TEKTRONIX®

INSTRUCTION MANUAL

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SAFETY SUMMARY

This manual contains safety information which the user must follow to ensure safe operation of this instrument. WARNING information is intended to protect the operator, CAUTION information is intended to protect the instrument. The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Tektronix Inc. assumes no liability for the customer's failure to comply with these requirements.

Dangerous procedure warning statements precede potentially dangerous procedures throughout this manual. The instructions contained in the warnings must be followed. The following warning statements are found in this manual.

WARNING

Use a Proper Power Source

This instrument is intended to be operated from a single-phase power source. A suitable power source is one where both current-carrying conductors are ungrounded, since over-current protection (fuse) is provided in both conductors. Operation from a grounded power source is not recommended. If the fuse in the grounded conductor opens, the power-source voltage appears on the internal primary wiring causing a possible shock hazard during troubleshooting.

Ground the Instrument

This instrument has a three-wire power cord with a three-terminal polarized plug for connection to the power source and safety-earth. The safety-earth terminal of the plug is directly connected to the instrument frame. For electric-shock protection, insert this plug only in a mating outlet with a safety-earth contact or otherwise connect the frame to a safety-earth system. Failure to complete the ground system may allow the chassis of this instrument to be elevated above ground potential and pose a shock hazard.

Avoid Live Circuits

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

Avoid Contact With Chemicals

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

Use Care When Handling the Crt

Protective clothing and safety glasses should be worn when handling a crt. 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.

CAUTION

Avoid Crt Phosphor Damage

Crt phosphor damage can occur under adverse conditions. Avoid any condition where an extremely bright, sharply focused spot exists on the crt.

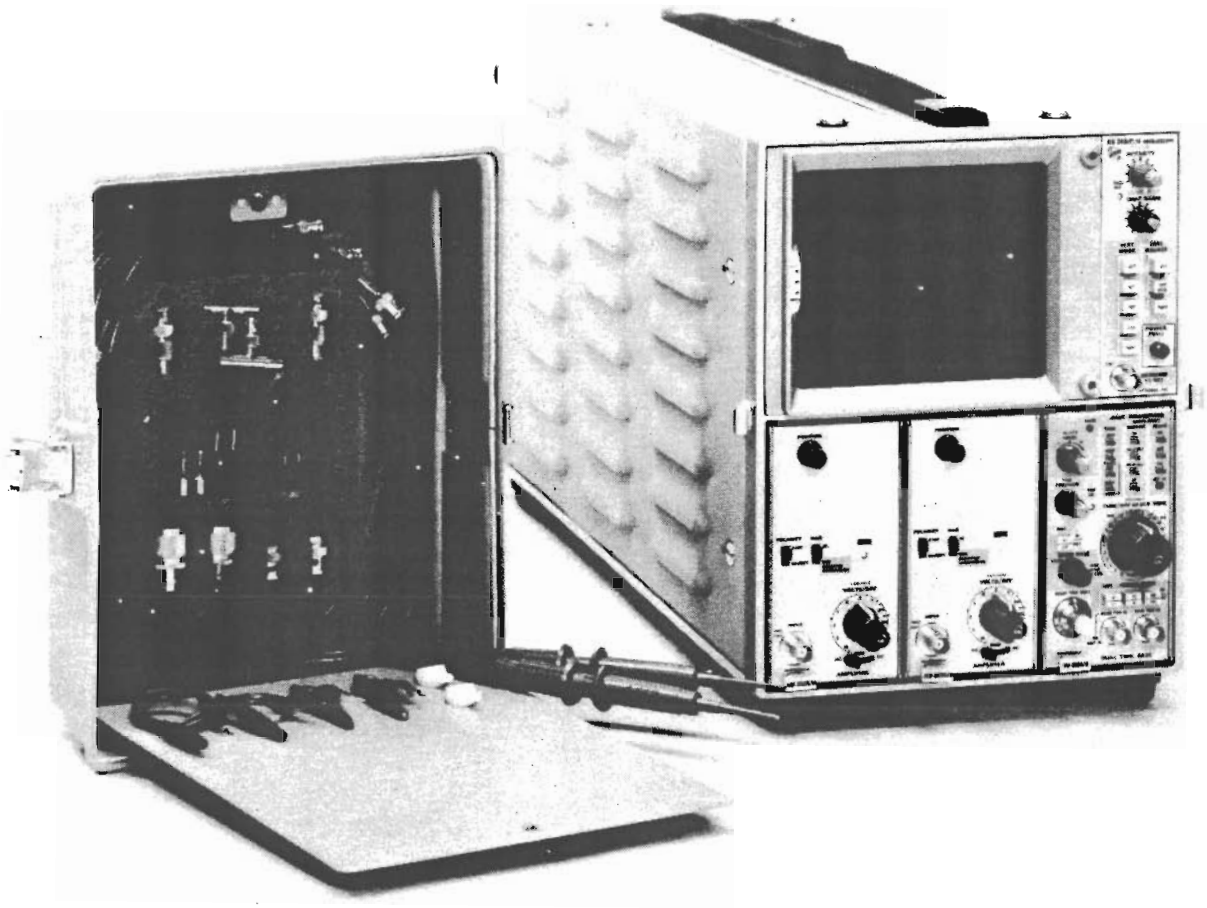

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Figure 1-1. OS-245(P)/U Oscilloscope and standard accessories shown with recommended plug-in units.

OPERATING INSTRUCTIONS

This manual includes operating information, specifications, theory of operation, maintenance information, performance check and calibration information, schematic diagrams, circuit board illustrations, and complete parts list for the OS-245(P)/U (hereinafter referred to as the Oscilloscope).

PRELIMINARY INFORMATION

Intended Usage

The Oscilloscope is designed specifically for use with (one) TD-1085/U Dual Time Base unit and (two) AM-6565/U Amplifier plug-in units to form a complete oscilloscope system; however, the Oscilloscope is compatible with all Tektronix 7A-series amplifier plug-in units and all 7B50 to 7B70-series time-base plug-in units.

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

Oscilloscope Features

The Oscilloscope is a solid state, light weight instrument designed for general-purpose measuring applications. This instrument has three plug-in compartments that accept plug-in units to form a complete measurement system. The two-plug-in compartments on the left are connected to the vertical deflection system. The right plug-in compartment is connected to the horizontal deflection system. Electronic switching between the vertical plug-in compartments allows a multi-trace vertical display. The flexibility of this plug-in feature and the variety of plug-in units available allow this system to be used for many measurement applications.

This instrument features a large-screen, 8 X 10 division display; each division equals one centimeter. The crt provides small spot size and fast writing speed. Regulated dc power supplies ensure that performance is not affected by variations in line voltage and frequency, or by changes in the load due to the varying power requirements of the plug-in units. Maximum power consumption is about 125 watts (60 hertz, 115-volt line). Ruggedization is provided to meet the requirements of military Specification MIL-0-24311 (EC).

Safety Information

This instruction manual contains warning information which the user must follow to ensure safe operation of the instrument. Warning information is intended to protect the operator and Caution information is intended to protect the instrument.

WARNING

This instrument is intended to be operated from a single-phase power source. A suitable power source is one where both current-carrying conductors are ungrounded, since over-current protection (fuse) is provided in both conductors. Operation from a grounded power source is not recommended. If the fuse in the grounded conductor opens, the power-source voltage appears on the internal primary wiring causing a possible shock hazard during troubleshooting.

This instrument has a three-wire power cord with a three-terminal polarized plug for connection to the power source and safety-earth. The safety-earth terminal of the plug is directly connected to the instrument frame. For electric-shock protection, insert this plug only in a mating outlet with a safety-earth contact or otherwise connect the frame to a safety-earth system. Failure to complete the ground system may allow the chassis of this instrument to be elevated above ground potential and pose a shock hazard. The color-coding of the cord conductors may be in accordance with one of the following recognized standards.

Conductor	USA & Canada	IEC
Line	Black	Brown
Neutral	White	Light Blue
Safety-Earth	Green with yellow stripe	Green with yellow stripe

Operating Voltage

This instrument can be operated from either a 115-volt or a 230-volt nominal line-voltage source. In addition, three operating ranges can be selected within each nominal line voltage source. The voltage selector jumper on the Rectifier board (in power unit, see Fig. 1-2) allows selection of the operating voltage. To convert the instrument from one regulating range to another, first disconnect the instrument from the power source. Then, slide out the power unit as described in the Maintenance section. Remove the voltage selector jumper and reinstall it on the set of pins which represent the desired regulating range. Select a range which

is centered about the average line voltage to which the instrument is to be connected (see Table 1-1 and select either Low, Med, or Hi regulating range).

TABLE 1-1
Regulating Range and Fuse Data

Pins Selected	Regulating Range	
	115-V Nominal (Brown Plug)	230-V Nominal (Red Plug)
LOW	110 V ±10%	220 V ±10%
MED (typical setting)	115 V ±10%	230 V ±10%
HI	120 V ±10%	240 V ±10%
Line Fuses	2 A slow-blow	1 A slow-blow

To convert from 115-volts to 230-volts nominal line voltage, or vice versa, remove the voltage selector jumper and replace it with the spare jumper stored on the pins adjacent to the voltage selector area (see Fig. 1-2). The jumpers are color-coded to indicate the nominal voltage for which they are intended; brown for 115-volt nominal operation and red for 230-volt nominal operation. Change the line fuse to provide protection for the selected nominal line voltage. A spare fuse is located in the Alt Fuse holder on the Rectifier board (see Fig. 1-2 for the Alt fuse location and Table 1-1 for value). Also, change the line-cord plug to match the power-source receptacle or use a suitable adapter.

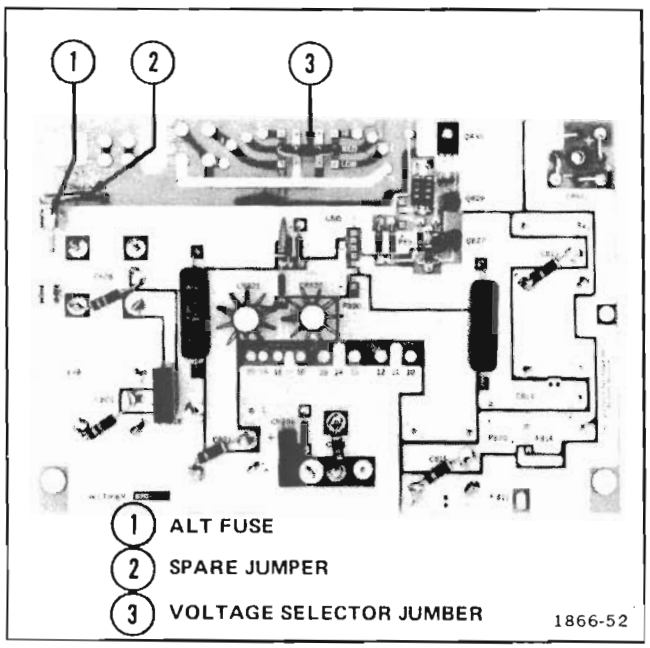


Figure 1-2. Locations of voltage selector jumper, spare jumper, and Alt Fuse in power unit.

Operating Temperature

The Oscilloscope can be operated where the ambient air temperature is between −28° and +65° C. This instrument can be stored in ambient temperatures between −62° and +75° C. After storage at temperatures beyond the operating limits, allow the chassis temperature to come within the operating limits before power is applied.

Components which require the most cooling are mounted externally on a heat radiator at the rear. Adequate clearance must be provided on all sides to allow heat to be dissipated from the instrument. Do not block or restrict the air flow through the holes in the cabinet or through the heat radiator on the rear. Maintain the clearance provided by the feet on the bottom and allow about two inches clearance on the top, sides and rear (more if possible).

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

Operating Position

The normal operating position of the Oscilloscope is horizontal, setting on a flat surface, on the four feet provided on the bottom surface. The Oscilloscope may be used in other positions without impairment of the electrical characteristics, including setting the cabinet on the six protective bumpers on the rear surface. It is important to remember, however, that in positions other than the normal horizontal position, characteristics such as cooling and resistance to shock and vibration are altered. Therefore, operation in other than the normal position should be for short periods only and with more than normal care exercised to protect the Oscilloscope from damage.

DISPLAY DEFINITIONS

The following definitions describe the types of displays which can be obtained with the Oscilloscope system using amplifier units, time-base units, or combinations of these. The use of special purpose plug-in units may result in different types of displays, which are defined in the instruction manuals for these special units. The following terminology will be used throughout this manual.

Alternate Mode

A time-sharing method of displaying two or more signals with a single cathode-ray tube beam. Channel switching is sequential and occurs at the end of each sweep.

Chopped Mode

A time-sharing method of displaying two or more signals with a single cathode-ray tube beam. Channel switching is sequential and occurs at a rate determined by an internal clock generator (chopping rate).

NOTE

See Simplified Operating Instructions in this section for set-up information to obtain each of the following displays.

Single Trace

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

Dual Trace

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

Delayed Sweep—Single Trace

A display of a single plot produced by one vertical signal and a delayed sweep. Two sweeps (separate sweep generators) are used to produce this display; the sweeps are operating with a delaying/delayed sweep relationship where one sweep (identified as the delaying sweep) delays the start of the second sweep (identified as the delayed sweep).

Delayed Sweep—Dual Trace

A display of two plots produced by combining two vertical signals and a delayed sweep. Two sweeps (separate sweep generators) are used to produce this display; the sweeps are operating with a delaying/delayed sweep relationship. Each vertical signal is displayed against the delayed sweep.

X-Y

A plot of two signals, one signal versus the other, rather than against the internal sweep. X refers to the horizontal axis and Y refers to the vertical axis.

PLUG-IN UNITS

The Oscilloscope is designed to accept up to three Tektronix plug-in units. This plug-in feature allows a variety of display combinations and also allows selection of bandwidth, sensitivity, display mode, etc. to meet the measurement requirements. In addition, it allows the Oscilloscope system to be expanded to meet future measurement requirements. The overall capabilities of the resultant system are in large part determined by the characteristics of the plug-in(s) selected. For complete information on plug-ins available for use with this instrument, see the current Tektronix, Inc. catalog.

Plug-In Installation

To install a plug-in unit into one of the plug-in compartments, align the slots in the top and bottom of the plug-in with the guide rails in the plug-in compartment. Push the plug-in unit slowly and firmly into the plug-in compartment until it locks into place. To remove a plug-in, pull the release latch on the plug-in unit to disengage it and pull the unit out of the plug-in compartment. Plug-in units can be removed or installed without turning off the instrument power; however, it is a recommended practice to turn the instrument power off (momentarily) when removing or installing the plug-in units.

It is not necessary that all of the plug-in compartments be filled to operate the instrument; the only plug-in units needed are those required for the measurement to be made. However, at environmental extremes, excess radiation may be radiated into or out of this instrument through the open plug-in compartment. Blank plug-in panels are available from Tektronix, Inc. to cover the unused compartment; order Tektronix Part 016-0155-00.

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

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

FRONT PANEL CONTROLS AND CONNECTOR

All controls required for the operation of the Oscilloscope are located on the front panel of the instrument. To make full use of the capabilities of this instrument, the operator should be familiar with the function and use of each control. A brief description of the front-panel controls and connector is given here. More detailed information is given under General Operating Information (later in this section). Figure 1-3 shows the location of the front-panel controls and connector.

Display Controls

(1) **INTENSITY Control**—Controls brightness of the display. The control is inoperative when horizontal compartment is empty.

