL)		
						(ATTACHING PARTS)		
-76	211-0504-00			5		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-77	131-0566-00			10		. BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-78	131-0589-00			11		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-79	131-0608-00			12		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-80	136-0252-07			74		. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-81	136-0514-00			2		. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-82	131-1784-00	B010100	B049999	2		. CONNECTOR,RCPT,:CKT CD,15/30 FEMALE,600V	05574	000-201-4897
	131-2063-00	B050000		2		. CONN,RCPT,ELEC:CIRCUIT CARD,15/30 FEMALE	05574	000-201-4986
-83	131-1003-00			2		. CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-84	----- -----			1		. RES.,VARIABLE:INTENSITY(SEE R566A,B EPL)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-85	361-0761-00			1		. SPACER,VAR RES.:0.5 X 0.325 X 0.08 INCH	80009	361-0761-00
-86	----- -----			1		. RES.,VARIABLE:ASTIG(SEE R576 EPL)		
-87	----- -----			1		. RES.,VARIABLE:TRACE ROTATION(SEE R571 EPL)		
-88	----- -----			1		. SWITCH,PUSH:BEAM FIND(SEE S500 EPL)		
-89	361-0608-00			2		. SPACER,PUSH SW:PLASTIC	80009	361-0608-00
-90	----- -----			1		. RES.,VARIABLE:SCALE ILLUM(SEE R785 EPL)		
-91	214-0579-00			17		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-92	337-2172-00			1		. SHIELD,ELEC:HIGH VOLTAGE	80009	337-2172-00
-93	129-0178-00			1		. INSULATOR,STDF:0.312 OD X 1.365 INCH LONG	80009	129-0178-00
						(ATTACHING PARTS)		
-94	211-0207-00	B010100	B069938	1		. SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	OBD
	211-0244-00	B069939		1		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
-95	129-0230-00			1		. SPACER,POST:1.375L,W/4-40THD EA END,BRAS	80009	129-0230-00
						(ATTACHING PARTS)		
-96	211-0207-00	B010100	B069938	1		. SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	OBD
	211-0244-00	B069939		1		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
	210-0994-00	XB030000		1		. WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
						- - - * - - -		
-97	----- -----			1		. SEMICOND DVC:HV MULTR,W/ANODE(SEE U550 EPL)		
-98	200-0258-00			1		. SHLD,CAPACITOR:PLASTIC	80009	200-0258-00
-99	----- -----			1		. RES.,VARIABLE:FOCUS(SEE R564 EPL)		
	210-0407-00	XB057000		1		. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-100	344-0154-00			6		. CLIP,ELECTRICAL:FUSE,CKT BD MT	80009	344-0154-00
-101	175-0862-00			FT		WIRE,ELECTRICAL:3 WIRE RIBBON	08261	SS-0322-1910610C
-102	131-1790-00			9		CONTACT,ELEC:18-24 AWG,FEMALE,BRASS	27264	08-56-0105
-103	204-0671-00			3		BODY,CONN,PLUG,:3 FEMALE POSN. NYLON	27264	09-50-4031
-104	131-0621-00			9		CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-105	352-0199-00			3		CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-106	348-0434-00			4		FOOT,CABINET:REAR COVER	80009	348-0434-00
-107	333-2073-00			1		PANEL,REAR:455	80009	333-2073-00
	333-2073-02			1		PANEL,REAR:	80009	333-2073-02
	----- -----			-		(FOR OPTION 3 ONLY)		
	333-2073-03			1		PANEL,REAR:	80009	333-2073-03
	----- -----			-		(FOR OPTION 37 ONLY)		
						(ATTACHING PARTS)		
-108	354-0195-00			2		RING,RETAINING:	97464	6100-12-ST-PA
						- - - * - - -		
	334-1904-00			1		MARKER,IDENT:MKD TEKTRONIXINC	22670	OBD
	334-3379-00	XB056840		1		MARKER,IDENT:MARKED GROUNDSYMBOL	80009	334-3379-00
-109	200-1802-01	B010100	B056979	1		COVER,SCOPE:REAR	80009	200-1802-01
	----- -----			-		(STANDARD ONLY)		
	200-1802-07	B056980		1		COVER,SCOPE:REAR	80009	200-1802-07
	----- -----			-		(STANDARD ONLY)		
	200-1802-03	B010100	B057069	1		COVER,SCOPE:REAR	80009	200-1802-03
	----- -----			-		(FOR OPTION 7 ONLY)		
	200-1802-08	B057070		1		COVER,SCOPE:REAR	80009	200-1802-08
	----- -----			-		(FOR OPTION 7 ONLY)		
	200-1802-03	B010100	B068189	1		COVER,SCOPE:REAR	80009	200-1802-03
	----- -----			-		(FOR OPTION 3 ONLY)		
	200-1802-09	B068190		1		COVER,SCOPE:REAR	80009	200-1802-09
	----- -----			-		(FOR OPTION 3 ONLY)		
	200-1802-04	B010100	B057069	1		COVER,SCOPE:REAR	80009	200-1802-04
	----- -----			-		(FOR OPTION 37 ONLY)		
	200-1802-10	B057070		1		COVER,SCOPE:REAR	80009	200-1802-10
	----- -----			-		(FOR OPTION 37 ONLY)		
						(ATTACHING PARTS)		
-110	211-0511-00			4		SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	OBD
						- - - * - - -		
-111	----- -----			3		TRANSISTORS:(SEE Q736,Q746,Q768 EPL)		
						(ATTACHING PARTS)		
-112	211-0016-00	B010100	B010299X	3		SCREW,MACHINE:4-40 X 0.625 INCH,PNH STL	83385	OBD
-113	210-0406-00			3		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-114	210-1122-00			3		WASHER,LOCK:0.228 ID X 0.375 INCH OD,STL	04713	B52200F006
						- - - * - - -		
-115	342-0163-00			3		INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
-116	175-1255-00			FT		CABLE,RF:50 OHM COAX,3.35 FT	80009	175-1255-00
-117	210-0774-00			3		EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-118	210-0775-00			3		EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-119	----- -----			3		CONN RCPT:BNC,W/HDWR(SEE J359,513,4289 EPL)		
						(ATTACHING PARTS)		
-120	210-0255-00			3		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
						- - - * - - -		
-121	214-2330-00			1		HEAT SINK,XSTR:	80009	214-2330-00
						(ATTACHING PARTS)		
-122	210-0457-00			4		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-123	337-2249-00			1		SHIELD,ELEC:POWER LINE	80009	337-2249-00
						(ATTACHING PARTS)		
-124	211-0097-00			2		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-125	----- -----			1		SWITCH,SLIDE:LINE SELECT(SEE S701 EPL)		
						(ATTACHING PARTS)		
-126	210-0406-00			2		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-127	210-0004-00			2		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
-128	210-0201-00			3		TERMINAL,LUG:SE #4	86928	A373-157-2
						(ATTACHING PARTS)		
-129	210-0586-00			3		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	211-041800-00
						- - - * - - -		
	210-0202-00			1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-130	131-0775-00	B010100	B057169	1		CONTACT,ELEC:HEX,0.25 INCH W/6-32 1 END	88245	1601-A
	131-0775-00	B057170		2		CONTACT,ELEC:HEX,0.25 INCH W/6-32 1 END	88245	1601-A
-131	161-0033-07			1		CABLE ASSY,PWR,:3 WIRE,92 INCH LONG	16428	KH8389
						(ATTACHING PARTS)		
-132	358-0323-00			1		BSHG,STRAIN RLF:90 DEG,0.515 DIA HOLE	28520	SR15-1
						- - - * - - -		
-133	200-0237-01	B010100	B063429	1		COVER,FUSE HLDR:BLACK PLASTIC	80009	200-0237-01
	200-0237-03	B033430	B069589	1		COVER,FUSE HLDR:	80009	200-0237-03
	200-0237-04	B069590		1		COVER,FUSE HLDR:PLASTIC	80009	200-0237-04
-134	352-0362-01			1		FUSEHOLDER:W/HARDWARE	75915	345002
-135	333-2091-00			1		PANEL,REAR:POWER INTAKE	80009	333-2091-00
-136	----- -----			1		TRANSFORMER:POWER(SEE T700 EPL)		
						(ATTACHING PARTS)		
-137	212-0522-00			4		SCREW,MACHINE:10-32 X 2.50",HEX HD STL	83385	OBD
-138	210-0812-00			4		WASHER,NONMETAL:#10,FIBER	86445	OBD
-139	166-0457-00			4		INSUL SLVG,ELEC:0.19 ID X 1.875"LONG MYLAR	80009	166-0457-00
-140	220-0410-00			4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
						- - - * - - -		
	334-3379-00	XB056840	B057169X	1		MARKER,IDENT:MARKED GROUND SYMBOL	80009	334-3379-00
-141	386-3132-00	B010100	B057169	1		SUBPANEL,REAR:	80009	386-3132-00
	386-3132-01	B057170		1		SUBPANEL,REAR:	80009	386-3132-01
						(ATTACHING PARTS)		
-142	211-0534-00			2		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-143	179-2188-00	B010100	B057169	1		WIRING HARNESS,:AC	80009	179-2188-00
	179-2188-01	B057170		1		WIRING HARNESS:	80009	179-2188-01
-144	131-0861-00			4		. TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
-145	200-1075-00			4		. COVER,TERM:QUICK DISCONNECT	00779	1-480435-0
-146	348-0080-01			4		FOOT,CABINET:BOTTOM	80009	348-0080-01
						(ATTACHING PARTS)		
-147	211-0511-00	B010100	B010349X	4		SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	OBD
-148	210-0803-00	B010100	B010349X	4		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD PL	12327	OBD
						- - - * - - -		
-149	105-0677-00			5		LATCH,CABINET:	80009	105-0677-00
						(ATTACHING PARTS)		
-150	354-0553-00			5		RING,RETAINING:0.188 " OD,PUSH ON,SLF LKG	79136	5115-18-.010
-151	210-1241-00			5		WASHER,SPR TNSN:0.265 ID X 0.5 " OD	78189	3515-14-11
						- - - * - - -		
	343-0592-00			1		COLLAR,SHAFT:0.213 ID X 0.25 H,AL 0.375	80009	343-0592-00
-152	348-0457-00			FT		SHLD,GSKT,ELEC:0.125 OD X 45.392 INCH LONG	07700	21-13900
-153	441-1259-00	B010100	B069427	1		CHASSIS,SCOPE:MAIN	80009	441-1259-00
	441-1259-04	B069428		1		CHASSIS,SCOPE:MAIN	80009	441-1259-04
	198-3958-00			1		WIRE SET,ELEC:	80009	198-3958-00





