MAINTENANCE

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance, or troubleshooting of the 485.

Cover Removal

WARNING

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

1. Move handle away from front of instrument and snap front plastic cover in place.

2. Place instrument front panel down on working surface and remove the rear feet (four screws).

3. Work the small, blue rear panel rim away from the back of the instrument. It may stick in place, due to EMI finger stock. The edge opposite the BNC connectors must tip up first in order to clear the BNC connectors.

4. Back the Accessory pouches large retaining screw out so that its tip will clear the back panel for removal of the wrap-around cover, and slip the cover up and off the instrument.

Reinstalling the Cover

1. Orient the instrument face down (with the plastic knob cover in place) on a working surface.

2. Slide the wrap-around cover on using care to avoid pinching any cables. Make sure that the cover edge is inserted into the EMI gasket groove around the full periphery.

3. Work the blue rear panel rim into place at the rear end. Slip the edge over the BNC connectors first and press the ring down around the EMI finger stock.

4. Set the feet and screws in place and recheck that the front end edge of the cover is iin the front panel EMI gasket groove. Tighten the four screws of the rear feet to a snug fit. Don't over-tighten these screws. Retighten the pouch retaining screw.

The cover protects this instrument from dust in the interior and also provides protection to personnel from the operating potentials present. In addition, it reduces the EMI radiation from the instrument or EMI interference to the display due to other equipment.

WARNING

Extreme caution must be used when troubleshooting in the Power Supply, due to the line voltage and the high potentials present. Refer to the discussion entitled Troubleshooting the Power Supply for troubleshooting information.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis may prevent instrument breakdown and will improve the reliability of this instrument. The severity of the environment to which the 485 is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding recalibration of the instrument.

Cleaning

General. The 485 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path which may result in instrument failure. The cover provides protection against dust in the interior of the instrument. Operation without the cover in place necessitates more frequent cleaning.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone or similar solvents. Recommended cleaning agent is isopropyl alcohol.

Switch Contacts. Most of the switching in the 485 is accomplished with circuit-board mounted, cam-actuated contacts. Care must be exercised to preserve the high-frequency characteristics of these switches. Seldom is switch maintenance necessary, but if it is required, observe the following precautions.

Cleaning the switch contacts should only be done using isopropyl alcohol or a solution of 1% Joy detergent and 99% water. Do not use acetone, MEK, MIBK, benzol, toluol, carbon tetrachloride, trichlor, trichlene, methyl alcohol, methylene chloride, sulfuric acid, or Freon TC-TE-TF-22-TA-12.

Air Filter. The air filter should be visually checked every few weeks and cleaned or replaced if dirty. More frequent inspections are required under severe operating conditions. If the filter is to be replaced, order new air filters from your local Tektronix Field Office or representative; order by Tektronix Part No. 378-0036-01. The following procedure is suggested for cleaning the filter.

1. Remove the filter by pulling it out of the retaining frame on the rear panel. Be careful not to drop any of the accumulated dirt into the instrument.

2. Flush the loose dirt from the filter with a stream of hot water.

3. Place the filter in a solution of mild detergent and hot water and let it soak for several minutes.

4. Squeeze the filter to wash out any dirt which remains.

5. Rinse the filter in clean water and allow it to dry.

6. Coat the dry filter with an air-filter adhesive (available from air conditioner suppliers or order Tektronix Part No. 006-0580-00).

7. Let the adhesive dry thoroughly.

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

Exterior. Loose dust accumulated on the outside of the 485 can be removed with a soft cloth or small brush. The brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

CRT. Clean the plastic light filter, and the CRT face with a soft, lint-free cloth dampened with denatured alcohol.

The CRT mesh filter (furnished with EMI Option 4 only) can be cleaned in the following manner:

1. Hold the mesh filter in a vertical position and brush lightly with a soft No. 7 water-color brush to remove light coatings of dust or lint.

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

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

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

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

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

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

Lubrication

The potentiometers, cam switches and pushbutton switches used in this instrument are factory lubricated and should not require further lubrication.

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

Visual Inspection

The 485 should be inspected occasionally for such defects as broken connections, broken or damaged ceramic strips, improperly seated semiconductors, damaged or improperly installed circuit boards, and heat-damaged parts.

The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Semiconductor Checks

Periodic checks of the semiconductors in the 485 are not recommended. The best check of semiconductor performance is actual operation in the instrument. More details on checking semiconductor operation are given under troubleshooting.

Recalibration

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

An elapsed-time meter is installed on the rear panel. This meter provides a full-scale indication of 5,000 hours of operating time and can be used to indicate when recalibration is necessary. Each minor division on this meter indicates 200 hours of operation. When the elapsed-time meter reaches 5,000 hours (full scale), it should be replaced.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the 485. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is helpful in locating troubles, particularly where integrated circuits are used. See the Circuit Description section for this information.