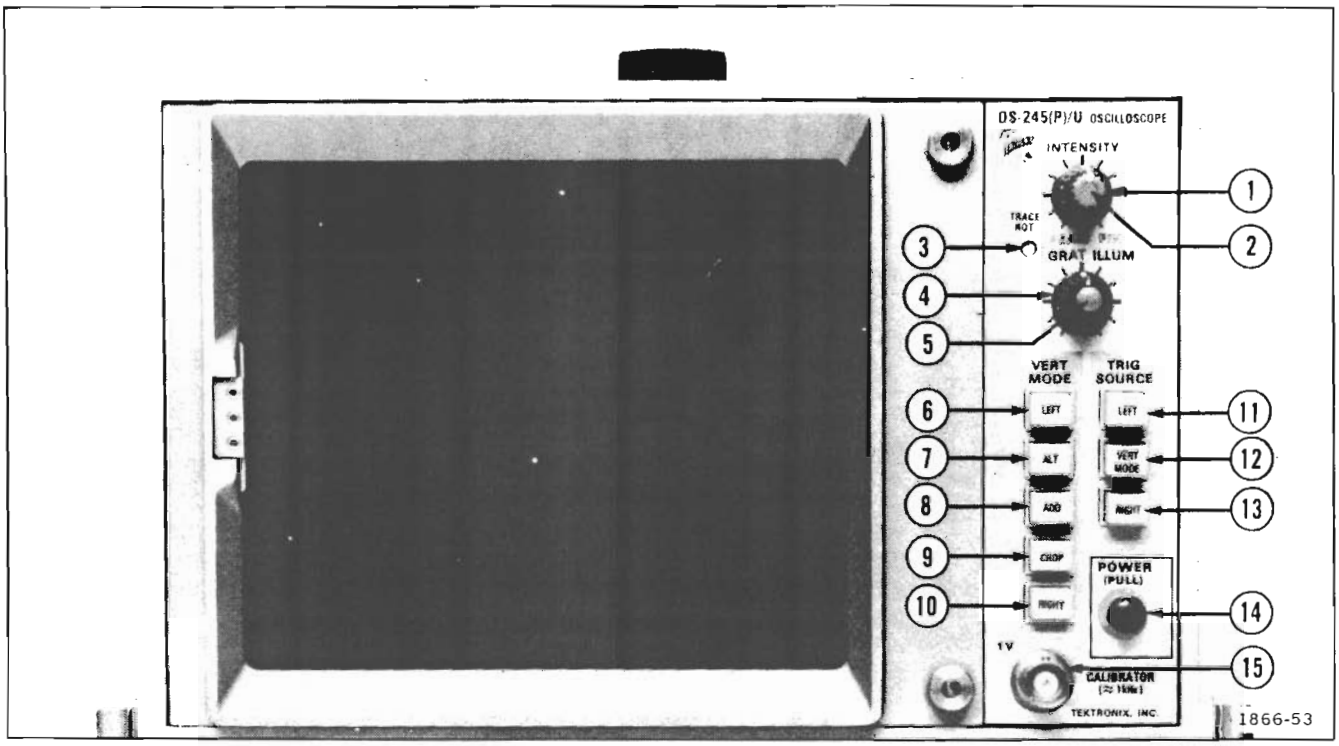


Figure 1-3. Front panel controls and connector.

(2) **FOCUS Control**—Provides adjustment for optimum display definition.

(3) **TRACE ROT Screwdriver Adjustment**—Controls alignment of trace with horizontal graticule lines.

(4) **GRAT ILLUM Control**—Controls brightness of crt graticule lines.

(5) **BEAM FIND Switch**—Spring-Loaded Push Button Switch. When pressed, causes display to be compressed within the graticule area independent of control settings or applied signals.

Vert Mode Switches

(6) **LEFT**—Selects signal from left vertical compartment for display.

(7) **ALT**—Selects signals from left and right compartments for display on alternate sweeps (dual trace).

(8) **ADD**—Selects signals from both vertical compartments for display. Signals are algebraically added and the sum is displayed.

(9) **CHOP**—Selects signals from left and right vertical compartments for display (dual trace). Signals are switched at a one-megahertz rate during the sweep.

(10) **RIGHT**—Selects signal from right vertical compartment for display.

Trig Source Switches

(11) **LEFT**—Selects internal trigger signal from left vertical compartment.

(12) **VERT MODE**—The internal trigger signal automatically follows the settings of VERT MODE switches except when CHOP mode is selected. In CHOP mode, the trigger occurs at a one-megahertz rate.

(13) **RIGHT**—Selects internal trigger signal from right vertical compartment.

Power Switch and Calibrator Connector

(14) **POWER Switch**—Push-pull switch. Controls power to the Oscilloscope.

(15) **CALIBRATOR Connector**—Provides the calibrator output signal.

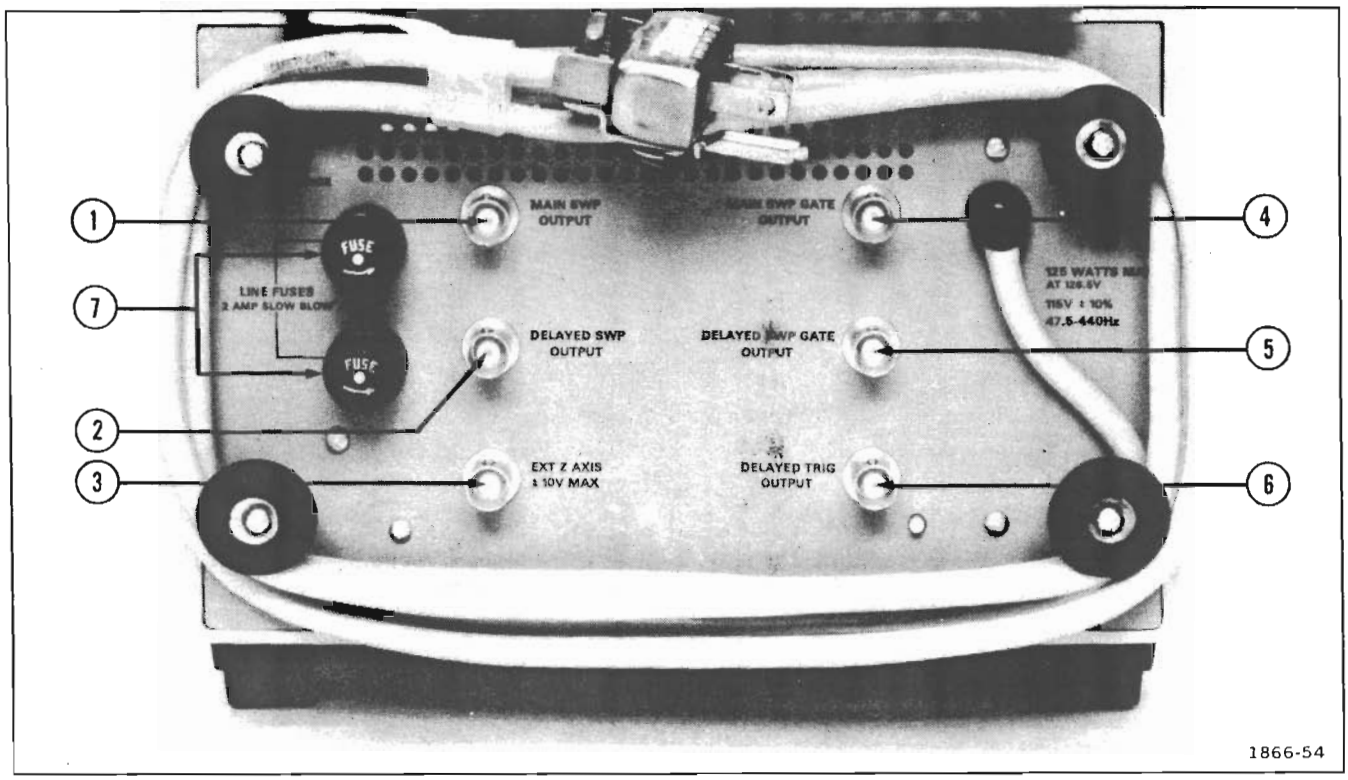


Figure 1-4. Rear panel connectors and fuses.

REAR PANEL CONNECTORS AND FUSES

The following descriptions are referenced to Figure 1-4.

(1) **MAIN SWP OUTPUT Connector**—Provides the main sweep output signal.

(2) **DELAYED SWP OUTPUT Connector**—Provides the delayed sweep output signal.

(3) **EXT Z AXIS Connector**—Provides for the input of an external signal for intensity modulation of crt display.

(4) **MAIN SWP GATE OUTPUT Connector**—Provides the main sweep gate output signal.

(5) **DELAYED SWP GATE OUTPUT Connector**—Provides the delayed sweep gate output signal.

(6) **DELAYED TRIG OUTPUT Connector**—Provides the delayed trigger output signal.

(7) **LINE FUSES**—Provides overload protection for Oscilloscope circuits.

OPERATING CHECKOUT

The following Operating Checkout procedure provides a means of verifying instrument operation and basic calibration without removing the covers or making internal adjustments. Since it demonstrates the use of front-panel controls and connectors, it can also be used to provide basic training on the operation of this instrument. If calibration of the Oscilloscope appears to be necessary, see the Calibration procedure in Section 5 of this manual. If calibration of a plug-in unit is indicated, see the instruction manual for the appropriate plug-in unit.

Set-Up Information

1. Set the front-panel controls as follows:

INTENSITY	Counterclockwise (off)
FOCUS	Midrange
GRAT ILLUM	Midrange
VERT MODE	LEFT
TRIG SOURCE	VERT MODE
POWER	Pushed in (off)

2. Connect the Oscilloscope to a power source which meets the voltage and frequency requirements of this instrument. The applied voltage should be within the recommended

voltage range marked on the rear panel (see Operating Voltage in this section for information on converting this instrument from one operating voltage to another).

3. Install amplifier units into both the left and right vertical plug-in compartments. Install a time-base unit into the horizontal compartment.

4. Pull the POWER switch to turn the instrument on. Allow at least 20 minutes warmup.

5. Set both vertical units for a deflection factor of 0.5 volts/division and center the vertical position controls. Set both vertical units for dc input coupling.

6. Set the time-base unit for a sweep rate of 0.5 millisecond/division in the auto, internal trigger mode.

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

8. Connect the 1 V CALIBRATOR output to the left amplifier unit input with a BNC cable.

Display Focus

9. Adjust the FOCUS control for a sharp, well-defined display over the entire trace length. If a properly focused display cannot be obtained with the FOCUS control, the internal Astigmatism adjustment must be reset; see the Calibration section of this manual.

Trace Alignment

10. Disconnect the input signal and position the trace with the left amplifier unit position control so it coincides with the center horizontal line of the graticule. If the trace is not parallel to the center horizontal line of the graticule, adjust TRACE ROT (front-panel screwdriver adjustment) to align the trace with the center horizontal graticule line.

Graticule Illumination

11. Rotate the GRAT ILLUM control throughout its range and notice that the illumination of the graticule lines increases as the control is turned clockwise. Set the control so the graticule lines are illuminated as desired.

Vertical Deflection

12. Connect the 1 V CALIBRATOR signal to the input connector of the left amplifier unit with the BNC cable. Set both amplifier units for a deflection factor of 0.5 volt/division. The display amplitude should be approximately two divisions. Notice the exact display amplitude for step 15.

13. Notice that the position control of only the left amplifier unit has an effect on the position of the display. Position the display to the upper half of the graticule.

14. Press the RIGHT button of the VERT MODE switch. Remove the CALIBRATOR signal from the left amplifier and connect it to the right amplifier. The display amplitude should be approximately two divisions. Note the exact display amplitude for the next step.

15. An accurate display amplitude in steps 12 and 14 indicates that the Oscilloscope and the vertical plug-in units are calibrated as a system. If the displays were noted to have amplitude errors in the same direction (i.e., high or low), the Oscilloscope vertical gain may need adjustment. However, the gain of each amplifier unit may be adjusted to eliminate any amplitude error. If desired, set the gain of the amplifier units (front-panel screwdriver adjustment) for an accurate two-division display.

16. Notice that the position control of only the right amplifier unit has an effect on the position of the display. Position the display to the lower half of the graticule. Disconnect the CALIBRATOR signal from the amplifier unit.

17. Press the ALT button of the VERT MODE switch. Notice that two traces are displayed on the crt. The top trace is produced by the left amplifier unit and the bottom trace is produced by the right amplifier unit. Set the sweep rate to 50 milliseconds/division. Notice that the display alternates between the left and right amplifier units after each sweep. Turn the sweep rate switch throughout its range. Notice that the display alternates between amplifier units at all sweep rates.

18. Press the CHOP button of the VERT MODE switch. Turn the sweep rate switch throughout its range. Notice that a dual-trace display is presented at all sweep rates, but unlike ALT, both amplifier units are displayed on each sweep in a time-sharing manner. Return the sweep rate to 0.5 millisecond/division.

19. Press the ADD button of the VERT MODE switch. Connect the 1 V CALIBRATOR output to both amplifier units using a BNC T-connector and BNC cables. The display should be approximately four divisions in amplitude. Notice that the position control of either amplifier unit moves the display. Return the VERT MODE switch to LEFT.

Triggering

20. Center the display on the crt with the left amplifier unit position control. Disconnect the input signal from the right amplifier unit. Set the time-base unit triggering level control for a triggered waveform. Press the ADD and CHOP buttons of the VERT MODE switch and notice that a stable display is obtained in both positions. Adjust the time-base unit triggering level for a stable display at any time.

21. Press the LEFT button of the TRIG SOURCE switch. Sequentially press all of the VERT MODE buttons. Notice that the display is triggered in all positions (straight line in RIGHT position).

22. Press the RIGHT button of the TRIG SOURCE switch. Sequentially press all of the VERT MODE buttons and notice that a triggered display cannot be obtained in any position. This is because there is no input signal connected to the right amplifier unit. Set the TRIG SOURCE and VERT MODE switches to RIGHT. Remove the CALIBRATOR signal from the left amplifier unit and connect it to the right amplifier unit. Sequentially press all of the VERT MODE switch buttons and notice a triggered display in all positions (straight line in LEFT position). Press the LEFT button of the TRIG SOURCE switch. Sequentially press all of the VERT MODE buttons and notice that a stable triggered display cannot be obtained in any position. Return the TRIG SOURCE switch to VERT MODE and set VERT MODE switch to RIGHT. Disconnect the CALIBRATION signal from the right amplifier unit.

Horizontal Deflection

23. Position the start of the trace to the left graticule line with the time-base unit position control.

24. Connect a 10X probe to the input of the right amplifier unit. Set the right amplifier unit for a deflection factor of 10 volts/division and set the time-base unit for a sweep rate of five milliseconds/division.

25. Connect the probe tip to a line-voltage source. The display should show three complete cycles over 10 divisions within 0.3 division. A correct display indicates that the Oscilloscope and the time-base unit are correctly calibrated. If the display is outside the given tolerance, either the Oscilloscope or the time-base unit needs to be calibrated. Refer to the Calibration section of this manual, and to the time-base unit manual for adjustment procedures.

NOTE

The previous step is based on an accurate 60-hertz line frequency. For other line frequencies, this procedure will need to be changed accordingly.

26. Disconnect the probe from the line-voltage source and the right amplifier unit. Set the VERT MODE switch to LEFT and set the time-base unit for a sweep rate of 0.5 millisecond/division. Connect the 1 V CALIBRATOR output to the left amplifier unit.

Beam Finder

27. Set the deflection factor of the left amplifier unit to 0.1 volt/division. Notice that a square-wave display is not completely visible, since the deflection exceeds the scan area of the crt.

28. Press and hold the BEAM FIND switch. Notice that the display is returned to the viewing area in compressed form. Increase the vertical and horizontal deflection factors until the display is reduced to less than two divisions vertically and horizontally (when the horizontal unit is operated in the time-base mode, change only the deflection factor of the amplifier unit). Adjust the position controls of the displayed amplifier unit and the time-base unit to center the compressed display about the center lines of the graticule. Release the BEAM FIND switch. Notice that the display remains within the viewing area.

Z-Axis Input

29. If an external signal is available (five volts peak-to-peak maximum at two megahertz or less), the function of the EXT Z AXIS input can be demonstrated. Set the left amplifier unit for a deflection factor of one volt/division. Connect the external signal to the input of the left amplifier unit and adjust the amplitude of the external signal for approximately two divisions of display. Set the time-base unit for a sweep rate which displays several cycles of the signal. Set the Oscilloscope INTENSITY control for a display of low brightness. Connect the external signal to both the EXT Z AXIS connector and the amplifier unit input using a BNC T-connector and an additional cable. The positive peaks of the waveform should now be blanked out and the negative peaks intensified. Notice that the setting of the INTENSITY control determines the amount of intensity modulation that is visible.

30. Disconnect the signal setup.

31. This completes the Operating Checkout procedure for the Oscilloscope. Instrument operations not explained here, or operations that need further explanation, are discussed under General Operating Information.

SIMPLIFIED OPERATING INSTRUCTIONS

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

Single-Trace Display

The following procedure will provide a display of a single-trace, using an amplifier unit and a time-base unit. For simplicity of explanation, the amplifier unit is installed in the left vertical compartment. The right vertical compartment can be used if the procedure is changed accordingly.

1. Install an amplifier unit in the left vertical compartment.

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

3. Install a time-base unit in the horizontal compartment.

4. Press the VERT MODE button of the TRIG SOURCE switch.

5. Connect the desired signal to the input connector of the amplifier unit.

6. Set the amplifier unit for ac input coupling and calibrated deflection factors.

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

8. Advance the INTENSITY control until a display is visible. (If no display is visible with INTENSITY at about midrange, press and hold the BEAM FIND switch and adjust the vertical deflection factor until the display is reduced in size vertically; then center the compressed display with vertical and horizontal position controls; release BEAM FIND.) Adjust the FOCUS control for a well-defined display.

9. Set the amplifier unit deflection factor and amplifier unit position control for a display which remains within the graticule area vertically.

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

11. Adjust the time-base position control so the display begins at the left edge of the graticule. Set the time-base sweep rate to display the desired number of signal cycles.

Dual-Trace Display

The following procedure will provide a display of two traces, using two single-trace amplifier units and a time-base unit.