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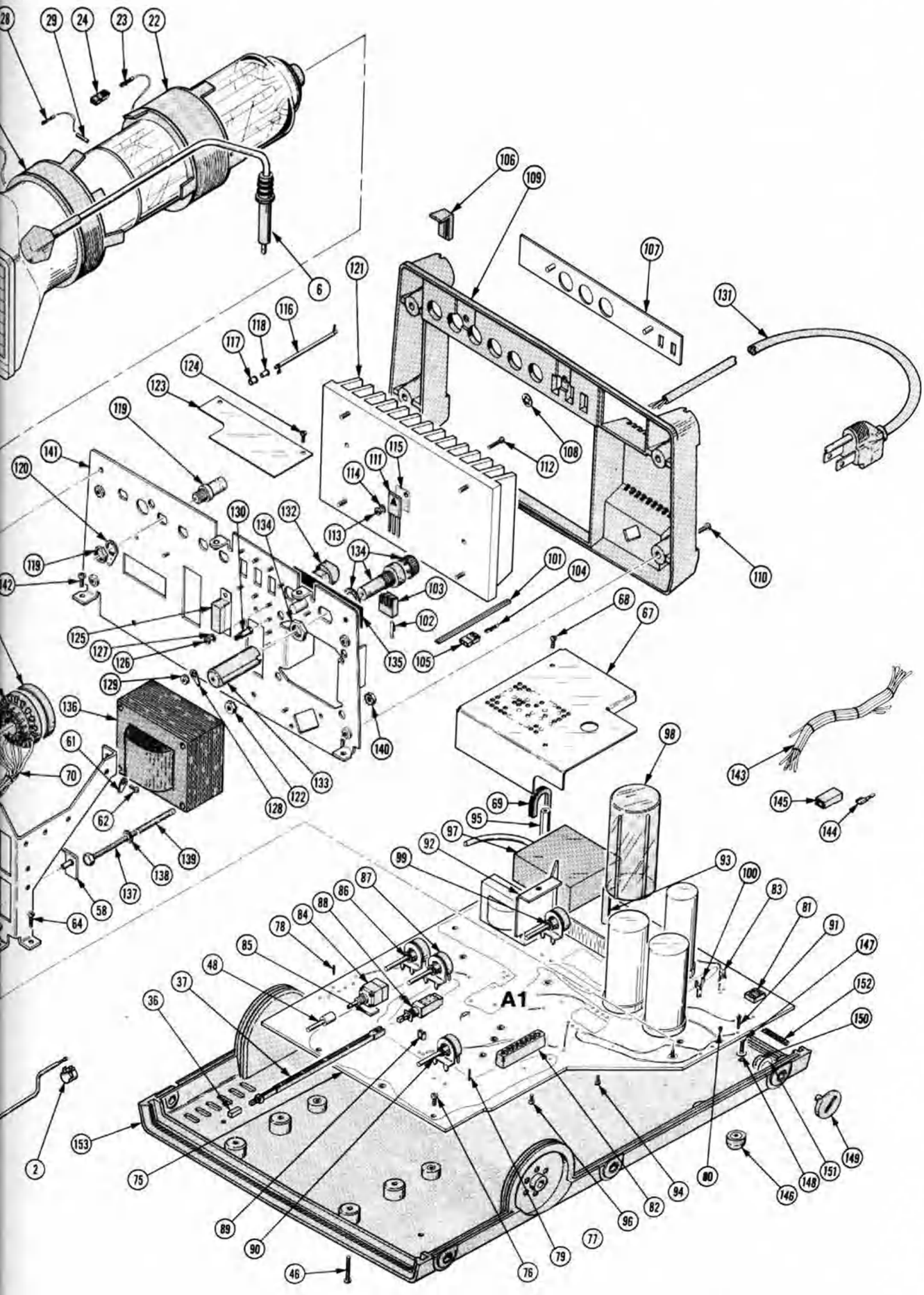

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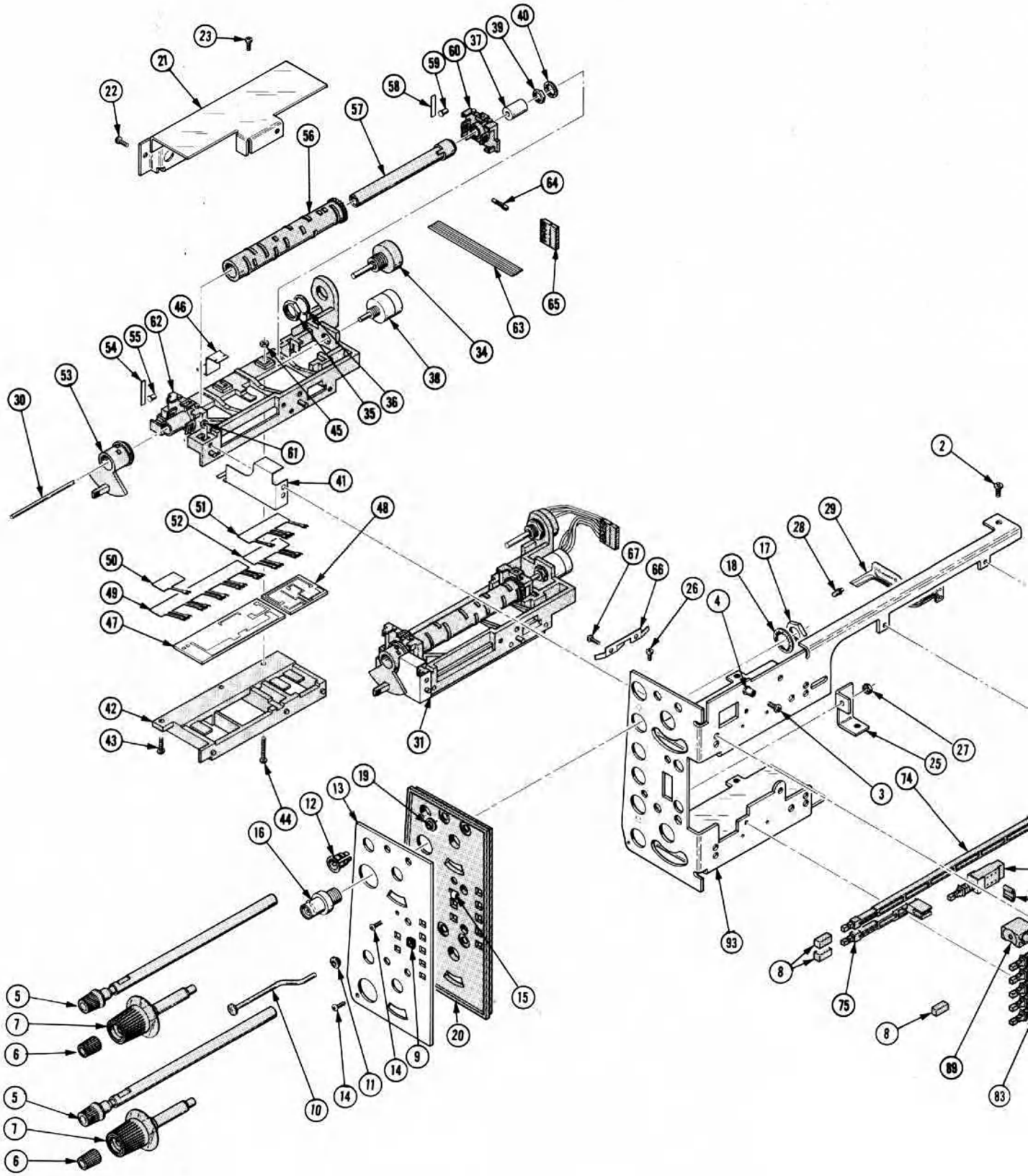
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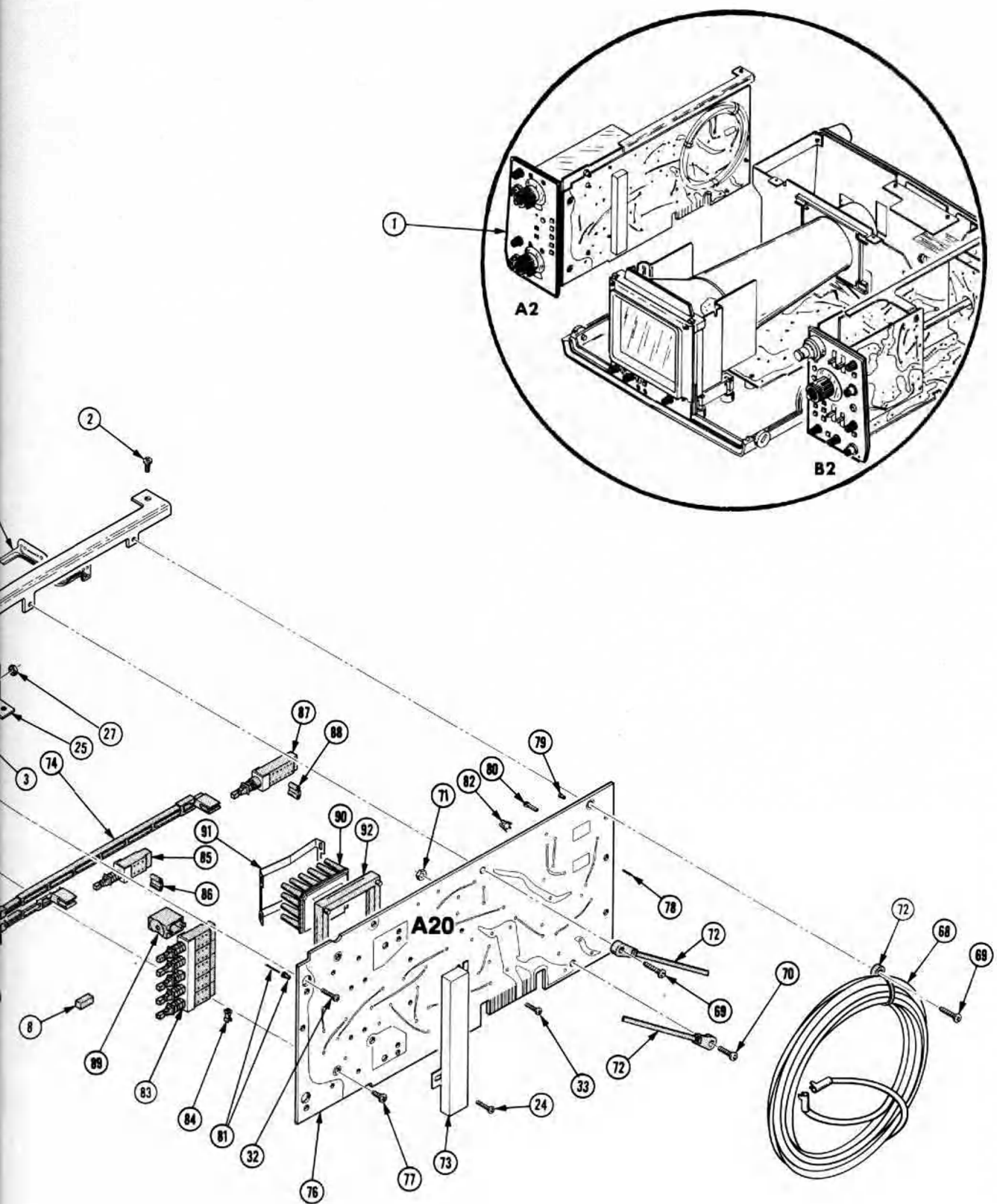
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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	672-0468-00			1		CKT BOARD ASSY:VERTICAL MODULE,A2	80009	672-0468-00
						(ATTACHING PARTS)		
-2	211-0504-00	B010100	B011709	1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
	211-0503-00	B011710		1		SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
-3	211-0510-00			1		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0457-00			1		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
-4	129-0575-00			1		SPACER,POST:0.312 L,W/6-32 THD,BRS,0.31	80009	129-0575-00
						- - - * - - -		
	----- -----			-		. VERTICAL MODULE ASSY INCLUDES:		
-5	384-1350-01			2		. EXTENSION SHAFT:0.2 OD X 6.193 " L,W/KNOB	80009	384-1350-01
-6	366-1031-02			2		. KNOB:RED,VAR,0.127ID X 0.392 OD	80009	366-1031-02
	213-0153-00			1		. . SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-7	384-1372-01			2		. EXTENSION SHAFT:2.701 " L,W/KNOB AND SKIRT	80009	384-1372-01
-8	366-1559-00			7		. PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-9	426-1072-00			7		. FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-10	378-0842-00			2		. LENS,LIGHT:0.125 DIA X 2.39 INCH LONG	80009	378-0842-00
-11	358-0378-01			2		. BUSHING,SLEEVE:0.250 OD X 0.131 ID,PRESS MT	80009	358-0378-01
-12	358-0550-00			2		. BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-13	333-1996-00	B010100	B022549	1		. PANEL,FRONT:VERTICAL	80009	333-1996-00
	333-1996-01	B022550	B046869	1		. PANEL,FRONT:VERTICAL	80009	333-1996-01
	333-1996-02	B046870		1		. PANEL,FRONT:VERTICAL	80009	333-1996-02
						(ATTACHING PARTS)		
-14	213-0120-00			2		. SCR,TPG,THD FOR:2-32 X 0.250 INCH,PNH STL	83385	OBD
	213-0113-00			2		. SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	93907	OBD
						- - - * - - -		
-15	214-2329-00			1		. SPRING,GROUND:FRONT PANEL	80009	214-2329-00
-16	131-0679-02			2		. CONNECTOR,RCPT,:BNC,MALE,3 CONTACT	24931	28JR270-1
						(ATTACHING PARTS)		
-17	220-0497-00			2		. NUT,PLAIN,HEX.:0.5-28 X 0.562 INCH HEX,BRS	73743	OBD
-18	210-1039-00			2		. WASHER,LOCK:INT,0.521 ID X 0.625 INCH OD	24931	OBD
						- - - * - - -		
-19	352-0419-00			4		. HOLDER,LED:0.131 ID X 0.205 INCH L,PLSTC	80009	352-0419-00
-20	342-0251-00	B010100	B045098	1		. INSULATOR:VERTICAL	80009	342-0251-00
	342-0366-00	B045099		1		. INSULATOR,PLATE:FRONT PANEL,VERTICAL	80009	342-0366-00
	334-3448-00	XB057560		1		. MARKER,IDENT:MARKED NOTICE	80009	334-3448-00
-21	337-2127-00	B010100	B033658	2		. SHIELD,ELEC:ATTENUATOR	80009	337-2127-00
	337-2127-01	B033659		2		. SHIELD,ELEC:ATTENUATOR W/GROUND	80009	337-2127-01
						(ATTACHING PARTS)		
	131-1937-00	XB033659		2		. CONTACT,GROUND:GROUNDING,CU BE CD PL	80009	131-1937-00
	210-0663-01	XB033659	B068729	4		. EYELET,MATALLIC:0.59 OD X 0.093 L,BRS CD PL	80009	210-0663-01
	210-0647-01	B068730		4		. EYELET,MEATLLIC:PLATED	80009	210-0647-01
-22	211-0007-00			2		. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-23	211-0008-00			4		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-24	211-0097-00			2		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-25	407-1627-00			2		. BRACKET,GROUND:ALUMINUM	80009	407-1627-00
						(ATTACHING PARTS)		
-26	211-0007-00			2		. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-27	210-0586-00			2		. NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	211-041800-00
						- - - * - - -		
-28	----- -----			2		. LAMP:LED,RED(SEE CR4115,CR4117 EPL)		
	----- -----			2		. LAMP:LED,RED(SEE CR4215,CR4217 EPL)		
-29	388-4660-00			2		. CKT BOARD:PROBE CODING HARNESS	80009	388-4660-00
-30	384-0700-00			2		. EXTENSION SHAFT:0.123 OD X 6.3 INCHES LONG	80009	384-0700-00
	213-0138-01	B010100	B033658X	2		. SCREW,TPG,TF:4-24 X 0.188,TYPE B,PNH	83385	OBD
-31	644-0061-00			1		. ATTENUATOR ASSY:CHANNEL 1	80009	644-0061-00
	644-0069-00			1		. ATTENUATOR ASSY:CHANNEL 2	80009	644-0069-00
						(ATTACHING PARTS)		
-32	211-0097-00			2		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-33	211-0012-00			2		. SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
						- - - * - - -		
	----- -----			-		. . EACH ATTENUATOR ASSY INCLUDES:		
-34	----- -----			1		. . RES.,VARIABLE:POSITION(SEE R4153,R4253 EPL)		
						(ATTACHING PARTS)		
-35	210-0590-00			1		. . NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-36	210-0012-00			1		. . WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
						- - - * - - -		