Troubleshooting Aids

Diagrams. Complete circuit diagrams are given on foldout pages in the Diagrams section. The component number and electrical value of each component in this instrument are shown on the diagrams (see first page of the Diagrams section for definition of the reference designators used to identify components in this instrument). Each main circuit is assigned a series of component numbers. Table 4-1 lists the main circuits in the 485 and the series of component numbers assigned to each. Important voltages and waveforms are also shown on the diagrams. The portions of the circuit mounted on circuit boards are enclosed with blue lines.

TABLE 4-1

Component Numbers

Diagram Number	Circuit	Component Numbers On Diagrams
1	ATTEN	1-199
2	PREAMPS	200-399
3	VERT SW	400-499
4	TRIG AMP	500-599
5	VERT AMP	600-699
6	A TRIG GEN	700-849
7	A TIME-BASE	850-999
8	B TRIG GEN	1000-1149
9	B TIME-BASE	1200-1299
10	TIMING SW	1400-1479
11	HORIZONTAL AMP	1300-1399, 1150-1199
12	LOGIC	1500-1599
13	CRT	1600-1799
14	POWER INVERTER	1800-1849, 1900-1959
15	POWER SUP	2000-2099
16	CALIBRATOR & FAN	1480-1499, 2100-2139

Circuit Boards. Circuit board assembly numbers are used on the diagrams and in the parts list to aid in locating the boards. Pictures of the circuit boards are located in the Diagrams section, on the back of the page opposite the circuit diagram, to aid the cross-referencing between the diagrams and the circuit-board pictures. Each electrical component on the boards is identified by its circuit