1. Install an amplifier unit in both vertical plug-in compartments.

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

3. Install a time-base unit in the horizontal compartment.

4. Press the VERT MODE button of the TRIG SOURCE switch.

5. Connect the desired signal to both amplifier units.

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

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

8. Advance the INTENSITY control until a display is visible. (If no display is visible with INTENSITY at midrange, press and hold BEAM FIND switch and increase the vertical deflection factor until the display is reduced in size vertically; then center compressed display with vertical and horizontal position controls; release the BEAM FIND switch.) Set the FOCUS control for a well-defined display.

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

10. Press the RIGHT button of the VERT MODE switch.

11. Set the right amplifier unit deflection factor for a display about two divisions in amplitude (if display cannot be located, use BEAM FIND switch). Position this display to the bottom of the graticule area with the right vertical unit position control.

12. Press the ALT or CHOP button of the VERT MODE switch. A dual-trace display of the signal from the left amplifier and right amplifier plug-in units should be presented on the crt. (For more information on choice of dual-trace mode, see Vertical Display Modes in this section.)

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

14. Adjust the time-base unit position control so the display begins at the left edge of the graticule. Set the time-base unit sweep rate for the desired horizontal display.

Delayed Sweep—Single Trace Display

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

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

2. Be sure the time-base unit installed in the horizontal compartment is a dual time-base unit with delaying/delayed sweep capabilities.

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

Delayed Sweep—Dual Trace Display

The following procedure will provide a delayed-sweep display of two single-trace amplifier units.

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

2. Be sure the time-base unit installed in the horizontal compartment is a dual time-base unit with delaying/delayed sweep capabilities.

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

X-Y Display

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

NOTE

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

1. Install amplifier units in both the left vertical and the horizontal compartments.

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

3. Connect the X-signal to the amplifier unit in the horizontal compartment.

4. Connect the Y-signal to the amplifier unit in the left vertical compartment.

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

6. Advance the INTENSITY control until a display is visible. (If the display amplitude is too great, reduce the amplitude of the input signals or adjust the deflection factors of both amplifier units until the display is reduced in size both vertically and horizontally; then center the display with the position controls.) Adjust the FOCUS control for a well-defined display.

GENERAL OPERATING INFORMATION

Intensity Control

The setting of the INTENSITY control may affect the correct focus of the display. Slight adjustment of the FOCUS control may be necessary when the intensity level is changed. To protect the crt phosphor, do not turn the INTENSITY control higher than necessary to provide a satisfactory display.

WARNING

Crt phosphor damage can occur under adverse conditions. Avoid any condition where an extremely bright, sharply focused spot exists on the crt.

Apparent trace intensity can be improved by reducing the ambient light level or using a viewing hood. Also, be careful that the INTENSITY control is not set too high when changing the time-base unit sweep rate from a fast to a slow sweep rate, or when changing to the X-Y mode of operation.

Display Focus

The FOCUS control allows adjustment for best definition of the crt display. If a properly focused display cannot be obtained with the FOCUS control, the internal Astigmatism adjustment must be re-set; see the Calibration section of this manual.

Graticule

The graticule of the Oscilloscope is marked on the inside of the faceplate of the crt providing accurate, no-parallax measurements. The graticule is divided into eight vertical and ten horizontal divisions; each division is one centimeter square. In addition, each major division is divided into five minor divisions. The vertical gain and horizontal timing of the plug-in units are calibrated to the graticule so accurate measurements can be made from the crt. The illumination of the graticule lines can be varied with the GRAT ILLUM control.

When making time measurements from the graticule, the center eight divisions provide the most accurate time measurements. Position the start of the timing area to the second vertical graticule line and set the time-base unit so the end of the timing area falls between the second and tenth vertical graticule lines (see Fig. 1-5).

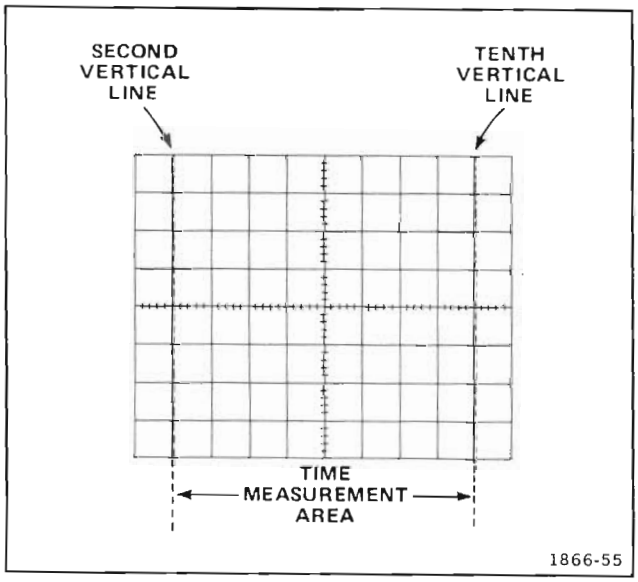


Figure 1-5. Area of graticule used for accurate time measurements.

A mesh filter is provided with the Oscilloscope. This filter provides shielding against radiated emi (electro-magnetic interference) from the face of the crt. It also serves as a light filter to make the trace more visible under high ambient light conditions.

Beam Finder

The BEAM FIND switch provides a means of locating a display which overscans the viewing area either vertically or horizontally. When the BEAM FIND switch is pressed and held, the display is compressed within the graticule area. Release the BEAM FIND switch to return to a normal display. To locate and reposition an overscanned display, use the following procedure:

1. Press and hold the BEAM FIND switch.

2. Increase the vertical and horizontal deflection factors until the vertical deflection is reduced to less than two divisions and the horizontal deflection is reduced to about four divisions (the horizontal deflection needs to be reduced only when in the X-Y mode of operation). If the time-base unit is set for magnified sweep, it may be necessary to turn the position control to obtain a horizontal deflection.

3. Set the vertical and horizontal position controls to center the display about the vertical and horizontal center lines of the graticule.

4. Release the BEAM FIND switch; most of the display should remain within the viewing area.

Display Photography

A permanent record of the crt display can be obtained with an oscilloscope camera system (see the current Tektronix catalog for a complete listing of oscilloscope cameras and mounting adapters). The instruction manuals for the Tektronix oscilloscope cameras include complete instructions for obtaining waveform photographs.

The crt bezel of the Oscilloscope provides integral mounting for a Tektronix oscilloscope camera. However, no voltage is provided at the bezel for camera power. The camera selected for use with the Oscilloscope may require battery operation.

Vertical Display Modes

LEFT AND RIGHT MODES. When the LEFT or RIGHT button of the VERT MODE switch is pressed, only the signal from the unit in the selected compartment is displayed.

ALTERNATE MODE. The ALT position of the VERT MODE switch produces a display which alternates between the amplifier units in the left and right vertical compartments with each sweep of the crt. Although the ALT mode can be used at all sweep rates, the CHOP mode provides a

more satisfactory display at sweep rates of 20 milliseconds/division or slower. At these slower sweep rates, alternate-mode switching becomes visually perceptible.

NOTE

The ALT mode will not function unless the horizontal plug-in unit is operating in the time-base mode.

The TRIG SOURCE switch allows selection of triggering for an alternate display. When this switch is set to the VERT MODE position, each sweep is triggered by the signal being displayed on the crt. This provides a stable display of two unrelated signals, but does not show the time relationship between the signals. In either the LEFT or RIGHT positions of the TRIG SOURCE switch, the two signals are displayed showing true time relationship. However, if the signals are not time-related, the display from the amplifier unit which is not providing a trigger signal will be unstable.

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

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

ALGEBRAIC ADDITION. The ADD position of the VERT MODE switch can be used to display the sum or difference of two signals, for common-mode rejection to remove an undesired signal, or for dc offset (applying a dc voltage to one channel to offset the dc component of a signal on the other channel). The common-mode rejection ratio between the vertical plug-in compartments of the Oscilloscope is greater than 20:1 up to 25 megahertz.

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

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

1. Do not exceed the input voltage rating of the amplifier units.

2. Do not apply large signals to the amplifier inputs. A good rule to follow is not to apply a signal which exceeds an equivalent of about eight times the deflection factor. For example, with a deflection factor of 0.5 volt/division, the voltage applied to that plug-in unit should not exceed 4 volts. Larger voltages may result in a distorted display.

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

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

Trigger Sources

The TRIG SOURCE switch allows selection of the internal trigger signal for the time-base unit. For most applications, this switch can be set to the VERT MODE position. This position is the most convenient, since the internal trigger signal is automatically switched as the VERT MODE switch is changed, or as the display is electronically switched between the left and right amplifier units in the ALT position of the VERT MODE switch. It also provides a usable trigger signal in the ADD or CHOP position of the VERT MODE switch, since the internal trigger signal in these modes is the algebraic sum of the signals applied to the amplifier units. Therefore, the VERT MODE position ensures that the time-base unit receives a trigger signal regardless of the VERT MODE switch setting, without the need to change the trigger source selection.

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

X-Y Operation

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

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

Intensity Modulation

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

Negative-going modulating signals increase the display intensity, and positive-going modulating signals decrease the display intensity. The useful input frequency range is dc to 10 megahertz (input voltage derating necessary above two megahertz). The maximum input voltage should be limited to 10 volts (dc plus peak ac).

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

Raster Display

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

To provide a stable raster display, both time-base units must be correctly triggered. Internal triggering is not provided for units operated in vertical compartments; external triggering must be used. Also, blanking is not provided from time-base units installed in vertical compartments. To blank out the retrace portion from a time-base unit in a vertical compartment, special connections must be made to the blanking network of the Oscilloscope. If this mode of operation is desirable, contact your local Tektronix Field Office or representative for specific information on obtaining blanking with the specific time-base unit being used.

Calibrator

The internal CALIBRATOR of the Oscilloscope provides a convenient signal source for checking basic vertical gain and for adjusting probe compensation. The signal at the front-panel output connector is a positive-going square wave with a repetition rate of 1 kilohertz. The output is an accurate 1 volt into one megohm or greater.

The CALIBRATOR signal can be used as a reference waveform when checking or adjusting the compensation of probes. Since the square-wave output from the CALIBRATOR has a flat top, any distortion in the displayed waveform is due to probe compensation. A 1-volt, dc output is also available from the CALIBRATOR by changing a jumper on the Calibrator and Mode Switches circuit board (see Fig. 1-6 for jumper location).

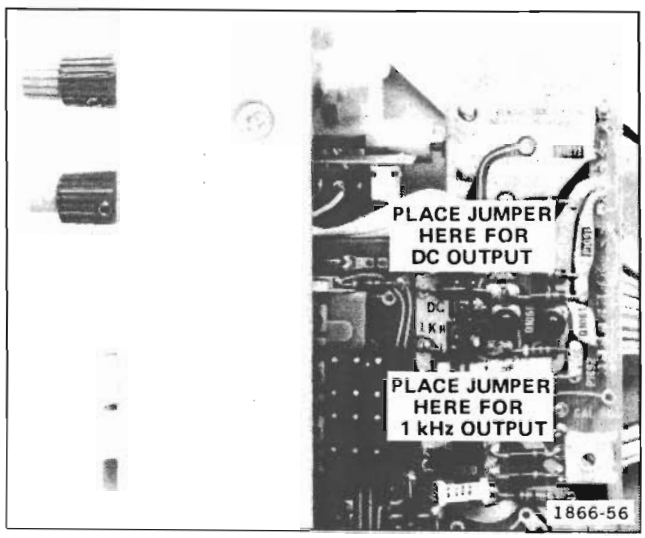


Figure 1-6. Jumper locations for dc or one-kilohertz output from Calibrator.

Rear Panel Output Signals

NOTE

The following sweep, gate, and trigger waveforms are available at the rear panel only when the Oscilloscope is used with a TD-1085/U Dual Time Base unit. When the Oscilloscope is used with some other 7000-series time-base units, a sawtooth signal may be available at the MAIN SWP OUTPUT connector.

MAIN SWEEP SIGNAL. The MAIN SWP OUTPUT connector provides a positive-going sample of the main sweep sawtooth from the time-base unit in the horizontal compartment. The unit of time for the sawtooth signal is controlled by the setting of the time/division switch; the output amplitude is approximately 5 volts into 100 kilohms or greater.

DELAYED SWEEP SIGNAL. The DELAYED SWP OUTPUT connector provides a positive-going sample of the delayed sweep sawtooth from the time-base unit in the horizontal compartment. The unit of time for the sawtooth signal is controlled by the setting of the delayed time/division switch. The output amplitude is approximately 5 volts into 100 kilohms or greater.

MAIN SWEEP GATE SIGNAL. The MAIN SWP GATE OUTPUT connector provides a positive-going sample of the main sweep gate from the time-base unit in the horizontal compartment. The duration of the gate signal is controlled by the setting of the time/division switch. The output amplitude is approximately 2 volts into 100 kilohms or greater.

DELAYED SWEEP GATE SIGNAL. The DELAYED SWP GATE OUTPUT connector provides a positive-going sample of the delayed sweep gate from the time-base unit in the horizontal compartment. The duration of the gate signal is controlled by the setting of the delayed time/division switch. The output amplitude is approximately 2 volts into 100 kilohms or greater.

DELAYED TRIGGER SIGNAL. The DELAYED TRIG OUTPUT connector provides a positive-going sample of the delayed sweep trigger from the time-base unit in the horizontal compartment. The trigger signal is coincident with the start of the delayed sweep. The output amplitude is approximately 1 volt into 100 kilohms or greater.

APPLICATIONS

The Oscilloscope and its associated plug-in units provide a very flexible measurement system. The capabilities of the overall system depend mainly upon the plug-in units that are chosen for use with this instrument. Specific applications for the individual plug-in units are described in the plug-in manuals. The overall system can also be used for many applications which are not described in detail in any manual.

Contact your local Tektronix Field Office or representative for assistance in making specific measurements with this instrument.

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

John D. Lenk, *"Handbook of Oscilloscopes, Theory, and Application"*, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1968.

J. Czech, *"Oscilloscope Measuring Techniques"*, Springer-Verlag, New York, 1965.

J. F. Golding, *"Measuring Oscilloscopes"*, Transatlantic Arts, Inc., 1971.

Charles H. Roth Jr., *"Use of the Oscilloscope"*, A programmed Text, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1970.

SPECIFICATION

This section lists the electrical, environmental, and physical characteristics of the OS-245(P)/U Oscilloscope.

CHARACTERISTICS

The Oscilloscope may be checked against the electrical characteristics in Table 2-1 when received from Tektronix Inc. or after complete calibration as given in Section 5, Calibration. An Operating checkout procedure (see Operating Checkout in Section 1, Operating Instructions) provides a convenient method of checking instrument performance without making internal checks or adjustments. The characteristics in this specification are valid with the following conditions, except as otherwise indicated.

1. The Oscilloscope must have been calibrated at an ambient temperature between +20° to +30° C.

2. The performance of the Oscilloscope should be checked within an ambient temperature range of +15° to +35° C to allow application of the most exact specifications. Performance can be checked within an ambient temperature range of 0° to +50° C for all characteristics and, when indicated, performance may be checked within an ambient temperature range of −28° to −65° C to the tolerance listed for that temperature range.

3. The Oscilloscope should have a warmup period of at least 20 minutes before checking performance or beginning calibration.

The Oscilloscope is part of a general-purpose, electrical measurement system designed to meet the rigid environmental and electrical specifications required under Military Specification MIL-O-24311 (EC). The system consists of (one) OS-245(P)/U Oscilloscope mainframe, (two) AM-6565/U Amplifier plug-in units, and (one) TD-1085/U Dual Time Base plug-in unit. When these units are assembled in a system (qualified system), all characteristics in this section are applicable.

The Oscilloscope may be used with plug-in units other than the recommended units previously mentioned under the qualified system. When other units are used, the following characteristics in this section are not a performance requirement:

1. The Electromagnetic Interference characteristics listed in Table 2-1.

2. The Environmental characteristics listed in Table 2-2.

3. The Electrical characteristics listed in Table 2-1 for Range III temperatures.

The temperature and humidity ranges referred to in this section are those ranges defined in Military Specification MIL-O-24311 (EC). An excerpt of the Military Specification appears below:

Range	Ambient Temperature	Relative Humidity
I	+15° to +35° C	75%
II	0° to +50° C	90%
III	−28° to +65° C	95%

NOTE

Many of the measurement capabilities of this instrument are determined by the choice of plug-in units. The following electrical characteristics apply to the Oscilloscope mainframe only. See the System Electrical Performance tables in this section (Tables 2-4 and 2-5) for a listing of suitable amplifier and time base plug-in units and their typical system performance when used with the Oscilloscope.