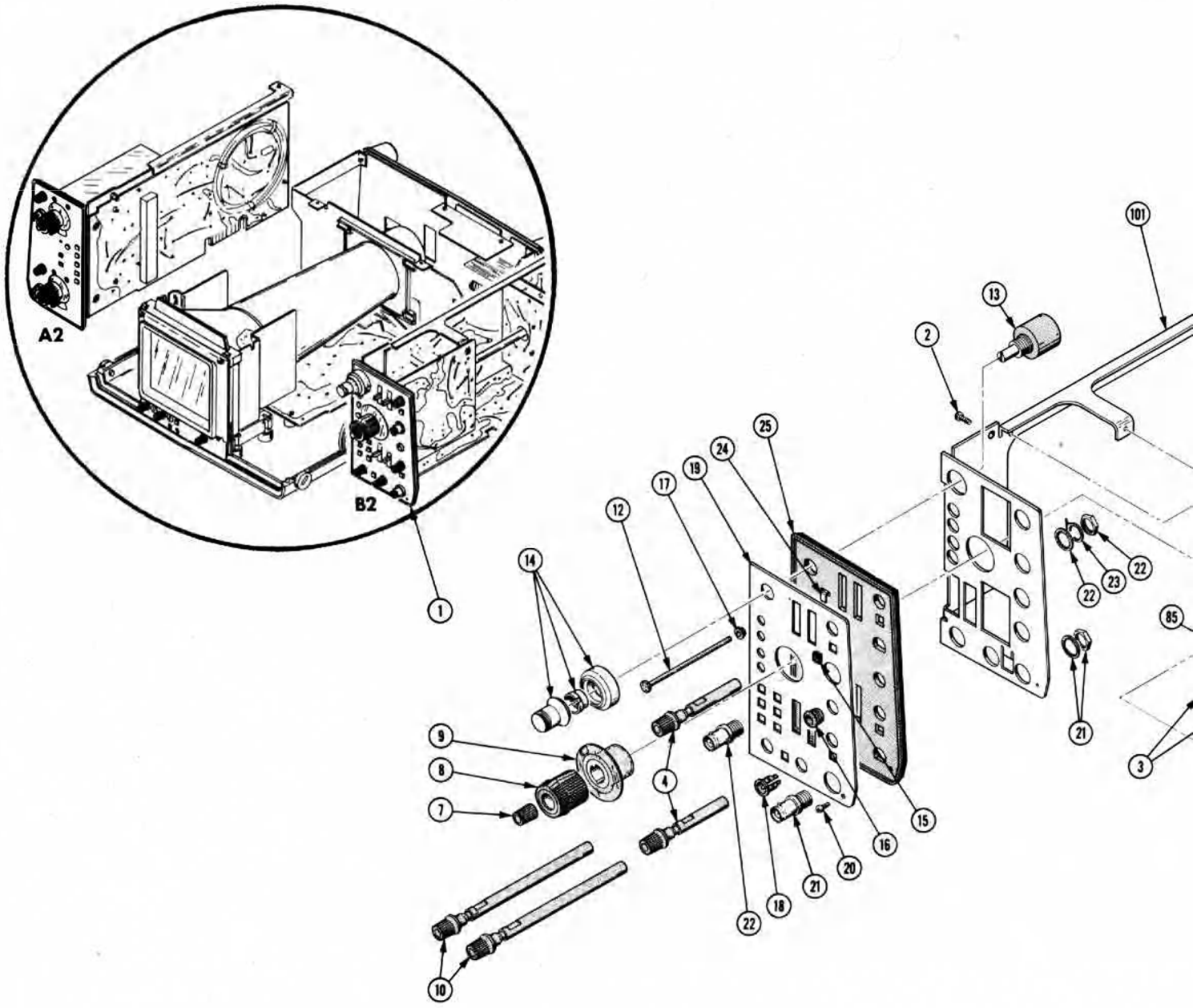
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-37	376-0029-00			1	. .	CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
	213-0075-00			2	. .	. SETSCREW:4-40 X 0.094,STL BK OXD,HEX SKT	000BK	OBD
-38	----- -----			1	. .	RES.,VAR:(SEE R4143/S4143,R4243/S4243 EPL)		
						(ATTACHING PARTS)		
-39	210-0583-00			1	. .	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-40	210-0046-00			1	. .	WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
						- - - * - - -		
-41	337-2229-00			1	. .	SHIELD,ELEC:ATTENUATOR	80009	337-2229-00
-42	426-1242-00			1	. .	FRAME SECT,SW:BOTTOM	80009	426-1242-00
						(ATTACHING PARTS)		
-43	211-0012-00			1	. .	SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
-44	211-0016-00			2	. .	SCREW,MACHINE:4-40 X 0.625 INCH,PNH STL	83385	OBD
-45	210-0406-00			3	. .	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
						- - - * - - -		
-46	344-0284-00			1	. .	CLIP,GROUND:COPPER	80009	344-0284-00
-47	----- -----			1	. .	ATTENUATOR,FXD:(SEE A4100,A4200 EPL)		
-48	----- -----			1	. .	RESISTOR,NTWK:GAIN(SEE A4162 EPL)		
	----- -----			1	. .	RESISTOR,NTWK:GAIN(SEE A4262 EPL)		
-49	131-1758-01			1	. .	CONT ASSY,ELEC:10 CONTACT	80009	131-1758-01
-50	131-1758-03			1	. .	CONT ASSY,ELEC:1 CONTACT	80009	131-1758-03
-51	131-1758-04			1	. .	CONT ASSY,ELEC:4 CONTACT	80009	131-1758-04
-52	131-1758-02			1	. .	CONT ASSY,ELEC:4 CONTACT	80009	131-1758-02
-53	----- -----			1	. .	ACTR,CAM SW:W/LEVER,(SEE S4100A,S4200A EPL)		
-54	214-1126-01			2	. .	SPRING,FLAT:GREEN COLORED	80009	214-1126-01
-55	214-1752-00			2	. .	ROLLER,DETENT:	80009	214-1752-00
-56	----- -----			1	. .	ACTR,CAM SW:(SEE S4100B/4162,		
	----- -----			-	. .	S4200B/4262 EPL)		
-57	376-0175-01			1	. .	CPLG,SHAFT,RGD:0.192 ID X 3.395L W/GROOVE	80009	376-0175-01
	354-0559-00			1	. .	. PACKING,PREFMD:0.208 ID X 0.348 OD	07322	8009366Y
-58	214-1126-01			2	. .	SPRING,FLAT:GREEN COLORED	80009	214-1126-01
-59	214-1752-00			2	. .	ROLLER,DETENT:	80009	214-1752-00
-60	401-0339-00			1	. .	BEARING,CAM SW:REAR,SNAP-IN	80009	401-0339-00
-61	210-0406-00			2	. .	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-62	426-1241-00			1	. .	FRAME SECT,SW:T,W/BEARING	80009	426-1241-00
-63	175-0829-00			FT	. .	WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
-64	131-0707-00			6	. .	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-65	352-0164-00			1	. .	CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
-66	131-1762-00			2	.	CONTACT,ELEC:GROUNDING	80009	131-1762-00
						(ATTACHING PARTS)		
-67	213-0055-00			4	.	SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	93907	OBD
						- - - * - - -		
-68	----- -----			1	.	DELAY LINE,ELEC:(SEE DL4400 EPL)		
						(ATTACHING PARTS)		
-69	213-0183-00			2	.	SCR,TPG,THD FOR:6-20 X 0.5 TYPE B,PNH,STL	83385	OBD
-70	211-0510-00			1	.	SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
-71	210-0407-00			1	.	NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
						- - - * - - -		
	----- -----			-	. .	DELAY LINE INCLUDES:		
-72	346-0121-00			3	. .	STRAP,ELEC COMP:TIE DOWN,5.0 LONG	59730	3Y-34M
-73	337-2234-00			1	.	SHIELD,ELEC:PREAMPLIFIER INPUT	80009	337-2234-00
-74	384-1392-00			1	.	EXTENSION SHAFT:7.277 INCH LONG,OFFSET	80009	384-1392-00
-75	384-1391-00			1	.	EXTENSION SHAFT:2.503 INCH LONG,OFFSET	80009	384-1391-00
-76	----- -----			1	.	CKT BOARD ASSY:VERTICAL(SEE A20 EPL)		
						(ATTACHING PARTS)		
-77	213-0146-00			2	.	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-	. .	CKT BOARD ASSY INCLUDES:		
-78	131-0608-00			22	. .	TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-79	136-0252-07			79	. .	SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-80	214-0579-00			7	. .	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-81	131-0158-00			2	. .	TERMINAL,FEEDTH:INSULATED,0.566 INCH LONG	98291	011103900479
-82	131-1003-00			1	. .	CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-83	----- -----			1	. .	SWITCH,PUSH:VERT MODE(SEE S4330 EPL)		
-84	361-0542-00			4	. .	SPACER,SWITCH:PLASTIC	71590	J-64281