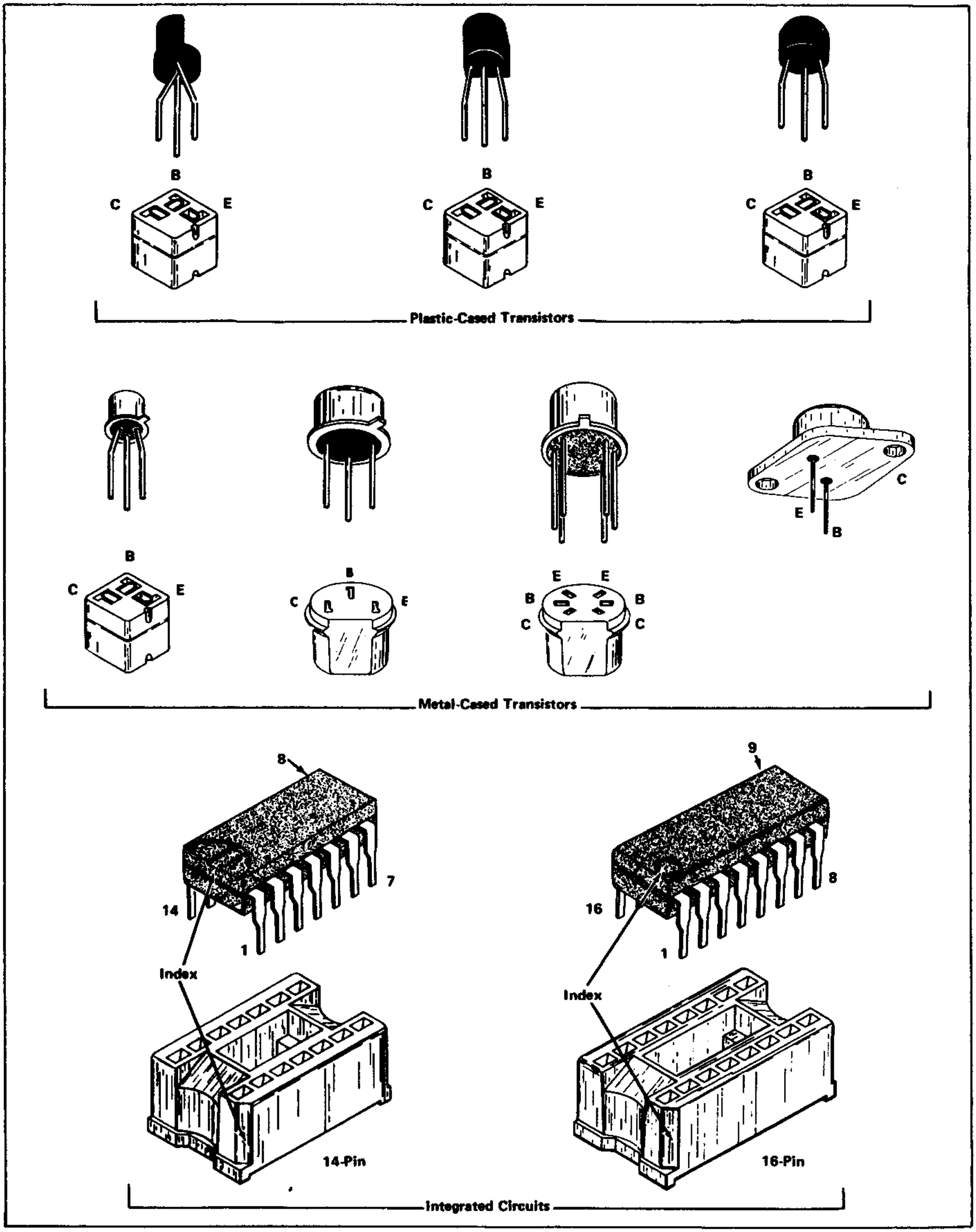


Fig. 4-1. Electrode configuration for semiconductors in this instrument.

number. The circuit boards are also outlined on the diagrams with a blue line to show which portions of the circuit are located on a circuit board.

Wiring Color-Code. All insulated wire and cable used in the 485 is color-coded to facilitate circuit tracing. Table 4-2 gives the wiring color-code used in this instrument.

WARNING

This color code applies to leads within the 485 only. Color code of the AC power cord is:

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

TABLE 4-2

Wiring Color Code

Supply or Function	Background Color	Stripe[1]
+15 volts	Red	Yellow
+9 volts	Red	Orange
+5.5 volts	Red	Brown
+5.0 volts	Red	Black
−5.0 volts	Violet	Black
−5.5 volts	Violet	Red
−9 volts	Violet	Orange
−15 volts	Violet	Yellow

Other power supply voltages are conducted by the comb connectors.

Semiconductor Lead Configuration. Fig. 4-1 shows the lead configuration for the semiconductors used in this instrument. This view is as seen from the bottom of the semiconductors.

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

Troubleshooting Equipment

The following equipment is useful for troubleshooting the 485.

1. Transistor Tester

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

Recommended type: Tektronix Type 576 Transistor-Curve Tracer.

2. Multimeter

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

NOTE

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

3. Test Oscilloscope

Description: Frequency response, DC to 100 megahertz minimum; deflection factor, 5 millivolts to 5 volts/division.

Purpose: To check operating waveforms in this instrument.

4. Isolation Transformer

Description: 1:1 turns ratio, 300 volt-amperes minimum rating, 50-60 cycle. Must have three-wire power cord, plug, and receptacle with ground connection carried through from input to output.

Purpose: To isolate the 485 from the line potential when troubleshooting in the power supply.

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

5. Variable Autotransformer

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

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

Recommended type: General Radio W10MT3W Metered Variac Autotransformer.

Troubleshooting Techniques

IMPORTANT

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

Power Supply. Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. However, a defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits. Table 4-3 lists the tolerances of the power supplies in this instrument. These voltages are measured between the power-supply and ground test points (on Low-Voltage Regulator board). If a power-supply voltage is within the listed tolerance, the supply can be assumed to be working correctly. If outside the tolerance, the supply may be misadjusted or operating incorrectly. Use the procedure given in the Calibration section to adjust the power supplies.

Power Supply Interaction. The semi-regulated supplies ±5.5, ±15, +25, +120, and +180 will track the adjustment of the +59.4-volt supply.

Regulated supplies ±5.0 and ±9.0 will track with +50. The cathode regulator will interact with both +50 and +59.4-volt supplies.

NOTE

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

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 and power supply waveforms are shown in Fig. 4-2 in this section.

TABLE 4-3

Power Supply Tolerance and Ripple (Referenced to TP GND)

Power Supply	Tolerance	Maximum Ripple (Peak to Peak)
+59.4 volts	±0.25 V	150 mV
+50 volts	±0.1 V	5 mV
Cath Reg (+95 volts)	±8.0 V (Beam Off)	
+5 volts	±0.1 V	10 mV
−5 volts	±0.1 V	10 mV
+9 volts	±0.15 V	10 mV
−9 volts	±0.15 V	10 mV
+15 volts	±0.25 V	20 mV
−15 volts	±0.25 V	20 mV
+25 volts	±0.6 V	50 mV
+120 volts	±2.4 V	300 mV
+180 volts	±3.6 V	1.0 volt
−2950 volts	±50.0 V	150 mV (Beam Off)

NOTE

Voltages are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the VOLTAGE CONDITIONS listed on each diagram page.

A. SEMICONDUCTORS.

CAUTION

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

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

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using integrated circuits. In addition, operating waveforms, logic levels, and other operating information for the integrated circuits are given in the Circuit Description section. Use care when checking voltages and waveforms around the integrated circuits so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin integrated circuits is with an integrated-circuit test clip. This device also doubles as an integrated-circuit extraction tool.