TABLE 2-1
Electrical

Characteristic	Performance Requirement	Supplemental Information
OSCILLOSCOPE VERTICAL		
Deflection Factor (Each Vertical Compartment)	Compatible with all 7000-series plug-in units.	
Difference Between Compartments	Less than 1%.	
Low Frequency Linearity	0.1 div or less compression or expansion of a center-screen, 2-div signal positioned anywhere vertically within the graticule area.	
Bandwidth With Amplifier Plug-In Unit	Varies with plug-in selected. See Vertical System Performance table.	Refer to Table 2-4.
Step Response Risetime With Amplifier Plug-in Unit	Varies with plug-in selected. See Vertical System Performance table.	
Isolation Between Vertical Compartments	At least 100:1 from dc to 100 MHz.	
Chopped Mode		
Repetition Rate		Approximately 1 MHz.
Time Segment from Each Compartment		0.42 μs to 0.625 μs.
Difference In Delay Between Vertical Compartments		0.5 ns or less.
Vertical Display Modes	LEFT: Left compartment only. ALT: Dual trace, alternates between compartments. ADD: Added algebraically. CHOP: Dual trace, chopped between compartments. RIGHT: Right compartment only.	Selected by front-panel VERT MODE switch.
Trigger Source	LEFT: From left compartment only. VERT MODE: Determined by setting of VERT MODE switch. RIGHT: From right compartment only.	Selected by front-panel TRIG SOURCE switch.

TABLE 2-1 (Cont.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
OSCILLOSCOPE HORIZONTAL		
Deflection Factor	Compatible with all 7000-series plug-in units.	
Fastest Calibrated Sweep Rate	5 ns/div.	
Low Frequency Linearity	0.1 div or less compression or expansion of a center-screen, 2-div signal positioned anywhere horizontally within the graticule area.	
Phase Shift Between Vertical and Horizontal Compartments	Less than 2° from dc to 35 kHz.	
Bandwidth (8-Div Reference)	At least 2 MHz.	
CALIBRATOR		
Waveshape	Positive-going square wave or dc (dc voltage selected by internal jumper).	
Voltage Output Amplitude	1 V p-p.	Into 1 MΩ or greater load impedance.
Voltage Output Accuracy		
+15° to +35° C (Range I)	Within 1%.	
0° to +50° C (Range II)	Within 2%.	
−28° to +65° C (Range III)	Within 4%.	
Repetition Rate		Approximately 1 kHz.
Output Resistance		Approximately 113 Ω.
EXTERNAL Z-AXIS INPUT		
Sensitivity	2 V p-p provides trace modulation over full intensity range.	
Useful Input Voltage Versus Repetition Frequency	2 V p-p, dc to 2 MHz; reducing to 0.4 V p-p at 10 MHz.	
Polarity of Operation	Positive-going signal decreases trace intensity.	
Maximum Input Voltage		10 V (dc + peak ac).
Input Resistance at DC		Approximately 500 Ω.

TABLE 2-1 (Cont.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
REAR PANEL OUTPUT SIGNALS		
Main Sweep Output	Available with TD-1085/U Dual Time Base unit only.	At least 5 V amplitude into 100 kΩ or more and 15 pF.
Delayed Sweep Output	Available with TD-1085/U Dual Time Base unit only.	At least 5 V amplitude into 100 kΩ or more and 15 pF.
Main Sweep Gate Output	Available with TD-1085/U Dual Time Base and some other time-base units.	At least 2 V amplitude into 100 kΩ or more and 15 pF.
Delayed Sweep Gate Output	Available with TD-1085/U Dual Time Base unit only.	At least 2 V amplitude into 100 kΩ or more and 15 pF.
Delayed Trigger Output	Available with TD-1085/U Dual Time Base unit only.	At least 1 V amplitude, with a minimum pulse duration of 50 ns, into 100 kΩ or more and 15 pF.
CRT DISPLAY		
Cathode-Ray Tube		
Graticule		
Type	Internal and illuminated.	
Area	8 x 10 div.	
Size of Divisions	1.0 cm.	
Phosphor	P31.	
BEAM FIND		Limits display to within graticule area when BEAM FIND switch is actuated.
POWER SOURCE		
Line Voltage Ranges (AC, RMS)		
115 V Nominal	110 V within 10%. 115 V within 10%. 120 V within 10%.	
230 V Nominal	220 V within 10%. 230 V within 10% 240 V within 10%.	
Line Frequency		47.5 to 440 Hz.
Maximum Power Comsumption at 126.5 V; 60 Hz		125 W, 2 A.

TABLE 2-1 (Cont.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
POWER SOURCE (Cont.)		
Fuse Data		
115 V Line (F1000) 115 V Line (F1001)		2 A slow blow.
230 V Line (F1000) 230 V Line (F1001)		1 A slow blow.
+130 V Supply (F855)		0.15 A fast blow.
ELECTROMAGNETIC INTERFERENCE		
Electromagnetic Interference (emi) Requirements in Accordance With MIL-STD-461A (Class II) as Tested in MIL-STD-462.		Any unused plug-in compartment must be covered with an emi-shielded, blank plug-in panel (Tektronix Part 016-0155-00) in order to meet emi specifications.
Conducted Emission (CE01, CE03)	Emi conducted out of the instrument through the power cord within the given limits of 30 Hz to 50 MHz.	
Conducted Susceptibility (CS01)	Emi conducted into the instrument through the power cord within the given limits of 30 Hz to 50 kHz.	
Conducted Susceptibility (CS02)	Electrical interference conducted into the instrument input terminals (excluding power cord) within the given limits of 50 kHz to 400 MHz.	
Conducted Susceptibility (CS06)	Spike interference test conducted into the power cord.	
Radiated Emission (RE01, RE02)	Radiated magnetic emissions from the instrument within the given limits of 30 Hz to 10 GHz.	
Radiated Susceptibility (RS01)	Magnetic interference subjected to the instrument within the given limits of 30 Hz to 30 kHz.	
Radiated Susceptibility (RS03)	Radiated electric field interference subjected to the instrument within the given limits of 14 kHz to 10 GHz.	

TABLE 2-2
Environmental[1]

Characteristic	Information
Temperature	
Operating	The instrument will meet the specified accuracies over the temperature range of 0° to +50° C (Range II). The instrument shall operate over the entire temperature range of −28° to +65° C (Range III).
Nonoperating	Temperatures from −62° up to +75° C shall not damage the instrument.
Humidity	Relative humidity of 95% over the entire operating temperature range.
Altitude	
Operating	No degradation of performance when subjected to decreased barometric pressures approximating an altitude of 10,000 ft.
Nonoperating	The instrument shall withstand barometric pressure approximating an altitude of 50,000 ft.
Shock (Operating)	Shall be in accordance with the requirements of MIL-E-16400. 9 consecutive 400-pound hammer blows without failure from 1, 3, and 5 feet in vertical, horizontal, and longitudinal axes as per MIL-S-901 for Grade A, Class I, Type A for lightweight equipment.
Vibration (Operating)	Shall be in accordance with the requirements of MIL-E-16400. 5 to 15 Hz at 0.060 inch, ±0.012 inch p-p amplitude; 16 to 25 Hz at 0.040 inch, ±0.008 inch p-p amplitude; 26 to 33 Hz at 0.020 inch, ±0.004 inch p-p amplitude.

[1] Applies to qualified system only (OS-245(P)/U, AM-6565/U, TD-1085/U).

TABLE 2-2 (Cont.)
Environmental[1]

Characteristic	Information
Inclination (Operating)	Shall be in accordance with the requirements of MIL-E-16400.
Drip Proof (Nonoperating)	As per MIL-STD-198.
Salt Spray (Nonoperating)	As per MIL-E-16400.

TABLE 2-3
Physical

Characteristic	Information		
The maximum dimensions of the Oscilloscope shall not exceed those given in Table III in paragraph 3.7.1 of MIL-0-24311(EC).			
Dimensions	Height	Width	Depth
Mainframe	11.5 in (29.2 cm)	9.7 in (24.6 cm)	23.5 in (59.7 cm)
Cover	10.9 in (27.7 cm)	9.7 in (24.6 cm)	3.3 in (8.3 cm)
Mainframe and cover	11.5 in (29.2 cm)	9.7 in (24.6 cm)	25.2 in (64.0 cm)
Weight			
Mainframe	36 lbs (16.3 kg)		
Cover	2.8 lbs (1.3 kg)		

SYSTEM ELECTRICAL PERFORMANCE

Your Tektronix OS-245(P)/U Oscilloscope provides exceptional system flexibility in operation with a wide choice of general and special purpose plug-in units. The type number of a particular plug-in unit identifies its usage as follows:

The first digit (7) denotes the oscilloscope system for which the plug-in unit is designated (7000-series). This series of plug-in units is applicable for use with the OS-245(P)/U Oscilloscope.

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

A—Amplifier unit

B—"Real time" time-base unit

C—Curve Tracer

L—Spectrum Analyzer

M—Miscellaneous

S—Sampling unit

T—Sampling time-base unit

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

Table 2-4 lists the typical vertical system performance of suitable amplifier units for sue with the Oscilloscope. For more complete information on these units, refer to the Tektronix Products Catalog.

TABLE 2-4
Oscilloscope Vertical System Performance

Amplifier Plug-In Unit	Probe	Bandwidth[1]	Risetime[2]	Accuracy[3]		
				EXT CAL	INT CAL	
				0° to +50° C	+15° to +35° C	0° to +50° C
7A11	Integral	100 MHz	3.5 ns	2%	3%	4%
7A12	None	80 MHz	4.4 ns	2%	3%	4%
	P6053B	80 MHz	4.4 ns	3%	4%	5%
7A13	None or P6053B	75 MHz	4.7 ns	1.5%	2.5%	3.5%
	P6055	55 MHz	6.4 ns	1.5%	2.5%	3.5%
7A14	P6021	50 MHz	7.0 ns	2%	3%	4%
	P6022	80 MHz	4.7 ns	2%	3%	4%
7A15A or	None or P6054A	65 MHz	5.4 ns	2%	4%	5%
AM-6565/U	P6006	35 MHz	10 ns	3%	4%	5%
7A16A	None	100 MHz	3.5 ns	2%	3%	4%
	P6053B	100 MHz	3.5 ns	3%	4%	5%
7A17	None	100 MHz	3.5 ns			
7A18	None	75 MHz	4.7 ns	2%	3%	4%
	P6065A	70 MHz	4.7 ns	3%	4%	5%
7A19	None	100 MHz	3.5 ns	3%	4%	5%
	P6056 or P6057	100 MHz	3.5 ns	4%	5%	6%
7A22	None	1 MHz, ±10%	350 ns, ±9%	2%	3%	4%
	P6055 or P6060	1 MHz, ±10%	350 ns, ±9%	3%	4%	5%
7A24	None	100 MHz	3.5 ns	2%	3%	4%
	P6056 or P6057	100 MHz	3.5 ns	3%	4%	5%
7A26	None	100 MHz	3.5 ns	2%	3%	4%
	P6053B	100 MHz	3.5 ns	3%	4%	5%

[1] System bandwidth ambient temperature range from +15° to +35° C; derate for 0° to +50° C temperature range.

[2] Risetime is calculated from the formula: $Tr = \frac{0.35}{BW\ (in\ MHz)}$

[3] Deflection Factor accuracy is checked as follows:
EXT CAL, 0° to +50° C—Plug-in gain set at a temperature within 10° C of operating temperature, using an external calibrator with accuracy within 0.25%.
INT CAL, +15° to +35° C—Plug-in gain set using the Oscilloscope calibrator.
INT CAL, 0° to +50° C—Plug-in gain set using the Oscilloscope calibrator within 10° C of the operating temperature.

Accuracy percentages apply to all deflection factors. Plug-in gain must be set at the deflection factor designated on each plug-in. When a probe is used, the gain must be set with the calibration signal applied to the probe tip.

The bandwidth of an amplifier plug-in used in the horizontal compartment is 2 MHz, except with the 7A22 where the system bandwidth is 850 kHz. The X-Y phase shift between two similar units is 2° at 35 kHz.

Table 2-5 lists the typical horizontal system performance of suitable time-base units for use with the Oscilloscope. For more complete information on these units, refer to the Tektronix Products Catalog.

Table 2-6 lists the special purpose plug-in units suitable for use with the Oscilloscope. For more complete information on these units, refer to the Tektronix Products Catalog.

TABLE 2-5
Oscilloscope Horizontal System Performance

Time-Base Plug-In	Performance Feature	Maximum Calibrated Sweep Rate	Triggering Maximum Frequency Range[1]
7B50	Single Time Base & Ext Amplifier	5 ns/div	External, dc to 100 MHz
7B53A or TD-1085/U	Dual Time Base (Delaying & Delayed Sweeps)	5 ns/div	External, dc to 100 MHz
7B70	Single Time-Base & Ext Amplifier	5 ns/div	External, dc to 100 MHz

[1] For Internal Triggering only, the specified −3 dB frequency of the vertical system replaces any frequencies in the above table when the number in the table is greater than the −3 dB frequency of the vertical system.

TABLE 2-6
Special Purpose Plug-In Units

Plug-In Unit	Performance Feature
7CT1N	Low-Power Semiconductor Curve Tracer
7K11	CATV Preamplifier
7L12	100 kHz to 1.8 GHz Spectrum Analyzer
7L13	1 kHz to 1.8 GHz Spectrum Analyzer
7M11	Dual Delay Line for Time Domain Reflectometer and Sampling Applications

TABLE 2-6 (Cont.)
Special Purpose Plug-In Units

Plug-In Unit	Performance Feature
7S11	Accepts Plug-In Sampling Heads
7S12	Time Domain Reflectometer and Sampling Applications
7S14	Dual-Trace Delayed Sweep Sampler
7T11	Random or Sequential; Equivalent or Real-Time Sampling

STANDARD ACCESSORIES

Standard accessories supplied with the Oscilloscope are listed in the Replaceable Mechanical Parts illustrations in this manual. For optional accessories available for use with this instrument, see the Tektronix Products Catalog.

THEORY OF OPERATION

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

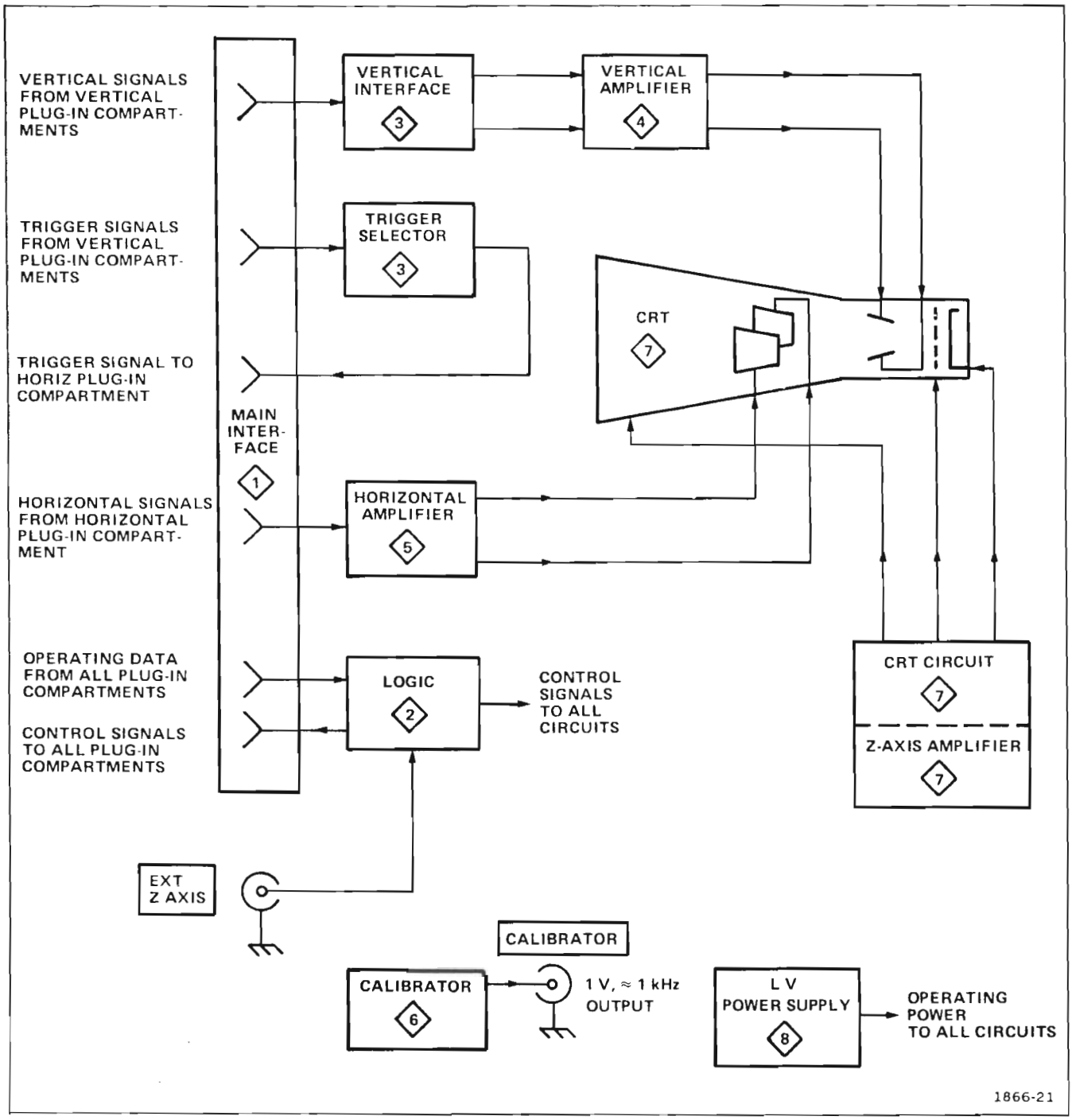


Figure 3-1. Basic block diagram of the Oscilloscope.