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-85	----- -----			1		. . SWITCH,PUSH:INVERT(SEE S4240 EPL)		
-86	361-0383-00			2		. . SPACER,PB SW:CHARCOAL,0.33 INCH LONG	80009	361-0383-00
-87	----- -----			1		. . SWITCH,PUSH:TRIG VIEW(SEE S4380 EPL)		
-88	361-0690-00			2		. . SPACER,PB SW:375 INCH HIGH,PLSTC	80009	361-0690-00
-89	352-0331-00			2		. . LAMPHOLDER:	80009	352-0331-00
-90	----- -----			1		. . MICROCIRCUIT:W/HEAT SINK(SEE U4160 EPL)		
						(ATTACHING PARTS)		
-91	343-0519-00			1		. . RTNR,HEAT SINK:2.01 X 1.20 IBRS,BLACK	80009	343-0519-00
						- - - * - - -		
-92	380-0421-00			1		. . HSG,CONTACT SET:1.940 X 1.440 W CONT	80009	380-0421-00
-93	441-1261-00			1		. CHAS,ELEC EQPT:MAIN,VERTICAL	80009	441-1261-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-1	672-0467-00			1		CKT BOARD ASSY:HORIZONTAL MODULE,B2	80009	672-0467-00
						(ATTACHING PARTS)		
-2	211-0504-00	B010100	B011709	1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
	211-0513-00	B011710		1		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
	211-0510-00			1		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. HORIZONTAL MODULE ASSY INCLUDES:		
-3	366-1559-00			9		. PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-4	384-1366-00			2		. EXTENSION SHAFT:0.2 OD X 2.135 " L,W/KNOB	80009	384-1366-00
-5	384-1389-00	B010100	B222749	1		. EXTENSION SHAFT:1.905 " LONG,OFFSET	80009	384-1389-00
	384-1389-01	B222750		1		. EXTENSION SHAFT:1.905 L,OFFSET,PLASTIC	80009	384-1389-01
-6	384-1136-00			1		. EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-7	366-1346-02			1		. KNOB:RED	80009	366-1346-00
	213-0153-00			1		. . SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-8	366-1219-00			1		. KNOB:0.906 OD X 0.89 INCH L	80009	366-1219-00
	213-0243-00			2		. . SETSCREW:5-40 X 0.25 INCH,HEX SOC STL	70276	OBD
-9	354-0442-01			1		. RING,KNOB SKIRT:CLEAR,1.45 OD	80009	354-0442-01
	213-0004-00			1		. . SETSCREW:6-32 X 0.188 INCH,HEX.SOC STL	74445	OBD
-10	384-1350-02			2		. KNOB:4.515 L X 0.28 OD PLASTIC	80009	384-1350-02
-11	384-1129-00			1		. EXTENSION SHAFT:5.607 INCH LONG	80009	384-1129-00
-12	378-0745-00			4		. LENS,LIGHT:CLEAR,TIMING	80009	378-0745-00
-13	----- -----			1		. RES.,VARIABLE:DELAY TIME(SEE R2749 EPL)		
						(ATTACHING PARTS)		
-14	331-0328-00			1		. DIAL,CONTROL:10 TURN FOR 0.25 DIA SHAFT	05129	461-S-70
						- - - * - - -		
	----- -----			-		. . DIAL INCLUDES:		
	213-0048-00			1		. . SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-15	426-1072-00			9		. FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-16	358-0216-00			1		. BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
	358-0569-00			1		. BUSHING,PLASTIC:0.412 OD,0.257 ID,0.293 L	80009	358-0569-00
-17	358-0378-01			4		. BUSHING,SLEEVE:0.250 OD X 0.131 ID,PRESS MT	80009	358-0378-01
-18	358-0550-00			4		. BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-19	333-1995-00	B010100	B046869	1		. PANEL,FRONT:HORIZONTAL	80009	333-1995-00
	333-1995-02	B046870		1		. PANEL,FRONT:HORIZONTAL	80009	333-1995-02
						(ATTACHING PARTS)		
-20	213-0120-00			1		. SCR,TPG,THD FOR:2-32 X 0.250 INCH,PNH STL	83385	OBD
						- - - * - - -		
-21	131-0352-02			1		. CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR166-1
-22	131-0352-02			1		. CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR166-1
						(ATTACHING PARTS)		
-23	210-0255-00			1		. TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
						- - - * - - -		
-24	214-2329-00			1		. SPRING,GROUND:FRONT PANEL	80009	214-2329-00
-25	342-0252-00	B010100	B045098	1		. INSULATOR:HORIZONTAL	80009	342-0252-00
	342-0367-00	B045099		1		. INSULATOR,PLATE:FRONT PANEL,HORIZONTAL	80009	342-0367-00
-26	343-0582-00			2		. RETAINER,SWITCH:BLACK PLASTIC	80009	343-0582-00
						(ATTACHING PARTS)		
-27	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	211-0012-00			1		. SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
-28	210-0406-00			2		. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
						- - - * - - -		
	672-0491-00			1		. CKT BOARD ASSY:TIMING SWITCH		
-29	384-1322-00			1		. . EXTENSION SHAFT:0.081 OD X 11.05 INCH LONG	80009	384-1322-00
-30	376-0141-00	B010100	B069649	1		. . CPLG,SHAFT,RDG:FOR 0.08 TO 0.125"DIA SHAFT	80009	376-0141-00
	376-0039-00	B069650		1		. ADPT,SHAFT,CPLG:0.128 AND 0.082"DIA SHAFT	80009	376-0039-00
	213-0075-00			2		. . . SETSCREW:4-40 X 0.094,STL BK OXD,HEX SKT	000BK	OBD
-31	----- -----			1		. . RES.,VARIABLE:(SEE R3128/S3128A,B EPL)		
						(ATTACHING PARTS)		
-32	210-0583-00			1		. . NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-33	210-0046-00			1		. . WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
						- - - * - - -		
-34	386-3156-00			1		. . PL,MTG,VAR RES:ALUMINUM	80009	386-3156-00
						(ATTACHING PARTS)		
-35	211-0019-00			2		. . SCREW,MACHINE:4-40 X 1.0 INCH,PNH STL	83385	OBD
-36	210-0054-00			2		. . WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
-37	210-0994-00			2		. . WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-38	----- -----			1	. . CKT BOARD ASSY:B SWEEP TIMING(SEE A14 EPL)		
					(ATTACHING PARTS)		
-39	211-0019-00			2	. . SCREW,MACHINE:4-40 X 1.0 INCH,PNH STL	83385	OBD
-40	210-0054-00			2	. . WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
-41	210-0994-00			2	. . WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
-42	210-0406-00			2	. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
					- - - * - - -		
	----- -----			-	. . . CKT BOARD ASSY INCLUDES:		
-43	136-0547-00			1	. . . CONNECTOR,RCPT,:6 PIN,FEMALE	00779	1-380949-6
-44	263-1110-00			1	. . ACTR ASSY,RTRY:TIMING SWITCH	80009	263-1110-00
	334-3448-00	XB057560		1	. . MARKER,IDENT:MARKED NOTICE	80009	334-3448-00
-45	----- -----			1	. . CKT BOARD ASSY:A SWEEP TIMING(SEE A13 EPL)		
-46	136-0547-00			1	. . . CONNECTOR,RCPT,:6 PIN,FEMALE	00779	1-380949-6
-47	136-0632-00			1	. . . SOCKET,PLUG-IN:8 PIN,FEMALE	00779	1-380949-8
-48	175-0828-00			FT	. . WIRE,ELECTRICAL:5 WIRE RIBBON	08261	OBD
-49	----- -----			1	. CKT BOARD ASSY:TRIGGER(SEE A10 EPL)		
					(ATTACHING PARTS)		
-50	213-0146-00			1	. SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. . CKT BOARD ASSY INCLUDES:		
-51	131-0566-00			3	. . BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-52	131-0608-00			18	. . TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-53	136-0252-07			18	. . SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-54	200-1673-00	B010100	B044539X	2	. . COVER,XSTR:TEMP STAB,S-SHAPED	05820	OBD
-55	214-0579-00			2	. . TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-56	----- -----			1	. . SWITCH,PUSH:B TRIG/SLOPE(SEE S2600 EPL)		
-57	361-0690-00	B010100	B022749	2	. . SPACER,PB SW:375 INCH HIGH,PLSTC	80009	361-0690-00
	361-0608-00	B022750		1	. . SPACER,PUSH SW:PLASTIC	80009	361-0608-00
-58	----- -----			1	. . SW,LEVER:W/CONT,A SOURCE(SEE S2150 EPL)		
					(ATTACHING PARTS)		
-59	211-0152-00	B010100	B022799	1	. . SCR,ASSEM WSHR:4-40 X 0.625 INCH,PNH BRS	83385	OBD
	211-0240-00	B022800		1	. . SCR,ASSEM WSHR:4-40 X 0.688"PNH,STL	78189	OBD
-60	210-0551-00			1	. . NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
-61	----- -----			1	. . SW,LEVER:W/CONT,A COUPLING(SEE S2170 EPL)		
-62	351-0448-01			2	. . GUIDE ,SWITCH:W/SPRING AND ROLLER	80009	351-0448-01
-63	----- -----			1	. . SW,LEVER:W/CONT,B SOURCE(SEE S2100 EPL)		
					(ATTACHING PARTS)		
-64	211-0152-00	B010100	B022799	1	. . SCR,ASSEM WSHR:4-40 X 0.625 INCH,PNH BRS	83385	OBD
	211-0240-00	B022800		1	. . SCR,ASSEM WSHR:4-40 X 0.688"PNH,STL	78189	OBD
-65	210-0551-00			1	. . NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
-66	----- -----			1	. . SW,LEVER:W/CONT,B COUPLING(SEE S2120 EPL)		
-67	351-0448-01			2	. . GUIDE ,SWITCH:W/SPRING AND ROLLER	80009	351-0448-01
-68	----- -----			1	. . RES.,VARIABLE:W/MTG BRKT(SEE R2612 EPL)		
-69	----- -----			1	. . RES.,VARIABLE:W/MTG BRKT(SEE R2712 EPL)		
-70	----- -----			1	. CKT BOARD ASSY:HORIZONTAL(SEE A12 EPL)		
					(ATTACHING PARTS)		
-71	213-0146-00			2	. SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. . CKT BOARD ASSY INCLUDES:		
-72	131-0566-00			3	. . BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-73	136-0260-02			1	. . SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
-74	136-0547-00			2	. . CONNECTOR,RCPT,:6 PIN,FEMALE	00779	1-380949-6
-75	136-0632-00			2	. . SOCKET,PLUG-IN:8 PIN,FEMALE	00779	1-380949-8
-76	136-0631-00			2	. . SOCKET,PLUG-IN:9 PIN FEMALE	00779	1-380949-9
-77	214-0579-00			2	. . TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-78	----- -----			1	. . SWITCH,PUSH:A SLOPE(SEE S2700 EPL)		
-79	361-0384-00			2	. . SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
-80	----- -----			1	. . SWITCH,PUSH:X 10 MAG(SEE S2920 EPL)		
-81	361-0608-00			2	. . SPACER,PUSH SW:PLASTIC	80009	361-0608-00
-82	----- -----			1	. . RES.,VAR:W/MTG BRKT AND HDWR(SEE R2913)		
-83	----- -----			1	. . RES.,VAR:W/MTG BRKT(SEE R2777 EPL)		
-84	384-1390-00			3	. EXTENSION SHAFT:4.460 INCH LONG,OFFSET	80009	384-1390-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-85	384-1341-00			3		. EXTENSION SHAFT:2.183 INCH LONG,OFFSET	80009	384-1341-00
-86	----- -----			1		. CKT BOARD ASSY:SWEEP(SEE A11 EPL)		
						(ATTACHING PARTS)		
-87	213-0146-00			4		. SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
-88	213-0138-00			1		. SCR,TPG,TF:4-24 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. . CKT BOARD ASSY INCLUDES:		
-88	131-0566-00			3		. . BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-89	131-0589-00			48		. . TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-90	131-0608-00			6		. . TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-91	131-0993-00			1		. . BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-92	136-0252-07			27		. . SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-93	136-0260-02			5		. . SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
-94	136-0514-00			1		. . SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-95	214-0579-00			8		. . TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-96	----- -----			1		. . SW,PUSH:HORIZONTAL DISPLAY(SEE S2650 EPL)		
-97	361-0542-00			4		. . SPACER,SWITCH:PLASTIC	71590	J-64281
-98	----- -----			1		. . SWITCH,PUSH:TRIGGER MODE(SEE S2750 EPL)		
-99	361-0385-00			4		. . SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
-100	352-0331-00			4		. . LAMPHOLDER:	80009	352-0331-00
-101	441-1263-00			1		. CHAS,ELEC EQPT:MAIN,HORIZONTAL	80009	441-1263-00
-102	175-0826-00			FT		. WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-103	131-0707-00			3		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-104	352-0161-00			1		. HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00