Special Troubleshooting Information

General. The following information provides a step-by-step procedure to aid in the troubleshooting of some of the more complex circuits and/or systems in the 485. A thorough understanding of the circuit operation is essential before troubleshooting in these areas. Read the applicable portions of the Circuit Description in Section 3 before proceeding with troubleshooting. This troubleshooting procedure refers to the diagrams, operating voltages, and waveforms in Section 8 and Fig. 4-2. Specifications for the troubleshooting equipment referred to in these procedures are given earlier in this section under Troubleshooting Equipment.

Troubleshooting the Power Supply. Table 4-4 gives a guide to troubleshooting the power supply of the 485.

A short on a semi-regulated supply may lower the transformer voltage so far that no supply can perform. An overloaded supply often discharges very fast when the inverter shuts off. Isolate shorts and overloads by withdrawing and replacing all connectors one by one; however, comb connectors BB, CC, DD, S, T, U, V, and W must not be removed with power on. With power off, any or all of the comb connectors can be removed for troubleshooting with an ohmmeter.

To detect a short in the −2950 V supply, perform the following: 1) Turn power off: 2) Remove comb U, and bend pin 3 to prevent contact; 3) Re-install comb U and turn power on.

If other supplies now perform correctly, locate and repair the short in the −2950 V supply. Turn power off, straighten pin 3 and re-install comb U.

WARNING

Line AC and stored DC potentials are present on the Inverter circuit board and on the transformer circuit board. The stored DC remains long after the instrument is disconnected from the power line. Verify that the line cord is disconnected and that the line storage capacitors, C1822 and C1823, are completely discharged before attempting any repairs or ohmic measurements. The stored DC voltage can be measured between TP1834 (POS) and TP1844 (NEG). If manual discharge is necessary use a 1.5 k 2 W insulated resistor with insulated leads. USE EXTREME CAUTION.

TABLE 4-4

Power Supply Troubleshooting

Trouble Symptom	Checks to Make	Comments
Inverter starts then shuts off at slow rate (3 Hz or less).	Check Balance Node TP1951 during 20 ms "sampling period"	BAL T.P. more positive than +200 mV means short on negative supply or overcurrent in H.V. winding of T1960. BAL T.P. more negative than −200 mV means short on positive supply or high beam current. Error on BAL T.P. stops inverter. SEE BALANCE NODE NOTE preceding Fig. 4-2.
	Check inverter current TP1926 during 20 ms "sampling period"	If current remains at limit level for entire sampling period, U1910 will stop inverter. Possible short on semi-regulated supply.
	Check Line Stop TP1918 during 20 ms "sampling period". Check Line Selector switch for correct position.	If proper AC voltage from T1801 does not reach pin 4 of U1910, TP1918 will go positive stopping the inverter.

TABLE 4-4 (cont)

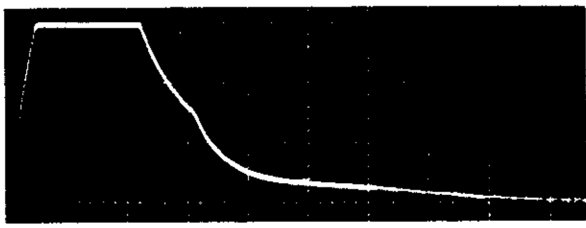
Trouble Symptoms	Checks to Make	Comments
Inverter starts then shuts off at fast rate (10 Hz or faster).	Check comb connector "R" for proper installation.	Overvoltage Stop circuit stops inverter when connector is out.
	Check power from T1848 reaching U1910 Pin 6 = +7.5 Pin 7 = −2 V	Stop monostable will stop inverter if U1910 does not have power to function.
	Check secondary voltages for overvoltage.	Overvoltage Stop circuit stops inverter if U1910 does not regulate.
Excessive ripple on semi-regulated supplies.	Look for an open rectifier diode. Compare ripple frequency on the input capacitor of each Semi-regulated Supply.	Due to symmetry of operation an open rectifier on one supply will cause ripple on all supplies.
	See Table 4-3 for max output ripple values.	Matching of the forward voltage drop of the two rectifiers in a supply may be necessary to avoid excess ripple.
Inverter won't start.	Check for blinking neon oscillator DS1824 on Inverter board.	If DS1824 is blinking, Line Input circuit is okay. If DS1824 is not blinking, check for open line fuse or other malfunction.
	Check for start pulse with AC-coupled probe at TP1835.	AC-coupled probe required due to lack of ground reference in Inverter circuit. Start pulse should occur each line cycle.
	Check Q1900 and Q1902 for shorts.	If either transistor is shorted, the inverter will not start.
Line fuse opens when power is turned on.	Check Line Selector switch for correct position.	If Line Selector is correct, check semiconductors on Inverter board with line cord disconnected and all capacitors completely discharged.
No intensity control or poor focus control (see Fig. 4-2).	Check DC restorer diodes in CRT circuit. Check for proper levels at outputs of Z Axis and Auto Focus circuits.	If diodes check okay compare circuit waveforms to those given in Fig. 4-2.
No high voltage.	Check Cathode Multiplier and Anode Multiplier circuits.	The Transformer board can be removed by first removing the Power board and Inverter board, disconnect Line Cord and wait five minutes for Line Storage capacitors to discharge before removing Inverter board.