BLOCK DIAGRAM

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

Vertical signals to be displayed on the crt are applied to the Vertical Interface circuit from both vertical plug-in compartments. The VERT MODE switch determines whether the signal from the left and/or right compartment is displayed. The selected vertical signal is then amplified by the Vertical Amplifier circuit to bring it to the level necessary to drive the vertical deflection plates of the crt (cathode-ray tube.

Horizontal signals for display on the crt are connected to the Horizontal Amplifier circuit from the horizontal plug-in compartment. The Horizontal Amplifier circuit amplifies the signal to provide horizontal deflection.

The internal trigger signals from both vertical plug-in compartments are connected to the Trigger Selector circuit. The VERT MODE and TRIG SELECT switches and the Trigger Selector circuit select which internal trigger signal is to be connected to the horizontal plug-in unit. The Calibrator circuit produces a square-wave output signal with accurate amplitude which can be used to check vertical deflection factor accuracy and probe compensation.

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

The power necessary for the operation of this instrument is produced by the Low-Voltage Power Supply circuit. These voltages are connected to all circuits within the instrument.

DETAILED CIRCUIT OPERATION

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

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

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

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

The following circuit analysis with supporting illustrations give the names of the individual stages within major circuits to show how they are connected together to form the major circuit. These illustrations also show the inputs and outputs for each circuit, and the relationship of the external controls and connectors to the individual stages. The circuit diagrams, from which the illustrations are derived, are shown in the Diagrams section.

LOGIC FUNDAMENTALS

Digital logic techniques are used to perform many functions within this instrument. The function and operation of the logic circuits are described using logic symbology and terminology. This portion of the manual is provided to aid in the understanding of these symbols and terms. The following information is a basic introduction to logic concepts, not a comprehensive discussion of the subject. For further information on binary number systems and the associated Boolean Algebra concepts, the derivation of logic functions, a more detailed analysis of digital logic, etc., refer to the following textbooks:

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

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

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

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

Symbols

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

NOTE

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

Logic Polarity

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

NOTE

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

Whenever possible, the input and output lines are named to indicate the functions that they perform when at the HI (true) state. For example, the line labeled, "Display Right Command" means that the right vertical unit will be displayed when this line is HI or true.

Input/Output Tables

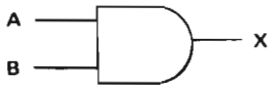
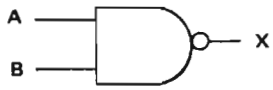
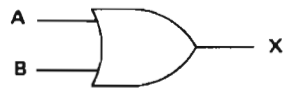
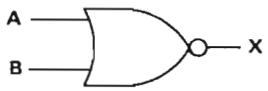
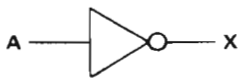
Input/Output (truth) tables are used in conjunction with the logic diagrams to show the input combinations which are of importance to particular function, along with the resultant conditions. This table may be given either for an individual device or for a complete logic stage. For examples of input/output tables for individual devices, see Table 3-1.

Non-Digital Devices

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

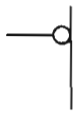
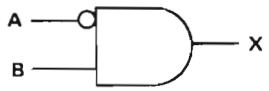
TABLE 3-1

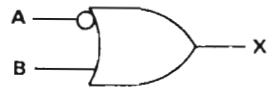
Basic Logic Reference

Device	Symbol	Description	Input/Output Table
AND gate		A device with two or more inputs and one output. The output of the AND gate is HI if and only if all of the inputs are at the HI state.	Input / Output A B X LO LO LO LO HI LO HI LO LO HI HI HI
NAND gate		A device with two or more inputs and one output. The output of the NAND gate is LO if and only if all of the inputs are at the HI state.	Input / Output A B X LO LO HI LO HI HI HI LO HI HI HI LO
OR gate		A device with two or more inputs and one output. The output of the OR gate is HI if one or more of the inputs are at the HI state.	Input / Output A B X LO LO LO LO HI HI HI LO HI HI HI HI
NOR gate		A device with two or more inputs and one output. The output of the NOR gate is LO if one or more of the inputs are at the HI state.	Input / Output A B X LO LO HI LO HI LO HI LO LO HI HI LO
Inverter		A device with one input and one output. The output state is always opposite to the input state.	Input / Output A X LO HI HI LO

@

TABLE 3-1 (cont)

<table>
<tr><th>Device</th><th>Symbol</th><th>Description</th><th>Input/Output Table</th></tr>
<tr><td rowspan="3">LO-state indicator</td><td>  </td><td>A small circle at the input or output of a symbol indicates that the LO state is the significant state. Absence of the circle indicates that the HI state is the significant state. Two examples follow:</td><td rowspan="2"><table><tr><th colspan="2">Input</th><th>/Output</th></tr><tr><td>A</td><td>B</td><td>X</td></tr><tr><td>LO</td><td>LO</td><td>LO</td></tr><tr><td>LO</td><td>HI</td><td>HI</td></tr><tr><td>HI</td><td>LO</td><td>LO</td></tr><tr><td>HI</td><td>HI</td><td>LO</td></tr></table></td></tr>
<tr><td>  </td><td>AND gate with LO-state indicator at the A input.

The output of this gate is HI if and only if the A input is LO and the B input is HI.</td></tr>
<tr><td>  </td><td>OR gate with LO-state indicator at the A input:

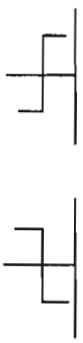
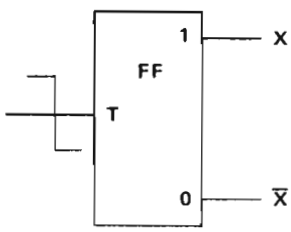
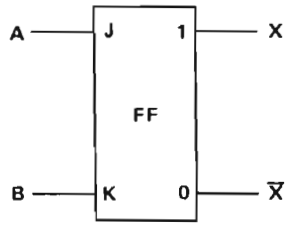
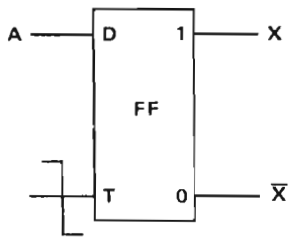
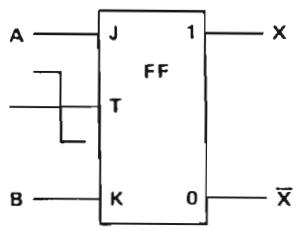
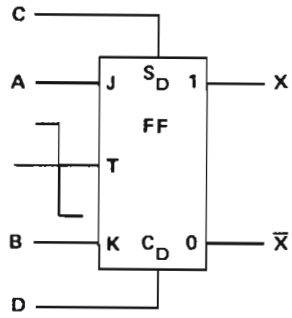
The output of this gate is HI if either the A input is LO or the B input is HI.</td><td><table><tr><th colspan="2">Input</th><th>/Output</th></tr><tr><td>A</td><td>B</td><td>X</td></tr><tr><td>LO</td><td>LO</td><td>HI</td></tr><tr><td>LO</td><td>HI</td><td>HI</td></tr><tr><td>HI</td><td>LO</td><td>LO</td></tr><tr><td>HI</td><td>HI</td><td>HI</td></tr></table></td></tr>
<tr><td>Edge symbol</td><td>  </td><td>Normally superimposed on an input line to a logic symbol. Indicates that this input (usually the trigger input of a flip-flop) responds to the indicated transition of the applied signal.</td><td></td></tr>
<tr><td>Triggered (toggle) Flip-Flop</td><td>  </td><td>A bistable device with one input and two outputs (either or both outputs may be used). When triggered, the outputs change from one stable state to the other stable state with each trigger. The outputs are complementary (i.e., when one output is HI the other is LO). The edge symbol on the trigger (T) input may be of either polarity depending on the device.</td><td><table><tr><th colspan="2">Input</th><th colspan="2">/ Output</th></tr><tr><th colspan="2">Condition before trigger pulse</th><th colspan="2">Condition after trigger pulse</th></tr><tr><td>X</td><td>$\overline{X}$</td><td>X</td><td>$\overline{X}$</td></tr><tr><td>LO</td><td>HI</td><td>HI</td><td>LO</td></tr><tr><td>HI</td><td>LO</td><td>LO</td><td>HI</td></tr></table></td></tr>
</table>

TABLE 3-1 (cont)

Device	Symbol	Description	Input/Output Table
Set-Clear (J-K) Flip-Flop		A bistable device with two inputs and two outputs (either or both outputs may be used). The outputs change state in response to the states at the inputs. The outputs are complementary (i.e., when one output is HI the other is LO).	Input / Output A B X $\overline{X}$ LO LO No change LO HI LO HI HI LO HI LO HI HI Changes state
D (data) Type Flip-Flop		A bistable device with two inputs and two outputs (either or both outputs may be used). When triggered the state of the "1" output changes to the state at the data (D) input prior to the trigger. The outputs are complementary (i.e., when one output is HI the other is LO). The edge symbol on the trigger (T) input may be of either polarity, depending on the device.	Input / Output A X $\overline{X}$ LO LO HI HI HI LO **Output conditions shown after trigger pulse**
Triggered Set-Clear (J-K) Flip-Flop		A bistable device with three or more inputs and two outputs (either or both outputs may be used). When triggered, the outputs change state in response to the states at the inputs prior to the trigger. The outputs are complementary (i.e., when one output is HI the other is LO). The edge symbol on the trigger (T) input may be of either polarity depending on the device.	Input / Output A B X $\overline{X}$ LO LO No change LO HI LO HI HI LO HI LO HI HI Changes state **Output conditions shown after trigger pulse**
Flip-Flop with Direct Inputs (may be applied to all triggered flip-flops)		For devices with direct-set (S_D) or direct-clear (C_D) inputs, the indicated state at either of these inputs over-rides all other inputs (including trigger) to set the outputs to the states shown in the input/output table.	Input / Output A B C D X $\overline{X}$ 1 1 LO LO No change[1] Φ Φ LO HI LO HI Φ Φ HI LO HI LO Φ Φ HI HI Undefined **Φ = Has no effect in this case** **[1]Output state determined by conditions at triggered inputs**

MAIN INTERFACE ①

The Main Interface consists of an assembly of circuit boards which accomplish all interface connections between the mainframe and the plug-in units. The few electrical components mounted directly to the Main Interface board are primarily for the purpose of coupling and matching. A schematic of the Main Interface, showing the plug-in interface and the interconnections between plug-in compartments, circuit boards, etc., of this instrument is shown on Diagram 1 at the rear of this manual.

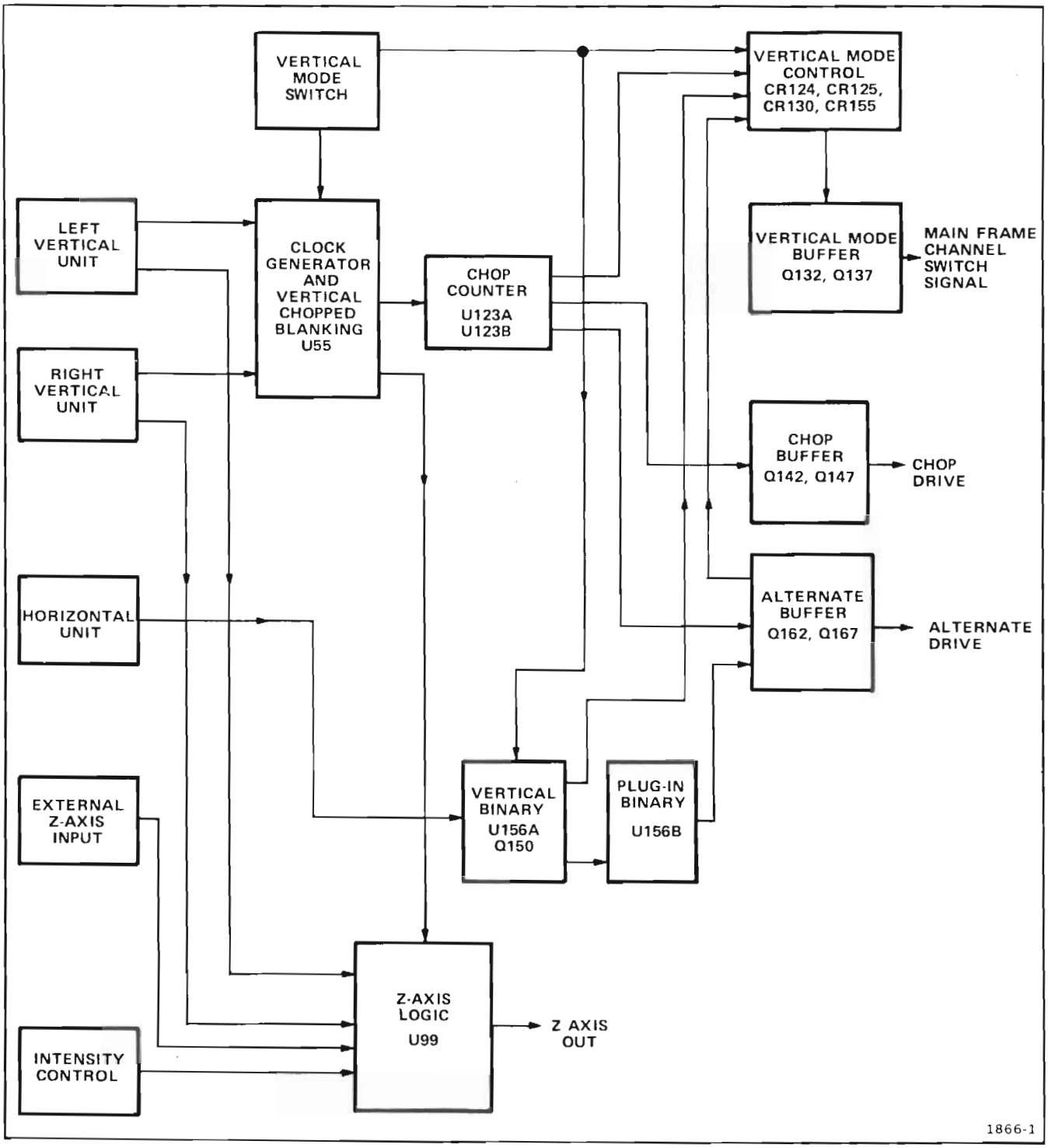


Figure 3-2. Logic circuit block diagram.

LOGIC ◈2

The Logic circuit develops control signals for use in other circuits within this instrument and in the associated plug-in units. These control signals automatically determine the correct instrument operation in relation to the plug-in installed and/or selected, plug-in control settings, and the Oscilloscope control settings.

Logic Block Diagram

A block diagram of the Logic circuit is shown in Figure 3-2. This diagram shows the source of the input control signals, the signals produced by this circuit, and the basic interconnections between blocks. The interconnections shown are intended only to indicate inter-relation between blocks, and do not indicate a direct connection or that only a single connection is made between the given blocks. Details of the inter-relationship between stages within this circuit are given in the detailed description which follows.

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

Z-Axis Logic

The Z-Axis Logic stage produces an output current which sets the intensity of the display on the crt. The level of this output current is determined by the setting of the front-panel INTENSITY control, an external signal from the rear-panel EXT Z AXIS input connector, or signals from the plug-in compartments. The Vertical Chopped Blanking Signal from U55 is applied to this stage to blank the crt display during vertical trace switching.

The Z-Axis Logic stage consists primarily of integrated circuit U99, which is a five-transistor array. A simplified schematic of the Z-Axis Logic stage is shown in Figure 3-3. Only the components essential to operation of this stage are shown in this simplified schematic. Transistor U99C is connected in the common-base configuration to provide the output for this stage. The collector load for U99C is provided by the Z-Axis Amplifier in the CRT Circuit. During vertical chopped blanking, the base of U99C is LO. This decreases the current from the base of U99C, so the collector current of U99C drops to minimum to blank the crt display during vertical trace switching.