A2
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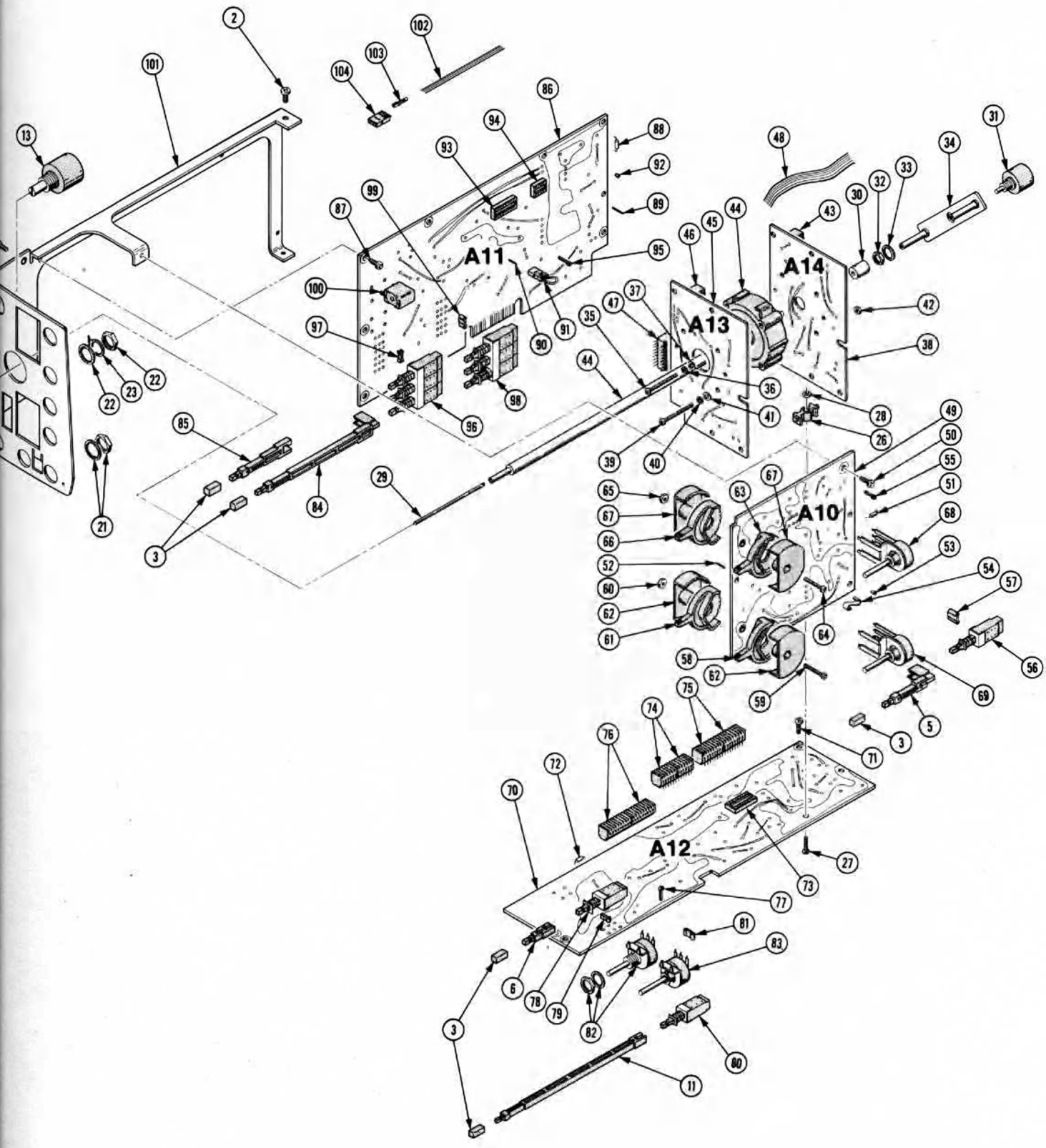