NOTE

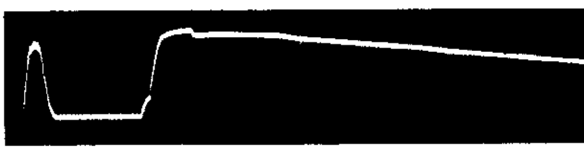
For additional information see circuit descriptions, Table 4-2, and circuit board connection map at the end of this section. Waveforms for comparison are given in Fig. 4-2A through Fig. 4-2P.

BALANCE NODE NOTE

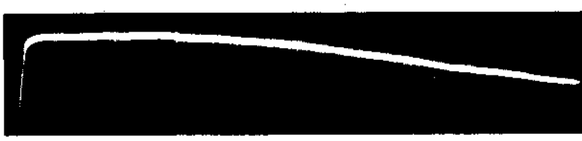
The balance node (TP1951) acts as an "OR" circuit for various faults which will stop the inverter. To isolate the fault, determine the voltage level at TP1951 during the 20 ms sampling period which immediately follows the turn-on transient of approximately 6 ms. If the balance node is more positive than +200 mV, look for a short on a negative supply or over-current in the H.V. winding of T1960. A H.V. current fault is present if the voltage at TP1958 (H.V.) goes positive during the sampling period, causing CR1958 to conduct. When observing power supplies, check to see that each supply comes up to nominal value during the sampling period. If the balance node is more negative than −200 mV, look for a short on a positive supply or high beam current. A beam limit fault is present if the voltage at TP1959 (LIM) goes negative during the sampling period causing CR1959 to conduct. A fault in the vertical circuit (output leads shorted, etc.) will cause Q688 to crowbar the +25 V supply which stops the inverter via the balance node. If the relays click each time the inverter starts, some semi-regulated supplies are briefly coming up to value. Look for a fault on +25 V, Beam Limit Shutdown, or a short on one of the regulated supplies (+50, +9, −9, +5, or −5 V).



A.) At TP +15. Power Supply coming up to nominal value during sampling period, then falling off as supply shuts down due to overload.

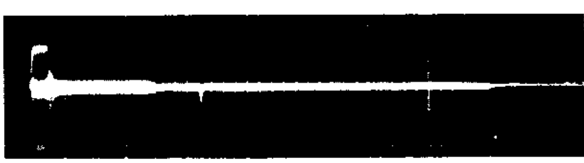


B.) At TP1951. Balance Node during sampling period with all supplies normal (test oscilloscope externally triggered on TP1926) then short applied to −9 V supply to cause second positive swing.



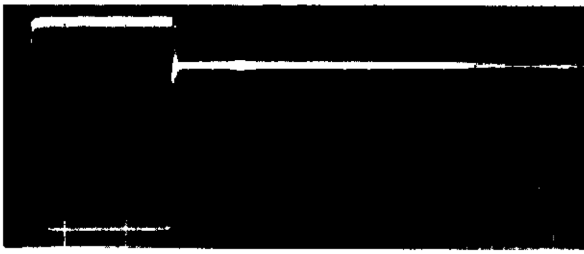
C.) At TP1951 Balance Node during sampling period then falling off due to short on −9 V supply.

D.) At TP1951. Balance Node with power supply coming up during sampling period then falling off as supply shuts down due to short on +9 V supply.

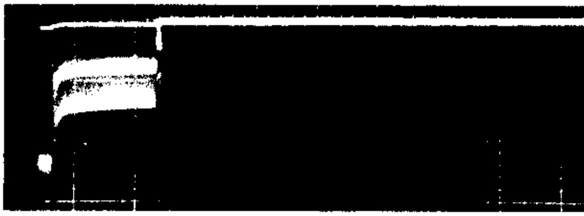


E.) At TP1958. H.V. Current Sens during sampling period with normal load.

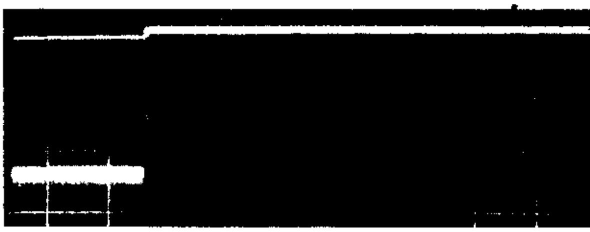
Fig. 4-2. Power Supply waveforms. Test oscilloscope internally triggered unless otherwise noted. **Fig. 4-2 continued on following pages.**



F.) At TP1958 H.V. Current Sens during sampling period with short on −2950 supply.