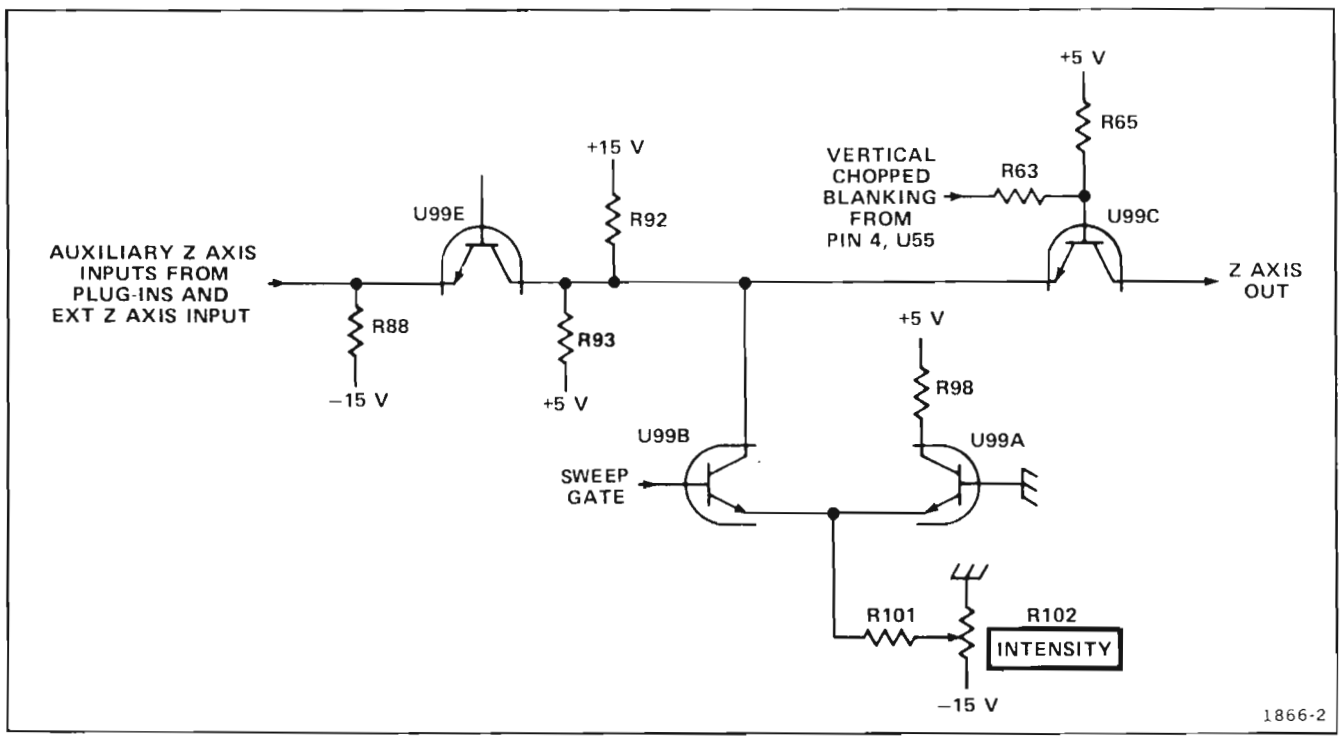


Figure 3-3. Z-Axis Logic stage simplified diagram.

The collector current of U99C is controlled by U99B and U99E. When the Sweep Gate level at the base of U99B is LO (no sweep in progress), and no signal is present at the emitter of U99E, the U99C collector current is minimum. This produces minimum display intensity. During sweep time, the level at the base of U99B is HI. This HI base level causes U99B to conduct and allows the INTENSITY control to determine the output current. The auxilliary Z-Axis inputs from the plug-in compartments and the signal from the EXT Z AXIS input connector are connected to the emitter of U99E. These signals modulate the U99C current to, in turn, modulate the intensity of the display.

Clock Generator

Half of integrated circuit U55, along with the external components shown in Figure 3-4A, make up the Clock Generator stage. Components R1, Q1, Q2, and Q3 represent an equivalent circuit contained within U55A. This circuit along with discrete components C59, R56, R57, and R59 compose a two-megahertz free-running oscillator to provide a timing signal (clock) for mainframe vertical and plug-in chopping.

The stage operates as follows: Assume that Q2 is conducting and Q1 is off. The collector current of Q2 produces a voltage drop across R1 which holds Q1 off. This LO level at the collector of Q2 is also connected to pin 14 through Q3 (see waveforms in Figure 3-4B at time T_0). Since there is no current through Q1, C59 begins to charge towards −15 volts through R56-R57. The emitter of Q1 goes negative as C59 charges until it reaches a level about 0.6 volt more negative than its base level. Then Q1 is forward biased and its emitter rapidly rises positive. Since C59 cannot change its charge instantaneously, the sudden change in voltage at the emitter of Q1 pulls the emitter of Q2 positive also, to reverse-bias it. With Q2 reverse biased, its collector rises positive to produce a positive output level at pin 14 (see Time T_1 on the waveforms).

Now, conditions are reversed. Since Q2 is reverse biased, there is no current through it. Therefore, C59 can begin to discharge through R59. The emitter level of Q2 follows the discharge of C59 until it reaches a level about 0.6 volts more negative than its base. Then Q2 is forward biased and its collector drops negative to reverse-bias Q1. The level at pin 14 drops negative also, to complete the cycle. Once again, C59 begins to charge through R56-R57 to start the second cycle.

Two outputs are provided from this oscillator. The Delay Ramp signal from the junction of R56-R57 is connected to the Vertical Chopped Blanking stage. This signal has the same waveshape as the signal at pin 13, with its slope

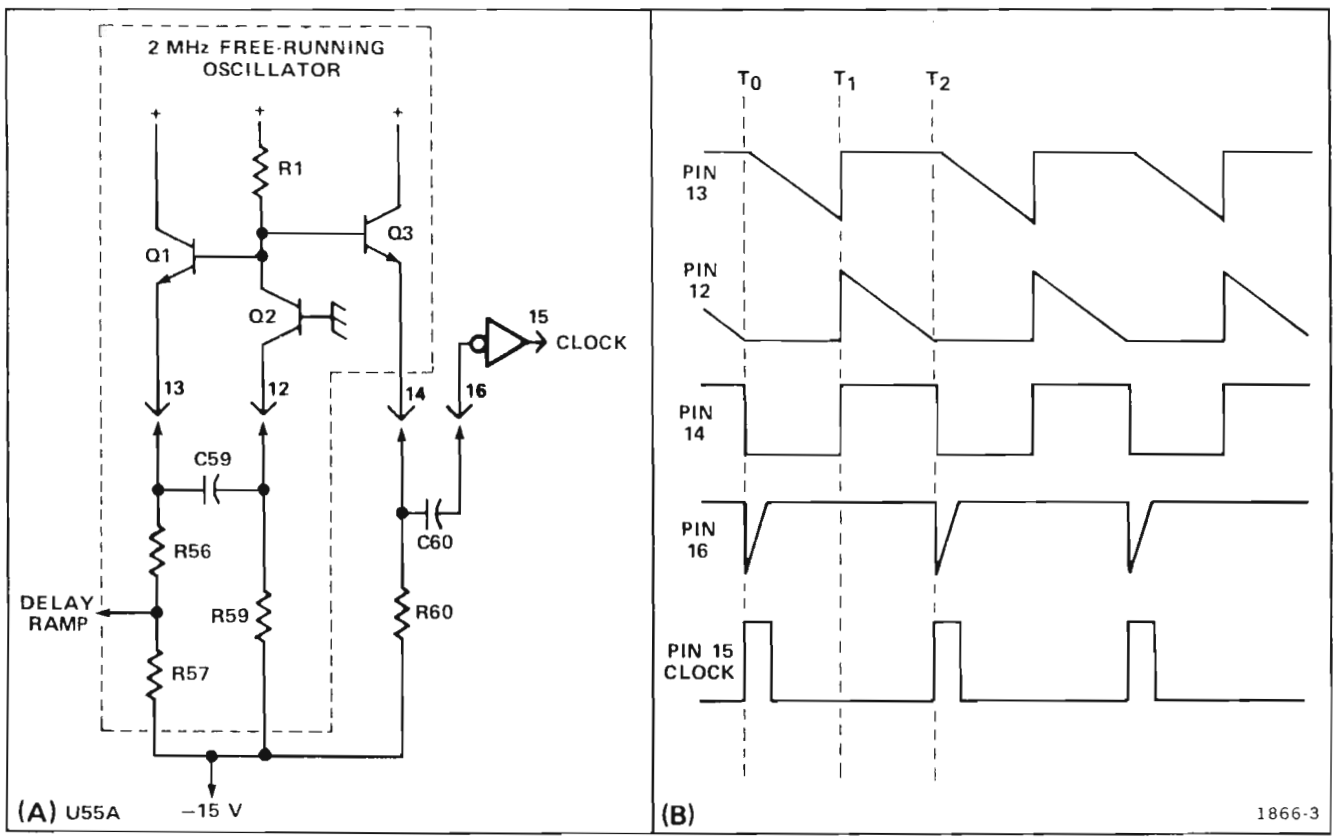


Figure 3-4. Clock Generator stage: (A) Simplified schematic, and (B) Timing diagram.

determined by the divider ratio between R56-R57. A square-wave output is provided at pin 14. The frequency of this square wave is determined by the RC relationship between C59 and R1. The duty cycle is determined by the ratio of R56-R57 to R59.

The square wave at pin 14 is connected to pin 16 through C60. Along with the internal resistance of U55A, C60 differentiates the square wave to produce a negative-going pulse coincident with the falling edge of the square wave (positive-going pulse coincident with rising edge has no effect on circuit operation). This negative-going pulse is connected to pin 15 through an inverter-shaper which is also part of U55A. The output at pin 15 is a positive-going Clock pulse at a repetition rate of about two megahertz.

Vertical Chopped Blanking

The Vertical Chopped Blanking stage is made up of the remaining half of integrated circuit U55B. Refer to Figure 3-5A. This stage determines if Vertical Chopped Blanking pulses are required, based upon the operating mode of the vertical system or the plug-in units (dual trace units only). Vertical Chopped Blanking pulses are produced if: (1) VERT MODE switch is set to CHOP; (2) dual-trace vertical unit is operating in the chopped mode and that unit is being displayed; (3) Dual-trace vertical unit is operating in the chopped mode with the VERT MODE switch set to ADD. The repetition rate of the negative-going Vertical Chopped Blanking pulse output at pin 4 is always two megahertz as determined by the Clock Generator stage. The Delay Ramp signal from the Clock Generator stage determines the repetition rate and pulse width of the Vertical Chopped Blanking pulses. The Delay Ramp applied to pin 10 starts to go negative from a level of about +1.1 volts coincident with the leading edge of the Clock pulse (see waveforms in Figure 3-5B). This results in a HI quiescent condition for the Vertical Chopped Blanking pulse. The slope of the negative-going Delay Ramp is determined by the Clock Generator stage. As it reaches a level slightly negative from ground, the Vertical Chopped Blanking pulse output level changes to the LO state. This signal remains LO until the Delay Ramp goes HI again. Notice the delay between the leading edge of the Clock pulses generated by U55A and the leading edge of the Vertical Chopped Blanking pulses (see Figure 3-5B). The amount of delay between the leading edges of these pulses is determined by the slope of the Delay Ramp applied to pin 10. This delay is necessary due to the delay line in the vertical deflection system. Otherwise, the trace blanking resulting from the Vertical Chopped Blanking pulse would not coincide with the switching between the displayed traces. The duty cycle of the square wave produced in the Clock Generator stage determines the pulse width of the Vertical Chopped Blanking pulses (see Clock Generator discussion for more information).

Whenever this instrument is turned on, the Vertical Chopped Blanking pulses are being produced at a two-megahertz rate. However, these pulses are available as an output at pin 4 only when the remaining inputs to U55B are at the correct levels. The following discussions give the operating conditions which produce Vertical Chopped Blanking pulses to blank the crt during vertical trace switching. Figure 3-5A identifies the function of the pins of U55B.

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

Pin 3 HI—VERT MODE switch is set to CHOP.

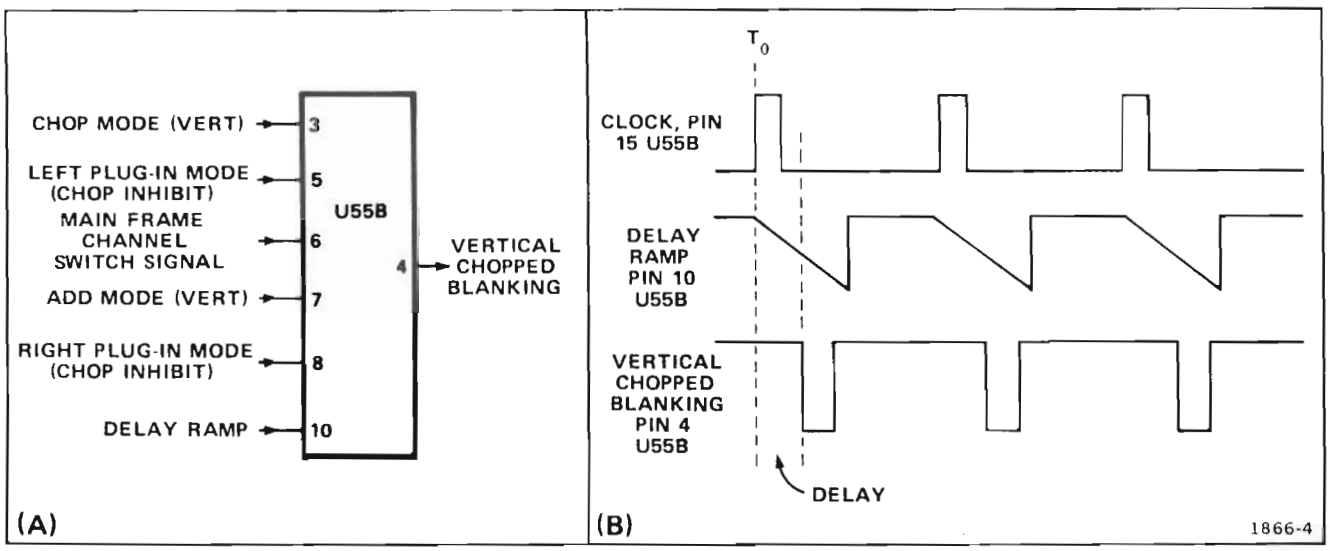


Figure 3-5. Vertical Chopped Blanking stage: (A) Input pin identification, and (B) Timing diagram.

Pin 7 LO—VERT MODE switch set to any position except ADD.

Pin 10 LO—Delay Ramp more negative than about 0 volts.

LEFT VERTICAL UNIT SET FOR CHOPPED OPERATION. If the Left Vertical unit is set for chopped operation, the setting of the VERT MODE switch determines whether the Vertical Chopped Blanking pulses are available. If the VERT MODE switch is set to the CHOP position, conditions are as described previously under Chop Vertical Mode. Operation in the ADD position of the VERT MODE switch is given later. For the LEFT position of the VERT MODE switch, or when the left vertical unit is to be displayed in the ALT mode, Vertical Chopped Blanking pulses are available at all times (two-megahertz rate). The input conditions are:

Pin 3 LO—VERT MODE switch set to any position except CHOP.

Pin 5 LO—Left vertical unit set to chopped mode.

Pin 6 LC—Left vertical unit to be displayed (Main Frame Channel Switch Signal).

Pin 7 LO—VERT MODE switch set to any position except ADD.

Pin 10 LO—Delay Ramp more negative than about 0 volts.

Notice that the Main Frame Channel Switch Signal at pin 6 must be LO for output pulses to be available at pin 4. This means that when the VERT MODE switch is set to ALT, Vertical Chopped Blanking pulses are produced only during the time that the left vertical unit is to be displayed (unless the right vertical unit is also set for chopped operation).

RIGHT VERTICAL UNIT SET FOR CHOPPED OPERATION. If the right vertical unit is set for chopped mode, operation is the same as described previously for the left vertical unit except that Vertical Chopped Blanking pulses are produced when the VERT MODE switch is set to RIGHT or when the Main Frame Channel Switch Signal is HI in the ALT mode. The input conditions are:

Pin 3—LO—VERT MODE switch set to any position except CHOP.

Pin 6 HI—Right vertical unit to be displayed (Main Frame Channel Switch Signal HI).

Pin 7 LO—VERT MODE switch set to any position except ADD.

Pin 8 LO—Right vertical unit set to chopped mode.

Pin 10 LO—Delay Ramp more negative than about 0 volts.

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

Pin 3 LO—VERT MODE switch set to any position except CHOP.

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

Pin 7 HI—VERT MODE switch set to ADD.

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

Pin 10 LO—Delay Ramp more negative than about 0 volts.