455/A2/B2

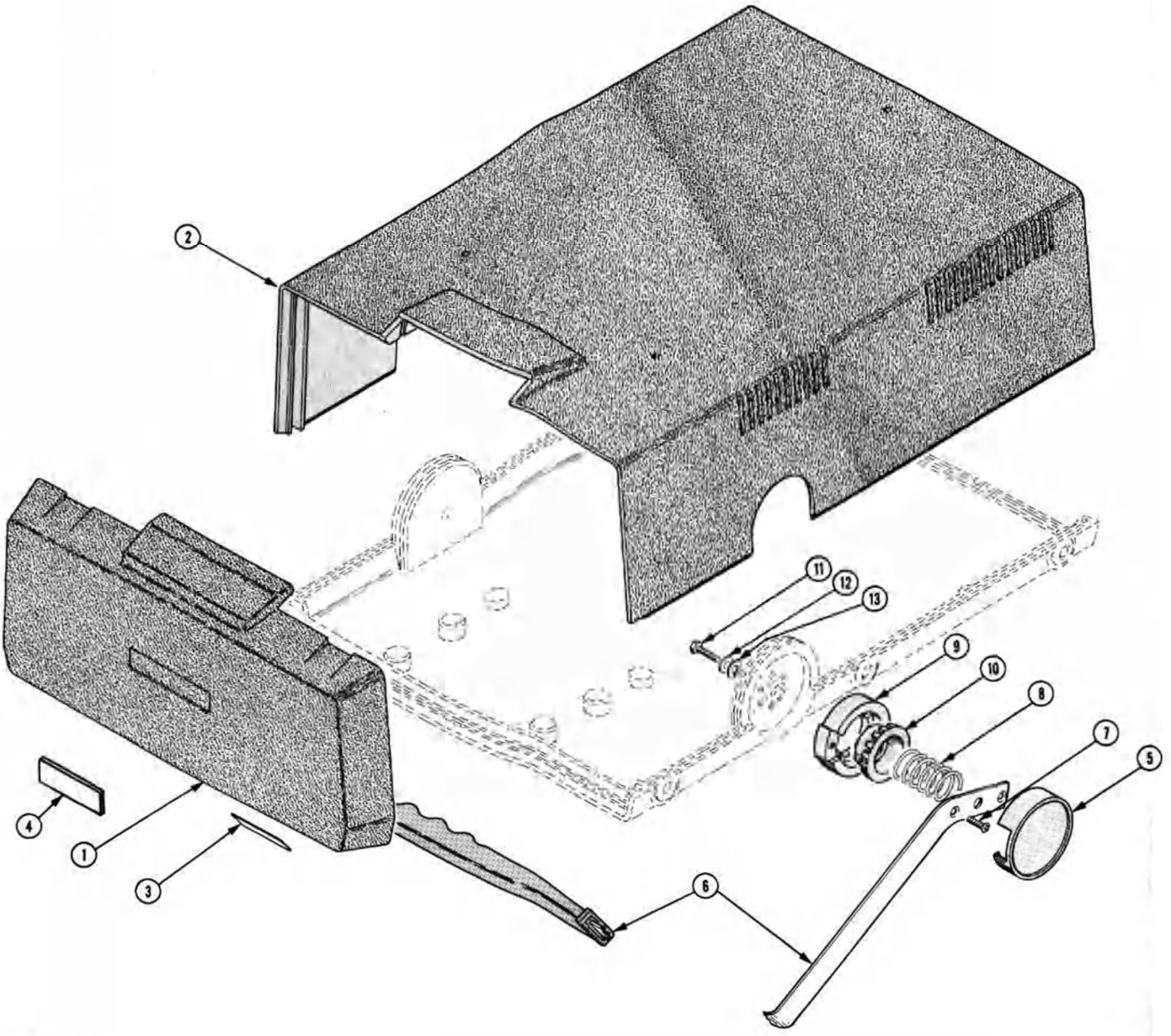


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
10-4-1	200-1866-00			1		COVER,FRONT:OSCILLOSCOPE	80009	200-1866-00
-2	390-0449-00	B010100	B069427	1		CAB. TOP,SCOPE:	80009	390-0449-00
	390-0449-03	B069428		1		CAB.TOP,SCOPE:	80009	390-0449-03
-3	334-2527-00			1		PLATE,IDENT:MKD 455	22670	OBD
-4	334-2661-00			1		PLATE,IDENT:MARKED TEKTRONIX	80009	334-2661-00
-5	200-0602-00			1		COVER,HDL LATCH:2.12 DIA X 0.7,ACETAL	80009	200-0602-00
-6	367-0210-00			1		HANDLE,CARRYING:	80009	367-0210-00
						(ATTACHING PARTS)		
-7	213-0227-00			4		SCR,TPG,THD FOR:6-32 X 0.50 DEG,FLH ST	83385	OBD
						- - - * - - -		
-8	214-0516-00			2		SPRING,HLCPS:0.959 DIA X 1.250 INCH LONG	80009	214-0516-00
-9	214-1987-00			2		INDEX,HDL RING:	80009	214-1987-00
-10	214-0515-02			2		HUB,HDL INDEX:1.42 DIA X 0.565 THK,AL CD	80009	214-0515-02
						(ATTACHING PARTS)		
-11	212-0623-00			2		SCREW,SLF LKG:10-24 X 0.75 INCH,HEX,STL	14438	OBD
-12	210-0056-00			2		WASHER,LOCK:SPLIT,0.195 ID X 0.32" OD,P BRZ	83385	OBD
-13	210-0805-00			2		WASHER,FLAT:0.204 ID X 0.438 INCH OD,STL	12327	OBD
						- - - * - - -		

STANDARD ACCESSORIES

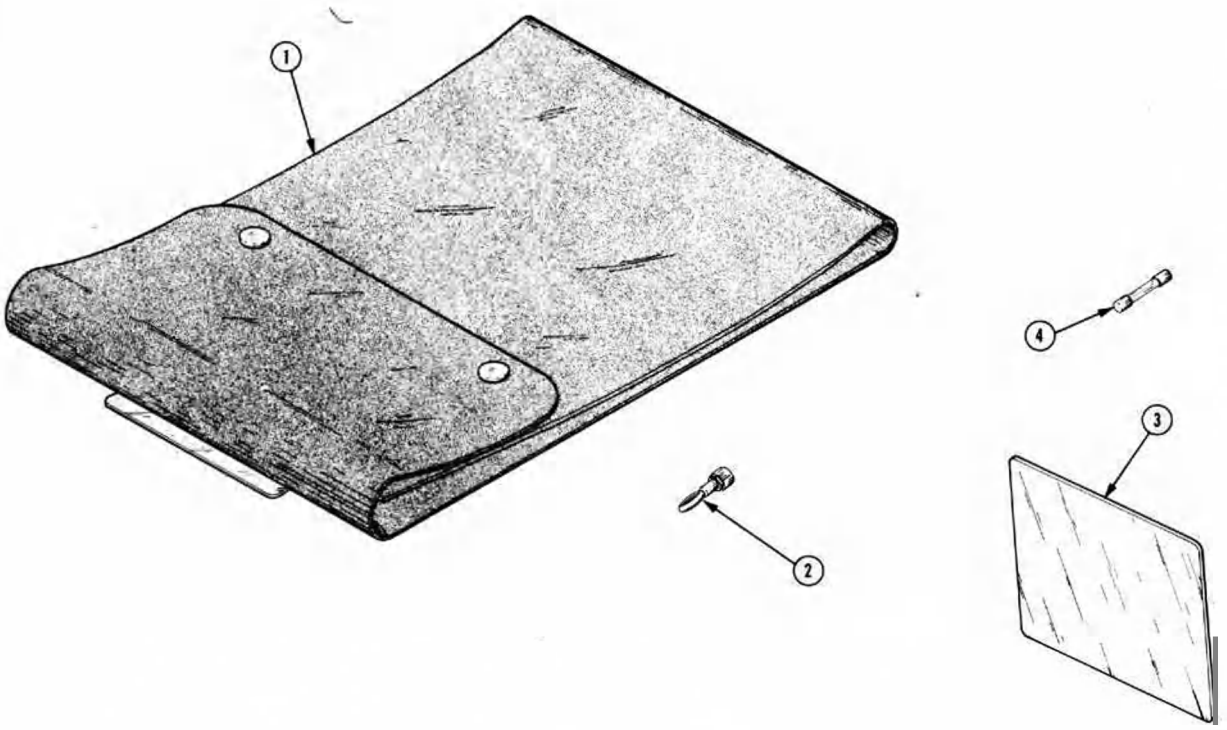


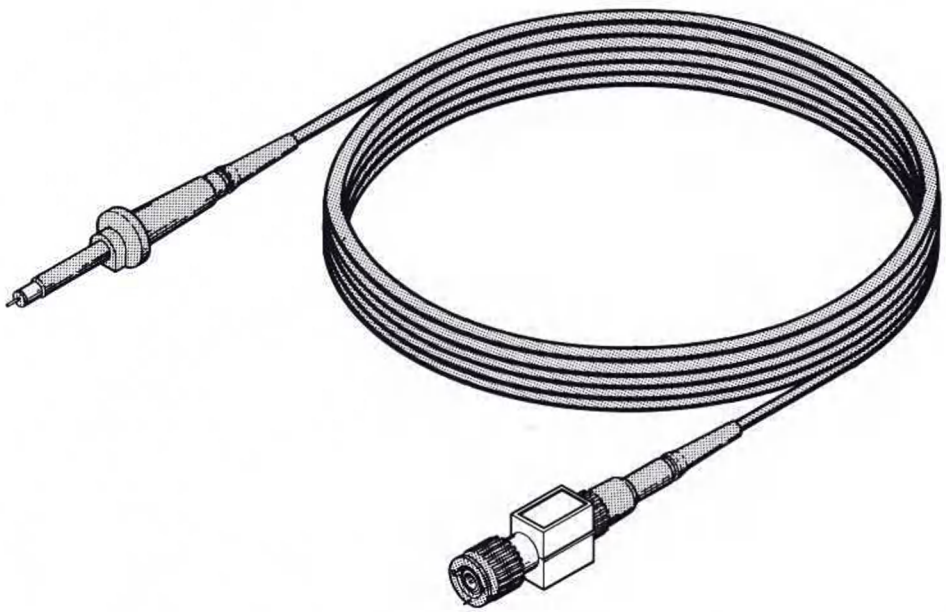
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
10-5-1	016-0339-00			1		POUCH,ACCESSORY:W/HARDWARE	80009	016-0339-00
	016-0537-00			1		POUCH,ACCESSORY:VINYL,W/ZIPPER	05006	OBD
-2	134-0016-01			1		PLUG,TIP:W/BINDING POST	80009	134-0016-01
-3	337-2122-01			1		SHLD,IMPLOSION:CLEAR	80009	337-2122-01
-4	159-0021-00			2		FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
	159-0022-00			1		FUSE,CARTRIDGE:3AG,1A,250V,FAST-BLOW	71400	AGC 1
	----- -----			-		(116V OPERATION)		
	159-0025-00			2		FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
	----- -----			-		(232V OPERATION)		
	070-1907-01			1		MANUAL,TECH:INSTRUCTION	80009	070-1907-01
	010-6105-03			2		PROBE,VOLTAGE:P6105,2 METER,10X,W/ACCESS	80009	010-6105-03
	161-0094-00			1		CABLE ASSY,PWR,:3 WIRE,36 INCHES LONG	16428	KH7667

Tektronix®
COMMITTED TO EXCELLENCE

data sheet

CUSTOMER SERVICES SUPPORT

P6105 PASSIVE PROBE



The P6105 Probe is a miniature, 10X, passive probe for use with dc to 100 MHz oscilloscopes with an input capacitance range of 15-47 pF and an input resistance of 1 MΩ.