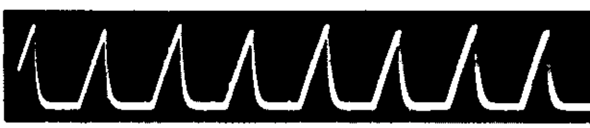


G.) At TP1926. Inverter Current Sens during sampling period with all supplies normal.

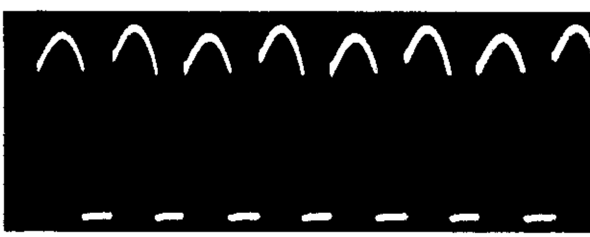


H.) At TP1926. Inverter Current Sens during sampling period with short on +15 supply.

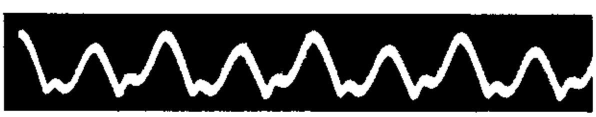
I.) At TP1926. Inverter Current Sens during normal operation.



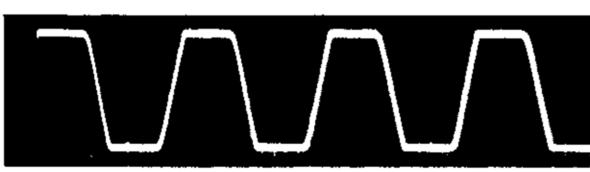
J.) At TP1919. Mono Ramp during normal operation.



K.) At collector of Q1900 during normal operation.



L.) At TP +59.4. Ripple on +59.4 supply during normal operation (AC coupled).



M.) X10 Probe at Anode of CR1660 Normal operation with intensity off.

Fig. 4-2. Power Supply Waveforms cont.

.5 V/DIV

20 μsec/DIV

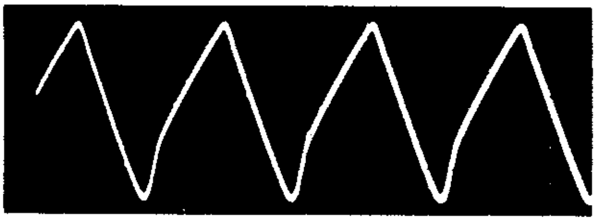
N.) AC coupled at TP1665. Normal operation with intensity off.

50 V/DIV

+150 V

20 μsec/DIV

O.) X10 Probe at Anode of CR1656 Normal operation with intensity off.



1 V/DIV

20 μsec/DIV

P.) AC coupled at TP1653. Normal operation with intensity off.

Fig. 4-2. Power Supply Waveforms cont.

CORRECTIVE MAINTENANCE

General

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

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

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the 485 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 lists for value, tolerance, rating, and description.

NOTE

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

Special Parts. In addition to the standard electronic components, some special components are used in the 485. 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.
2. Instrument serial number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix Part Number.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques which apply to maintenance of any precision electronic equipment should be used when working on this instrument. Use only 60/40 rosin-core, electronic-grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards, use a 35- to 40-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Also, apply only enough solder to make a firm solder joint; do not apply too much solder.

CAUTION

The Vertical Preamplifier Attenuator circuit boards are made of material easily damaged by excessive heat. When soldering to these boards, do not use a soldering iron with a rating of more than approximately 15 watts. Avoid prolonged applications of heat to circuit-board connections. Use only isopropyl alcohol when cleaning this circuit board.

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

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

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

WARNING

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

Circuit Board Replacement. If a circuit board is damaged beyond repair, the entire assembly including all soldered on components, can be replaced. Part numbers are given in the Parts List.

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

To remove circuit boards first remove all plug-on type wiring and comb connectors. Plugs with more than one lead are indexed with the arrow on the board matching the arrow on the plug. A group of single plugs in the same area have abbreviations of the wire color silkscreened by the pin.

a. To remove circuit boards, remove all plug-on type wiring and comb connectors.

b. Remove all of the securing screws on the board.

c. Lift the board away from the instrument being careful not to bend any pins protruding from the board.

d. To replace the circuit board, position it so that the securing screws align with the mounting holes.

e. Do not tighten the securing screws until all of the comb connectors have been inserted.

f. Uniformly tighten the securing screws. Recommended torque is four to six inch-pounds.