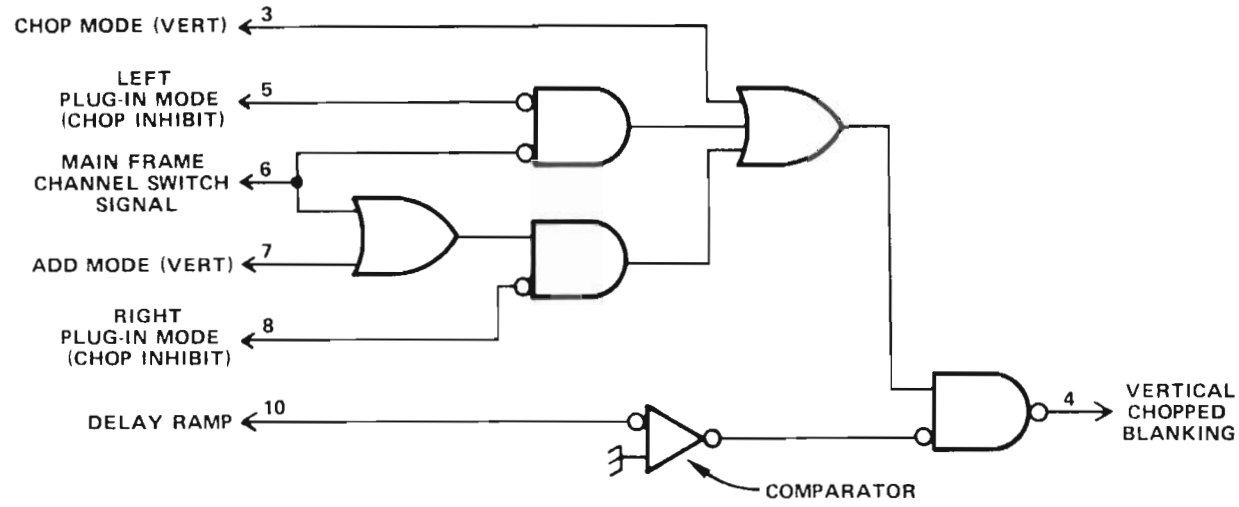
Figure 3-6A shows a logic diagram of the Vertical Chopped Blanking stage. Notice the comparator block on this diagram (one input connected to pin 10). The output of this comparator is determined by the relationship between the levels at its inputs. If pin 10 is more positive (HI) than the grounded input, the output is HI also; if it is more negative (LO), the output is LO. An input/output table for this stage is given in Figure 3-6B.

Chop Counter

The Chop Counter stage produces the Main Frame Chop Signal and the Vertical Plug-In Chop Signal. The Clock pulse produced by the Clock Generator stage provides the timing signal for this stage. A logic diagram of the Chop Counter, identifying the inputs and outputs, is shown in Figure 3-7.

The Chop Counter stage consists of integrated circuit U123A and B, two dual D-type flip-flops with direct-set, direct-clear inputs (see Table 3-1 for operation of D-type flip-flop). As connected in this circuit, these D-type flip-flops operate as triggered (toggle) flip-flops.

The two-megahertz Clock pulses from the Clock Generator stage are connected to the CP (clock pulse) input of U132B. As connected, U123B changes output states with each positive-going Clock pulse, and the output at pin 9 is a square wave which switches between the HI and LO levels at a one-megahertz rate. This signal is connected to the Vertical Mode Control stage to provide the Main Frame Chop Signal. It is also connected to the CP input of U123A. U123A also changes output states with each positive-going pulse at its CP input to produce a 500-kilohertz square wave at pin 5. The output from U123A provides the Vertical Plug-In Chop Signal to the Chop Buffer stage. Idealized waveforms showing the timing relationship between the input and output signals for these stages are also shown in Figure 3-7.



(A) U55B

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

Φ = HAS NO EFFECT IN THIS CASE.

[1] RAMP SIGNAL: CONSIDERED LO WHEN MORE NEGATIVE THAN ABOUT ZERO VOLTS.

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

[3] PIN 5 CAN BE HI AND NOT AFFECT OPERATION IF PIN 8 IS LO, AND VICE VERSA.

(B)

1866-5

Figure 3-6. Vertical Chopped Blanking stage: (A) Logic diagram, and (B) Truth table.

Vertical Mode Control

The Vertical Mode Control stage is made up of discrete components CR124-CR125, CR126, CR130-CR155, and buffer Q132-Q137. These components develop the Main Frame Channel Switch Signal which is connected to the Main Interface circuit (vertical plug-in compartments and trigger selection circuitry) and the Vertical Interface circuit to indicate which vertical unit is to be displayed. When this output level is HI, the right vertical unit is displayed and when it is LO, the left vertical unit is displayed.

The VERT MODE switch (shown on diagram 6) provides control levels for this stage. This switch provides a HI level on only one of four output lines to indicate the selected vertical mode; the remaining lines are LO. The fifth mode, LEFT, is indicated when all four output lines are LO. Operation of this stage in all positions of the VERT MODE switch is as follows:

RIGHT. When the VERT MODE switch is set to RIGHT, a HI level is connected to the buffer through R126 and CR126. The LO level at the anodes of diodes CR125 and CR130 holds them reverse biased. The resultant Main Frame Channel Switch Signal output from the Vertical Mode Buffer is a HI level to indicate that the right vertical unit is to be displayed.

CHOP. In the CHOP position of the VERT MODE switch, a HI level is applied to the anodes of diodes CR124-CR125 through R125. Both diodes are forward biased so the Vertical Plug-In Chop Signal from pin 9 of U123B can pass to the emitter of Q132. This signal switches between the HI and LO levels at a one-megahertz rate and it produces a corresponding Main Frame Channel Switch Signal output at the emitter of Q137. When this output is HI, the right vertical unit is displayed and when it switches to LO, the left vertical unit is displayed.

ALT. In the ALT mode, the VERT MODE switch applies a HI level to the anodes of diodes CR130-CR155 through R130. These diodes are foward biased so the Display Right Command from pin 5 of U156A can pass to the emitter of Q132 to determine the Main Frame Channel Switch Signal level. The Display Right Command switches between its HI and LO levels at a rate determined by the Vertical Binary stage.

ADD AND LEFT. The control levels in the ADD and LEFT positions of the VERT MODE switch are not connected to this stage. However, since only the line corresponding to the selected vertical mode can be HI, the RIGHT, CHOP, and ALT lines must remain at their LO level when either LEFT or ADD are selected. Therefore, the emitter of Q132 remains LO to produce a LO Main

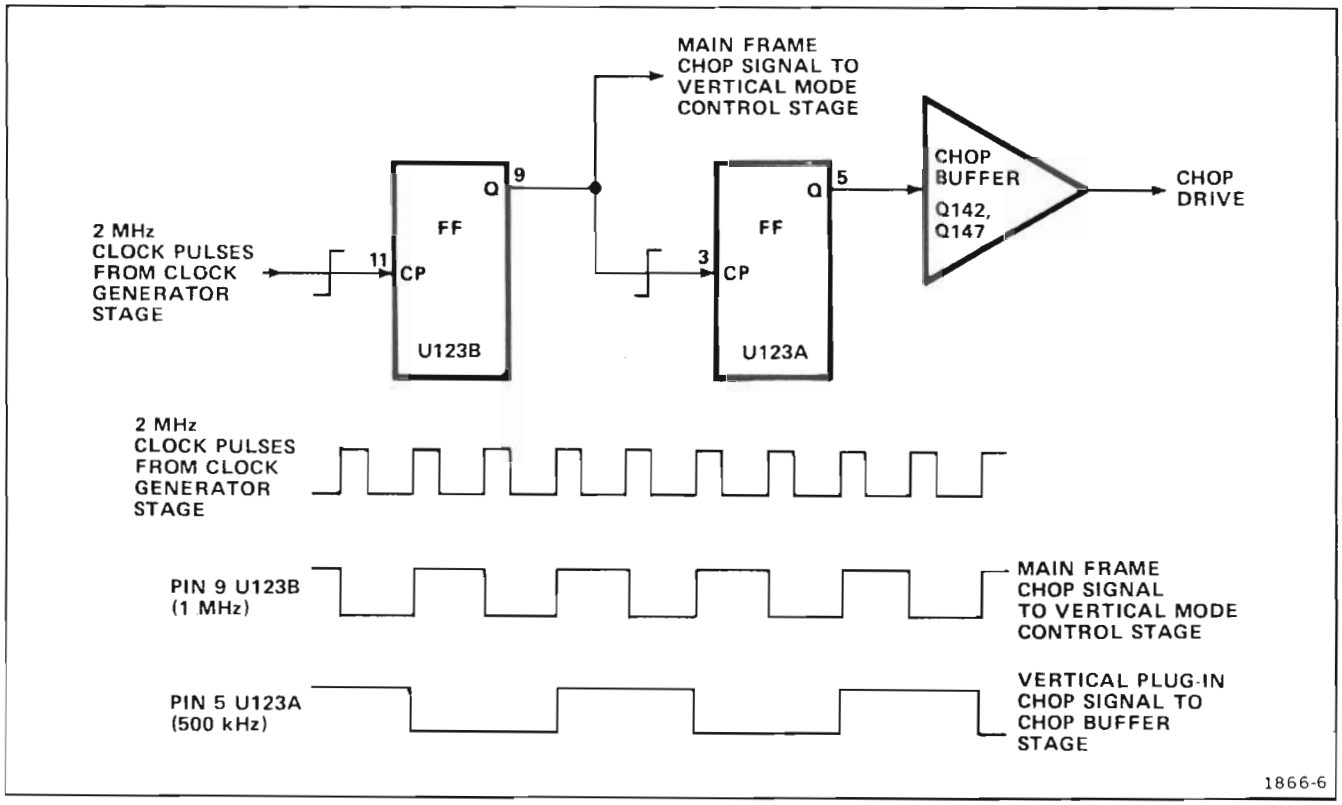


Figure 3-7. Chop Counter stage logic diagram and timing diagram.

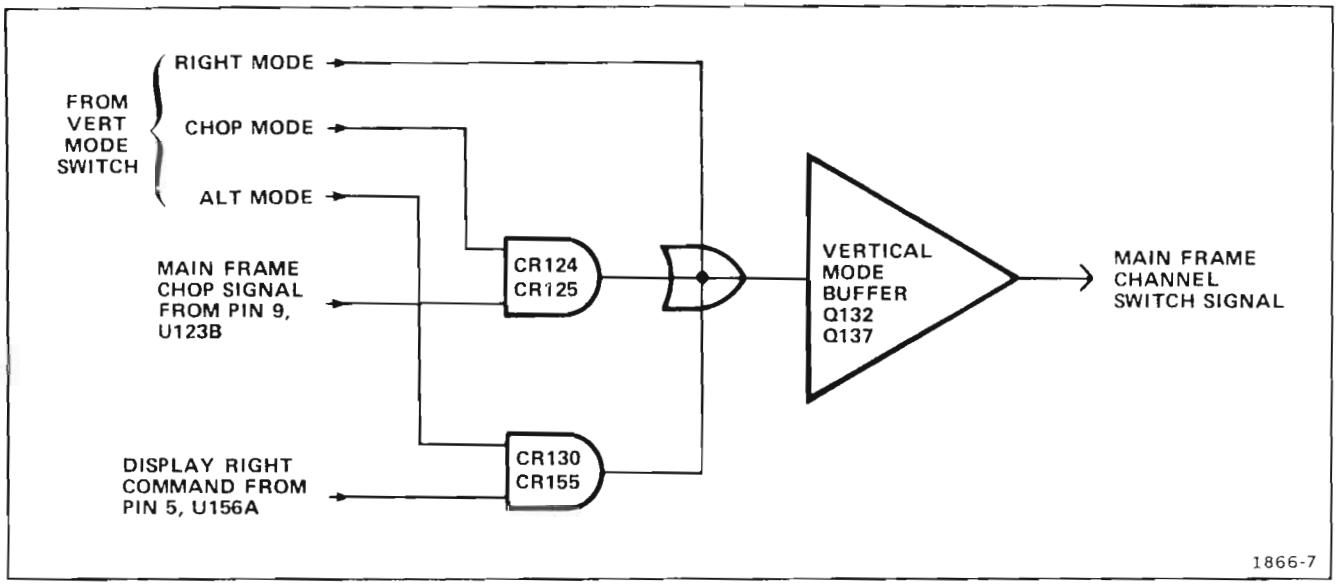


Figure 3-8. Vertical Mode Control and Vertical Mode Buffer logic diagram.

Frame Channel Switch Signal output level. Final control of LEFT or ADD mode is made by the Vertical Interface circuit.

A logic diagram of the Vertical Mode Control stage is shown in Figure 3-8. The discrete components which make up each logic function are identified. The gate connected to the input of the Vertical Mode Buffer is a phantom-OR gate. A phantom-OR gate performs the OR-logic function merely by interconnection of the three inputs.

Vertical Binary

The Vertical Binary stage consists of integrated circuit U156A and transistor Q150. U156A is a D-type flip-flop with direct-set and direct-clear inputs (see Table 3-1 for operating details). The connection between pin 6 and the D (data) enables this flip-flop to operate in the triggered mode. A logic diagram of the Vertical Binary stage is shown in Figure 3-9.

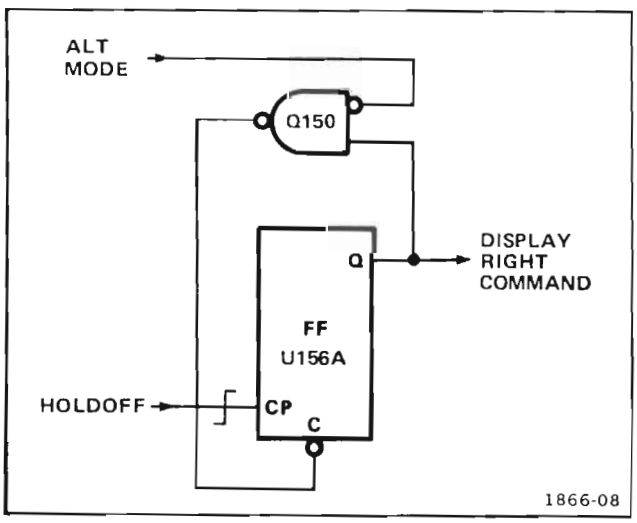


Figure 3-9. Vertical Binary stage logic diagram.

The operation of the Vertical Binary stage is controlled by the level of the ALT Mode line from the VERT MODE switch. When this switch is set to ALT, a HI level is connected to the emitter of Q150 through R152. This HI level disables Q150 so its collector remains HI. As a result, Q150 has no effect upon operation of the Vertical Binary stage and the direct-clear input of U156A remains HI so it does not affect the operation of U156A. Therefore, U156A operates as a basic triggered flip-flop which changes output states with each positive-going Holdoff pulse at the CP input. The Holdoff pulse goes positive at the end of each sweep. The output at pin 5 of U156A switches between the HI and LO levels at one-half the rate of the Holdoff signal from the horizontal plug-in unit. Figure 3-10 shows the time relationship between the input and output signals for this stage, and gives the resultant display with each signal combination.

For any position of the VERT MODE switch except ALT, the emitter of Q150 is pulled LO by a LO level on the ALT Mode line. This enables Q150, but it does not change output state unless the level at pin 5 of U156A is HI. Quiescently, the output of Q150 is LO. Therefore, when the positive-going Holdoff pulse is received at the end of the sweep, the output of U156A goes HI. This activates Q150 and its output goes LO to provide a direct-clear to U156A. The output of U156A is reset to its LO level, and Q150 is again disabled so its output returns to the HI level.

The stage is now ready for the next positive-going Holdoff pulse. The action is the same with each pulse, so the signal at the output of this stage is at the same repetition rate as the Holdoff input. Therefore, this stage is now operating as a divide-by-one counter rather than a divide-by-two counter as described previously. The output under this condition is used only by the Plug-In Binary stage.

Since the Vertical Binary stage can change output states only at the end of each sweep, there will be no Alternate Drive signal for either the mainframe or vertical plug-in units if a sweep is not being produced by the horizontal plug-in unit.

Plug-In Binary

The Plug-In Binary stage consists of U156B, which is connected as a triggered flip-flop with a direct-set input. The CP input for this stage is the Display Right Command from the Vertical Binary stage. When the VERT MODE switch is set to ALT, the repetition rate of the Display Channel 2 Command output of this stage is one-fourth of the Holdoff input (see waveforms in Figure 3-10). For any position of the VERT MODE switch except ALT, the repetition rate of the output signal from this stage is one-half of the Holdoff input. A logic diagram of the Plug-In Binary stage is shown in Figure 3-11.

Output Buffers

The output switching commands from the Logic circuit are provided through buffer stages Q132-Q137, Q142-Q147, and Q162-Q167. Each of these stages includes a common-base input transistor to provide a low-impedance load for the associated driving stages. The output transistor is connected as an emitter-follower provide isolation between the Logic circuit and other circuits within the instrument or the plug-in units.

OUTPUT SIGNALS ◇2

The Output Signals circuit processes signals from the time-base unit in the horizontal compartment and provides signal outputs to connectors mounted on the rear panel of the Oscilloscope.