A ground reference push button on the probe head permits the user to obtain a ground reference or to determine a trace in a multitrace display. A coding pin on the BNC output connector actuates the Volts/Div readout encoding of the oscilloscope to include the 10X attenuation of the probe.

WARNING

To avoid shock, do not disassemble when connected to voltage source. Disassembly is a service operation only. Refer servicing to qualified service personnel.

The compensating box houses a network that provides optimum transient response when used with 100 MHz oscilloscopes. Modular construction of the probe simplifies repairs, as both probe head and compensating box can be unplugged from the cable assembly. The P6105 Probe is available in three lengths and is identified by the colored strain relief at each end of the cable: blue = 1 meter (3.3 ft), yellow = 2 meter (6.6 ft), red = 3 meter (9.9 ft).

NO. 062-1796-00
DATE NOV. 1979 (R)

WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

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

Specifications and price change privileges reserved.

U.S.A. and foreign Tektronix products covered by U.S. and foreign patents and/or patents pending.

SPECIFICATIONS

Electrical:

Attenuation: 10X within 3% (oscilloscope input, 1 MΩ within 2%).

Input Resistance: 10 MΩ within 0.5% (oscilloscope input, 1 MΩ within 2%).

Approximate Input Capacitance:

1 Meter (3.3 ft) Blue	2 Meter (6.6 ft) Yellow	3 Meter (9.9 ft) Red
≈ 10.5 pF	≈ 13.0 pF	≈ 15.5 pF

See Fig. 1 and 2. Typical parallel reactance (X_p) and resistance (R_p) vs. frequency.

Compensation Range: 15 pF to 47 pF.

Bandwidth (-3 dB): At least 100 MHz for the 1 and 2 meter, and at least 95 MHz for the 3 meter.

Maximum Input Voltage: 500 Volts (dc + peak ac), derated with frequency.

See Fig 3, Voltage vs Frequency Derating.

Environmental:

Probe operates within specifications over the following ranges:

Temperature: -15 C (+5 F) to +75 C (+167 F).

Altitude: To 15,000 feet.

Physical:

Net Weight (including accessories):

1 Meter (3.3 ft) Probe: 105.8 grams (3.7 oz.)

2 Meter (6.6 ft) Probe: 130.4 grams (4.6 oz.)

3 Meter (9.9 ft) Probe: 153.0 grams (5.4 oz.)

OPERATING CONSIDERATIONS

Probe Grounding

A passive probe is a capacitive divider for high-frequency components. Inductance introduced by a long signal or ground lead will form a series resonant circuit that will "ring" if driven by a signal containing significant frequency components at or above circuit resonance. These oscillations can appear on the oscilloscope display and distort the true waveform. Ground leads and probe tip connections should be kept as short as possible to maintain the best fidelity.

WARNING

To avoid shock, do not disassemble the probe when connected to a signal or voltage source.

PROBE COMPENSATION

Due to slight variations in the input capacitance, it is usually necessary to compensate the probe whenever it is transferred from one instrument to another, or from one channel to another for dual (multitrace) units.

Procedure

1. Touch probe tip to oscilloscope calibrator output connector and display several cycles of calibrator square wave at approximately 4 divisions in amplitude.
2. Adjust probe compensation through hole in compensation box for best flat top on display.

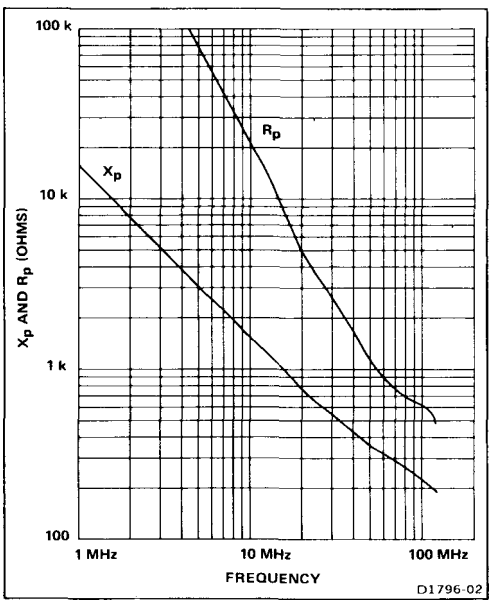


Fig. 1. Typical parallel reactance (X_p) and resistance (Rp) vs. frequency for 1 meter (3.3 ft) probe.

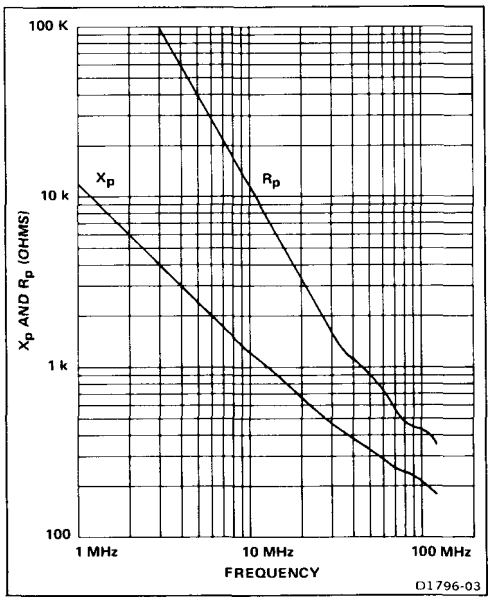


Fig. 2. Typical parallel reactance (X_p) and resistance (Rp) vs. frequency for 2 meter (6.6 ft) and 3 meter (9.9 ft) probes.

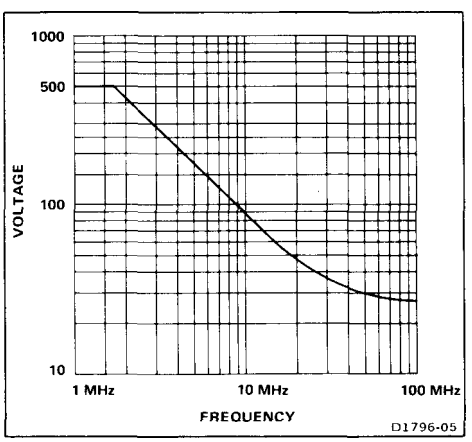


Fig. 3. Voltage vs. frequency derating.

MAINTENANCE

WARNING

To avoid shock, do not disassemble probe when connected to voltage source. Only qualified service personnel should use the following service instructions. Unless you are qualified to do so, perform no servicing except that contained in the preceding operating instructions.

The P6105 Probe is designed to withstand normal operation and handling. However, if the probe fails or breaks, replacement parts are available. See Replaceable Parts List for part numbers.

Replacing a Probe Assembly:

If the coaxial cable, probe head, or compensation box should fail, the assemblies are available. When replacing probe assemblies, make sure to use the proper probe head and/or compensation box for the length of cable being used (check that colors on the probe head ground collar, and compensation box retainer nut match with the cable strain reliefs).

Removing Probe Tip:

See Fig 4 for probe tip removal and replacement.

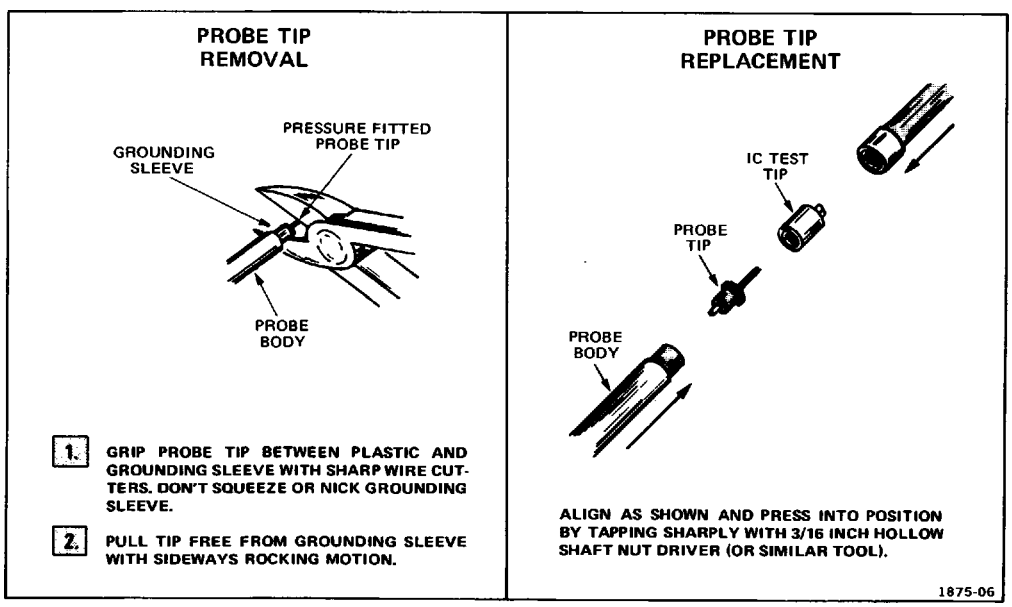
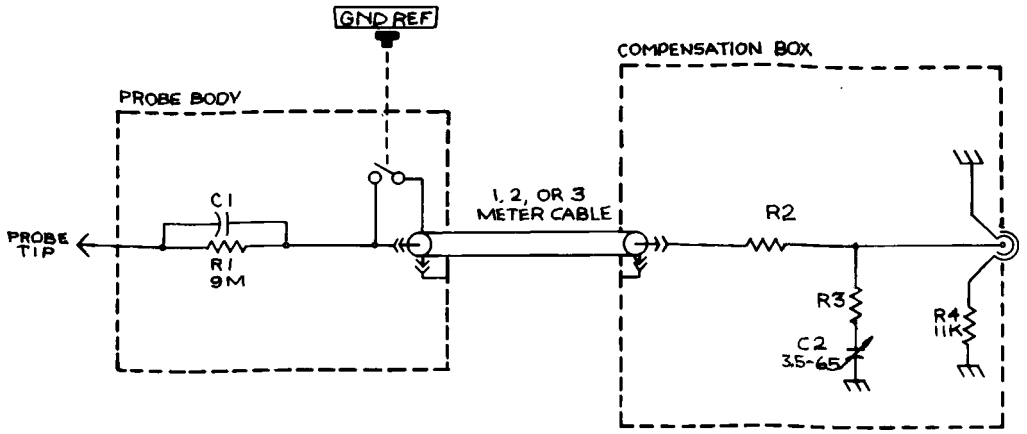


Fig. 4. Probe tip removal and replacement.