TIMING BOARD REMOVAL.

a. Remove upper two rows of sweep board comb connectors.

b. Remove Horizontal Amplifier board.

c. Remove Sweep board.

d. Remove Inverter board (see Inverter board removal procedure).

e. Remove shield around the rear portion of the Timing board.

f. Remove Timing switch knobs.

g. Remove the blue rear panel rim.

h. Remove the blue rear panel cover (10 screws).

i. Remove the fan blade.

j. Remove 8 screws holding the Timing board.

k. Tilt outside edge of the board up and carefully lift the board out of the instrument.

l. To install, reverse the procedure.

TRANSFORMER BOARD REMOVAL.

a. Slide Inverter board out of the way (see Inverter board removal procedure).

b. Remove the Sweep board.

c. Remove the Power board.

WARNING

A high voltage charge will remain on the Post Accelerating Anode lead after the instrument has been turned off. When disconnecting the Post Accelerating lead, pull it out in a manner that it will touch and discharge to the chassis ground immediately after clearing the housing (take care to avoid discharge to the nearby Vertical Deflection connections). This procedure must be repeated every time the Post Accelerating lead is removed. If it is connected and removed without the instrument being turned on, it will have accepted a charge from the Anode Multiplier and will again be dangerous when disconnected.

d. Disconnect the Post Accelerating Anode lead (top side of instrument). Unclamp the female connection housing for this lead.

e. Remove plastic shield on rear of the Horizontal Amplifier board. Remove the two comb connectors from under the shield and the one in front of the shield.

f. Remove the blue wrap-around rear panel rim.

g. Remove the blue rear panel cover (10 screws).

h. Disconnect the three plugs with leads that are connected to the CRT base socket at the rear of the oscilloscope.

i. Unclamp the interconnecting lead to the Inverter board.

j. Remove the Transformer board mounting screws (four No. 4 screws). This does not include the two No. 6 screws (transformer mounting).

k. Slide the Transformer board out.

l. To install the Transformer board, reverse this procedure.

m. Connect all interconnecting leads.

INVERTER BOARD REMOVAL

WARNING

Line AC and stored DC potentials are present on the Inverter and Transformer boards. The stored DC remains long after the instrument is disconnected from the power line. Verify that the line cord is disconnected and that the line storage capacitors, C1822 and C1823, are completely discharged before attempting any repairs (wait three minutes after DS1824, located under the metal shield, stops flashing). The stored DC can be measured between TP1834 (POS) and TP1844 (NEG). If manual discharge is necessary use a 1.5 kΩ, 2 W insulated resistor with insulated leads. USE EXTREME CAUTION.

a. Remove the metal protective shield (4 screws).

b. Remove the 4 shield mounting standoffs so that the board can come straight out.

c. Remove the comb connector and unplug the 2 pin cable.

d. Remove the 4 screws holding the Inverter board and the 4 screws holding the insulating material of the two large transistors at the rear of the board.

e. To repair the Inverter board or gain access to the Transformer board, lift the Inverter board up and turn it to one side. It is not necessary to unsolder the primary leads.

f. For complete removal of the Inverter board, unsolder the three primary leads.

g. To install the board, reverse the procedure.

Semiconductor Replacement. Semiconductors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the calibration of this instrument. When semiconductors are replaced, check the operation of the part of the instrument which may be affected.

CAUTION

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

Replacement semiconductors should be of the original type or a direct replacement. Fig. 4-1 shows the lead configuration of the semiconductors used in this instrument. Some plastic case transistors have lead configurations which do not agree with those shown here. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for the standard basing as used for metal-cased transistors. Transistors which have heat radiators or are mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease when replacing these transistors.

WARNING

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

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

Interconnecting Pin Replacement. The following information provides the replacement procedure for the various types of interconnecting methods.

A. CIRCUIT-BOARD PINS.

NOTE

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

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

B. CIRCUIT BOARD PIN SOCKETS.

The pin sockets on the circuit boards are soldered to the rear of the board. To replace one of these sockets, first unsolder the pin (use a vacuum-type desoldering tool to remove excess solder). Then, straighten the tabs on the socket and remove it from the hole in the circuit board. Place the new socket in the circuit-board hole and press the tabs down against the board. Solder the tabs of the socket to the circuit board; be careful not to get solder into the socket.

NOTE

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

C. END-LEAD PIN CONNECTORS.

The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads. To replace damaged end-lead pin connectors, remove the old pin connector from the end of the lead and clamp the replacement connector to the lead.

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

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

WARNING

Use care when handling a CRT. Protective clothing and safety glasses should be worn. Avoid striking it on any object which might cause it to crack or implode. When storing a CRT, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the faceplate to protect it from scratches. A high voltage charge remains on the Post Accelerating Anode lead after the instrument has been turned off. When disconnecting the Post Accelerating lead pull it out in a manner that it will touch and discharge to the chassis ground immediately after clearing the housing (take care to avoid discharge to the nearby vertical deflection connections). This procedure must be repeated every time the Post Accelerating lead is removed. If it is connected and removed without the instrument being turned on, it will have accepted a charge from the Anode Multiplier and will again be dangerous when disconnected.

1. Disconnect Post Accelerating lead.
2. Disconnect the 6 CRT deflection plate leads.
3. Remove rear panel for access to CRT base.
4. Remove CRT base connector.
5. Remove four screws from CRT bezel and remove bezel from the front of the instrument.
6. Push CRT carefully out the front of the instrument.

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

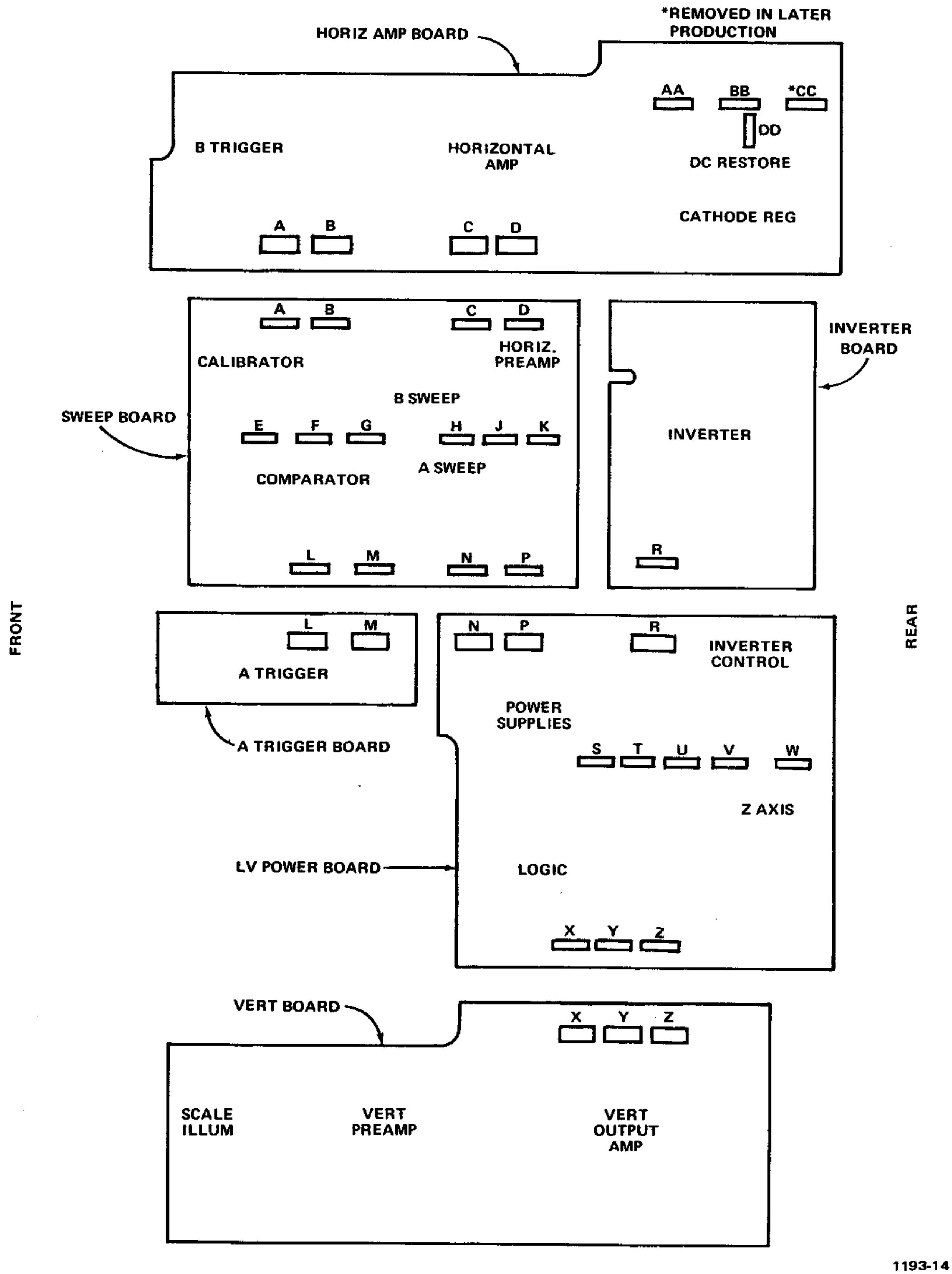


Fig. 4-3. Interboard comb connection locations.