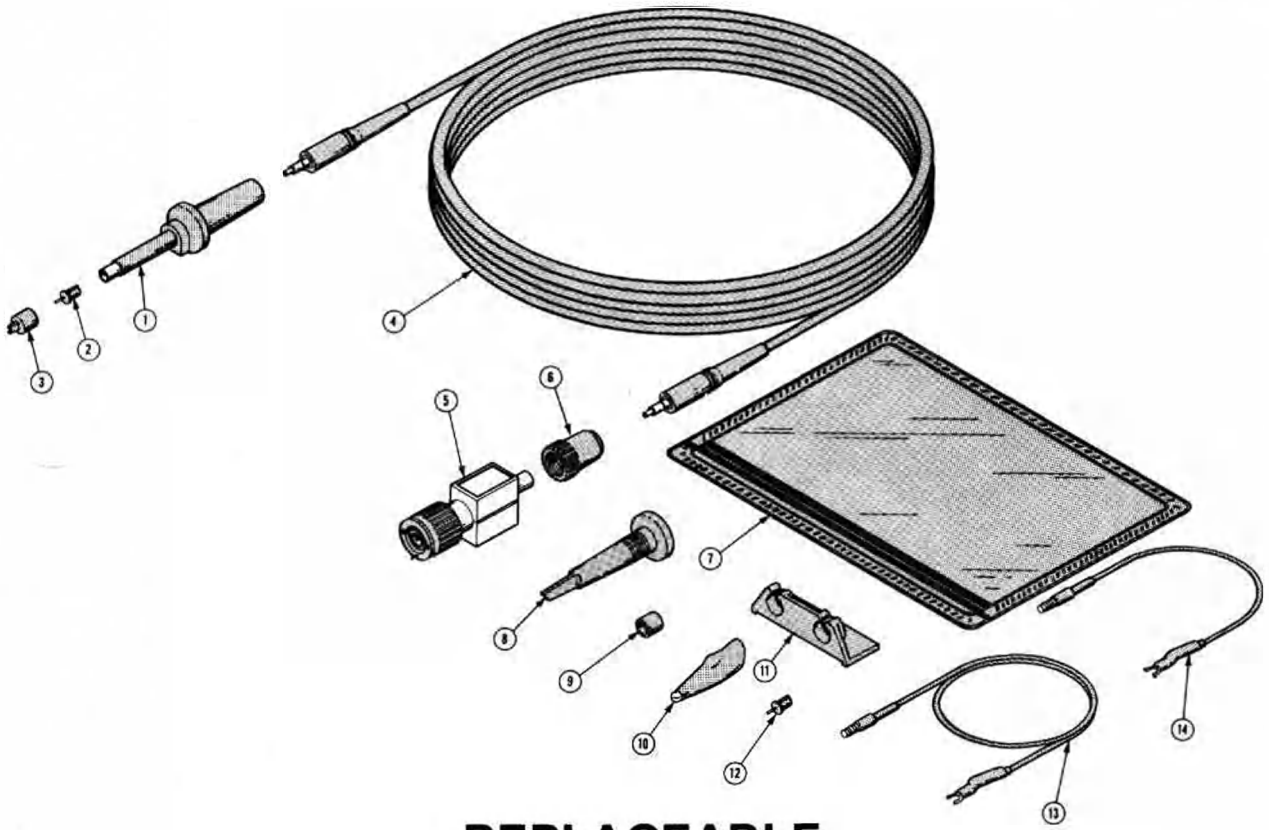
REPLACEABLE
ELECTRICAL PARTS

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1[1]	----- -----			CAP.,FXD,CER DI:		
C2[2]	----- -----			CAP.,VAR,PLSTC:3.5-65PF,100V		
R1[1]	----- -----			RES.,FXD,FILM:		
R2[3]	----- -----			RES.,FXD,FILM:162 OHM,1%,0.25W	91637	MFF1421G162ROF
R2[4]	----- -----			RES.,FXD,FILM:133 OHM,1%,0.125W	75042	CEATO-1330F
R2[5]	----- -----			RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEATO-75ROOF
R3[3]	----- -----			RES.,FXD,FILM:75 OHM,1%,0.125W	75042	CEBTO-75ROOF
R3[4]	----- -----			RES.,FXD,FILM:130 OHM,1%,0.125W	75042	CEBTO-130OF
R3[5]	----- -----			RES.,FXD,FILM:187 OHM,1%,0.125W	75042	CEATO-1870F
R4[2]	----- -----			RES.,FXD,CMPSN:11K OHM,5%,0.125W	01121	BB1135

[1]Replaceable under 206-0216-00, 1 Meter, 206-0217-00, 2 Meter, 206-0218-00, 3 Meter Assemblies
[2]Replaceable under 206-0219-00, 1 Meter, 206-0220-00, 2 Meter, 206-0221-00, 3 Meter Assemblies
[3]Replaceable under 206-0219-00, 1 Meter Assembly only.
[4]Replaceable under 206-0220-00, 2 Meter Assembly only.
[5]Replaceable under 206-0221-00, 3 Meter Assembly only.

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
05006	TWENTIETH CENTURY PLASTICS INC.	415 E. WASHINGTON BLVD.	LOS ANGELES, CA 90015
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97005
80031	ELECTRA-MIDLAND CORP., MEPCO DIV., A NORTH AMERICAN PHILIPS CO.	22 COLUMBIA RD.	MORRISTOWN, NJ 07960
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NB 68601



REPLACEABLE MECHANICAL PARTS

Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						1 METER PROBE		
	010-6105-01			1		PROBE,VOLTAGE:10X,1M,W/ACCESSORIES	80009	010-6105-01
	010-6105-00			1		. PROBE,VOLTAGE:10X,1 METER	80009	010-6105-00
-1	206-0216-00			1		. . PROBE,HEAD:1 METER,BLUE	80009	206-0216-00
-2	----- -----[1]			1		. . . TIP,PROBE:		
-3	----- -----[2]			1		. . . TIP,PROBE:IC TEST		
-4	175-1661-00			1		. . CA ASSY,SP,ELEC:1 METER,BLUE	80009	175-1661-00
-5	206-0219-00			1		. . COMP BOX:1 METER	80009	206-0219-00
-6	343-0570-00			1		. . . RETAINER,COVER:COMP BOX,1 METER,BLUE	80009	343-0570-00
						2 METER PROBE		
	010-6105-03			1		PROBE,VOLTAGE:10X,2M,W/ACCESSORIES	80009	010-6105-03
	010-6105-02			1		. PROBE,VOLTAGE:10X,2 METER	80009	010-6105-02
-1	206-0217-00			1		. . PROBE,HEAD:2 METER,YELLOW	80009	206-0217-00
-2	----- -----[1]			1		. . . TIP,PROBE:		
-3	----- -----[2]			1		. . . TIP,PROBE:IC TEST		
-4	175-1661-01			1		. . CA,ASSY,SP,ELEC:2 METER,YELLOW	80009	175-1661-01
-5	206-0220-00			1		. . COMP BOX:2 METER	80009	206-0220-00
-6	343-0570-01			1		. . . RETAINER,COVER:COMP BOX,2 METER,YELLOW	80009	343-0570-01

[1]Available only in packs of 10, P.N. 206-0191-03.
[2]Available only in packs of 10, P.N. 015-0201-04, or 100, P.N. 015-0201-05.

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	010-6105-05			1	PROBE,VOLTAGE:10X,3M,W/ACCESSORIES	80009	010-6105-05
	010-6105-04			1	. PROBE,VOLTAGE:10X,3 METER	80009	010-6105-04
-1	206-0218-00			1	. . PROBE,HEAD:3 METER RED	80009	206-0218-00
-2	----- -----[1]			1	. . . TIP,PROBE:		
-3	----- -----[2]			1	. . . TIP,PROBE:IC TEST		
-4	175-1661-02			1	. . CA ASSY,SP,ELEC:3 METER,RED	80009	175-1661-02
-5	206-0221-00			1	. . COMP,BOX:3 METER	80009	206-0221-00
-6	343-0570-02			1	. . . RETAINER,COVER:COMP BOX,3 METER,RED	80009	343-0570-02
					ACCESSORIES		
-7	016-0521-00			1	POUCH,ACCESSORIES:	05006	OBD
-8	013-0107-03			1	TIP,TEST PROD:RET HOOK ASSY	80009	013-0107-03
-9	166-0404-01			1	INS SLV,ELEC:FOR 0.188 DIA PROBE BSHG	80009	166-0404-01
-10	344-0046-00			2	CLIP,ELECTRICAL:ALLIGATOR TYPE,W/COVER	80009	344-0046-00
-11	352-0351-00			1	HLDR,TEST PROD:	80009	352-0351-00
-12	----- -----[1]			2	TIP,PROBE:		
-13	175-0125-01			1	LEAD,ELECTRICAL:PROBE GND,12 INCHES LONG	80009	175-0125-01
-14	175-0124-01			1	LEAD,ELECTRICAL:PROBE GND,5 INCHES LONG	80009	175-0124-01
	334-2794-00			2	BAND,MARKER:0.371 DIA,BLACK,PLASTIC	80009	334-2794-00
	334-2794-01			2	BAND,MARKER:0.371 DIA,WHITE,PLASTIC	80009	334-2794-01
	334-2794-02			2	BAND,MARKER:0.371 DIA,SILVER,PLASTIC	80009	334-2794-02
	062-1803-00			1	DATA CARD:	80009	062-1803-00
	062-1796-00			1	DATA SHEET:P6105 PASSIVE PROBE	80009	062-1796-00

[1]Available only in packs of 10, Part Number 206-0191-03.
[2]Available only in packs of 10, Part Number 015-0201-04, or 100, Part Number 015-0201-05.

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.