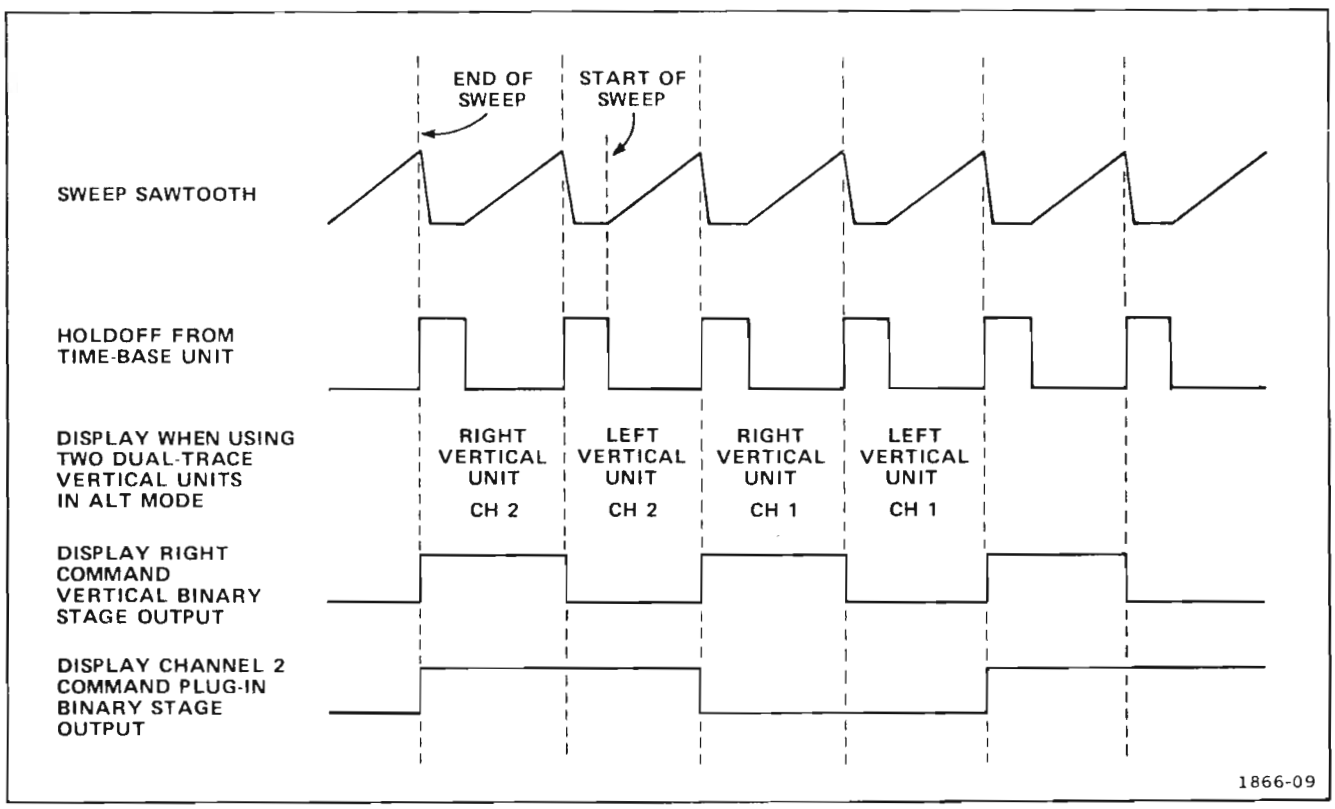


Figure 3-10. Vertical Binary and Plug-In Binary stages alternate mode timing diagram.

NOTE

The output signals in the following discussion are available only when a TD-1085/U Dual Time Base plug-in unit is used in the horizontal compartment of the Oscilloscope. The TD-1085/U is designed to be part of a system with the Oscilloscope, and its use is assumed when reference to time-base unit is made in this discussion.

The primary electronic component of the Output Signals circuit consists of integrated circuit U180, which is a five-transistor array. A schematic of this circuit is shown on diagram 2 at the rear of this manual.

Main Sweep Output

The MAIN SWP OUTPUT connector provides a sawtooth signal that originates from the main sweep generator of the time-base unit. A negative going sawtooth signal from the time-base unit is applied to the base of U180A, an inverting fedback amplifier stage. The current flow through U180A is reduced, causing its collector to go positive. Thus, the negative-going input signal is inverted to a positive-going signal at the output connector (J174). The output signal is coincident with the time that the main sweep generator runs.

Delayed Sweep Output

The Delayed Sweep Output circuitry operates the same as the Main Sweep Output circuit (previously described) except that the sawtooth signal originates from the delayed sweep generator of the time-base unit. The DELAYED SWP OUTPUT connector (J179) provides a positive going sawtooth signal that is coincident with the time that the delayed sweep runs.

Main Sweep Gate Output

The MAIN SWP GATE OUTPUT connector provides a square-wave signal that originates from the main sweep generator of the time-base unit. The signal from the time base is applied to the base of emitter follower U180D and a positive-going square-wave signal is supplied to the output connector (J187). The output signal is coincident with the sawtooth at the MAIN SWP OUTPUT connector.

Delayed Sweep Gate Output

The Delayed Sweep Gate Output circuitry operates the same as the Main Sweep Gate Output circuit (previously described) except that the square-wave signal originates from the delayed sweep generator of the time-base unit. The DELAYED SWP GATE OUTPUT connector (J183) provides a positive-going square-wave signal that is coincident with the time that the delayed sweep runs.

Delayed Trigger Output

The DELAYED TRIG OUTPUT connector provides a trigger pulse that originates as a delayed-gate square-wave signal in the main sweep generator of the time-base unit. The signal is applied to differentiation network C188-R188. Then, an inverting fedback amplifier stage U180E, normally operating in saturation, responds only during the negative portion of this differentiated delayed gate signal at its base. The current flow through U180E is reduced momentarily (approximately 50 nanoseconds), then returns to the saturation level. The resultant output at the DELAYED TRIG OUTPUT connector (J192) is a positive-going trigger pulse coincident with the start of the delayed sweep.

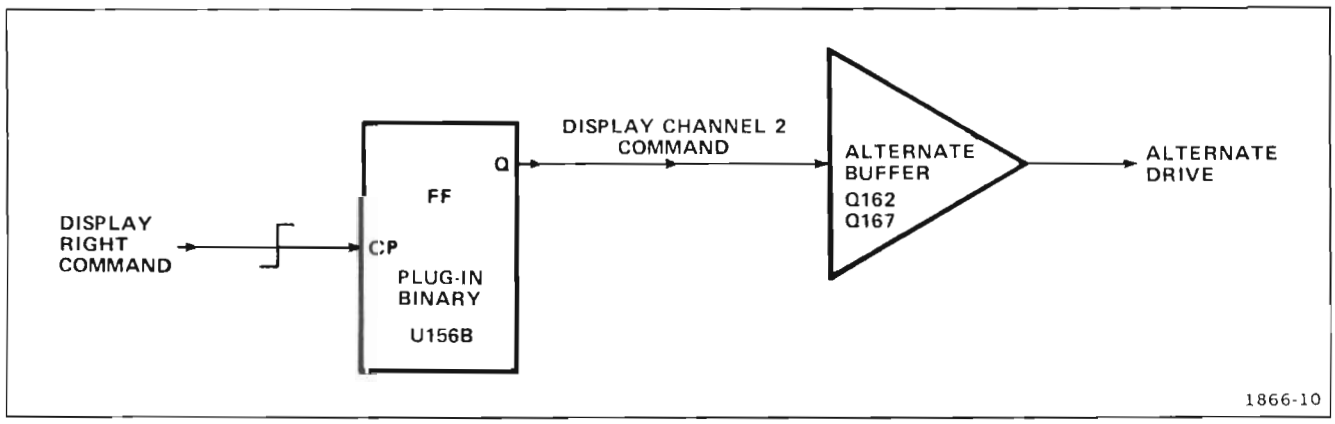


Figure 3-11. Plug-In Binary and Alternate Buffer stage logic diagram.

TRIGGER SELECTOR ③

The TRIG SOURCE switch determines which vertical signal is connected to the horizontal compartment. Figure 3-12 shows a detailed block diagram of the Trigger Selector circuit, along with a simplified diagram of all the circuitry involved in selection of the trigger source. A schematic of the Trigger Selector circuit is shown on diagram 3 at the rear of this manual. Also, see diagram 6 for the signal selection circuitry not shown on diagram 3.

Trigger Mode and Add Signals

The circuitry shown on the left side of the simplified diagram in Figure 3-12 determines the operation of the Trigger Channel switch stage. TRIG SOURCE switch S1011 controls Trigger Channel Switch U324 through Q314. When the TRIG SOURCE switch is set to the VERT MODE position, the setting of the VERT MODE switch determines the trigger selection. In the LEFT or RIGHT positions, the trigger signal is obtained from the indicated vertical unit. The following discussions describe the operation for each position of the TRIG SOURCE switch.

VERT MODE. In the VERT position of the TRIG SOURCE switch, the setting of the VERT MODE switch determines the operation of the Trigger Channel Switch stage. In the LEFT position of the VERT MODE switch, the base of Q314 is connected to ground through the ALT and RIGHT sections of S1021, CR1021 and CR1026, and S1011. This holds Q314 reverse biased to provide a LO level to pin 4 of U324 (see Figure 3-13).

When the VERT MODE switch is set to ALT, +5 volts is applied to the base of Q314 through CR1021 and S1011. Q314 is forward biased and its emitter level is determined by the Mainframe Channel Switch Signal from the Logic circuit applied to its collector. This signal switches between the HI level (Right Vertical unit to be displayed) and LO level (Left Vertical unit to be displayed) at the end of each sweep. When the Mainframe Channel Switch Signal is HI, it provides a positive collector voltage to Q314. Q314 is saturated due to CR1021, and its emitter level is very near the collector level. This provides a HI output level to the Trigger Channel Switch stage. As the Mainframe Channel Switch Signal goes LO, the collector supply for Q314 also goes negative. Q314 remains saturated and the output again follows the collector level to supply a LO output level to U324.

For ADD and CHOP vertical mode operation, +5 volts is connected to pin 14 of U324 through CR1023 or CR1024 and S1011. At the same time, the base of Q314 is held LO by the ground connection through the ALT and RIGHT section of S1021 so the level at pin 4 of U324 is LO also (produces an ADD mode in Trigger Channel Switch; see description of this stage which follows). In the RIGHT position of the VERT MODE switch, +5 volts is connected to the base of Q314 through CR1026 and S1011 to forward bias the transistor. The Mainframe Channel Switch Signal connected to the collector of Q314 is also HI in this mode, and a HI output level is produced at the emitter of Q314.

LEFT. When the LEFT trigger source is selected, the VERT MODE switch is disconnected from the trigger selector circuitry. Now the ground connection through the RIGHT section of S1011 establishes a LO output level at the emitter of Q314.

RIGHT. In the RIGHT position of the TRIG SOURCE switch, +5 volts is connected to the emitter of Q314 through S1011 and R312. This produces a HI output level to the Trigger Channel Switch stage.

Trigger Channel Switch

The Trigger Channel Switch stage determines which input signal provides the trigger signal to the horizontal compartment as controlled by the Trigger Mode and ADD signals from the trigger selection circuitry. Refer to diagram 3 during the following discussion.

Resistors R317-R319 establish the input resistance and provide a load for the trigger signal from the right vertical plug-in unit. Resistors R20-R24, located in the Main Interface circuit, provide the input resistance and load for the left vertical plug-in unit. R321-R323-R324 and R326-R327-R328 establish the operating level of the Trigger Channel Switch; R321-R323 and R326-R328 set the current gain for each channel. This stage is made up primarily of integrated circuit U324. An input/output table for U324 is shown in Figure 3-14. U324 provides a high-impedance differential input for the trigger signal from the left vertical unit at pins 2 and 15, and for the trigger signal from the right vertical unit at pins 7 and 10. The output signal at pins 12 and 13 is a differential signal. The sum of the dc current at pins 12 and 13 is always equal to the sum of the dc currents at pins 1, 8, 9, and 16 in all modes. This provides a constant dc bias to the stages which follow as the TRIG SOURCE or the VERT MODE switch positions are changed.

When the level at pin 4 is LO (see Trigger Mode and ADD Signals discussion and Figure 3-14), the trigger signal from the left vertical unit passes to the output, while the trigger signal from the right vertical unit is blocked. A HI level at pin 4 connects the trigger signal from the right vertical unit to the output and the trigger signal from the left

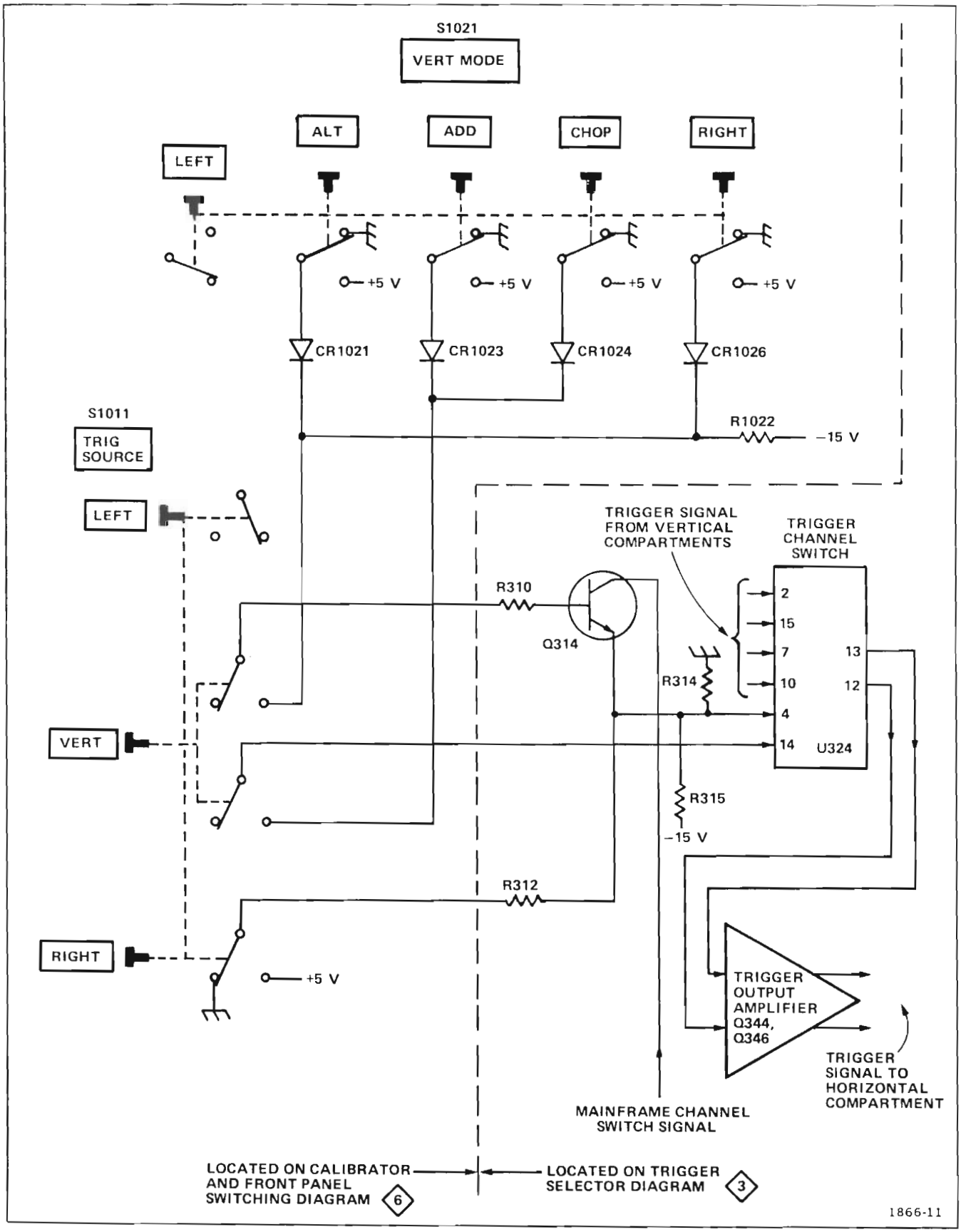


Figure 3-12. Trigger Selector and trigger-source selection circuitry.

vertical unit is blocked. For VERT MODE operation in the ALT position of the VERT MODE switch, the level at pin 4 switches between the LO and HI level at a rate determined by the Vertical Binary stage (see Logic circuit description). This action obtains the trigger signal from the left vertical unit when the left vertical unit is being displayed and from the right vertical unit when it is being displayed.

When the level at pin 4 is LO and the level at pin 14 is HI, the trigger signal from both the left and right vertical units passes to the output pins. This condition occurs only when the TRIG SOURCE switch is set to VERT and the VERT MODE switch is set to either ADD or CHOP. In this operating mode, the trigger output signal is the algebraic sum of the trigger input signals from the left and right vertical units to prevent triggering on the vertical chopping transition or on only one signal of an added display.

Trigger Output Amplifier

The trigger output at pins 12 and 13 of U324 is connected to the bases of Q344-Q346 to provide the internal trigger signal for the horizontal unit (via the Main Interface circuit). The horizontal unit provides a 50-ohm differential load for this stage. If it is removed from its compartment, the collector load for Q344-Q346 changes and the voltage at their collectors increases. This stage prevents this change from affecting the Trigger Channel Switch stage. CR341-CR349 clamp the collectors of Q344 and Q346 to about +0.6 volt to prevent these transistors from saturating under this no-load condition.

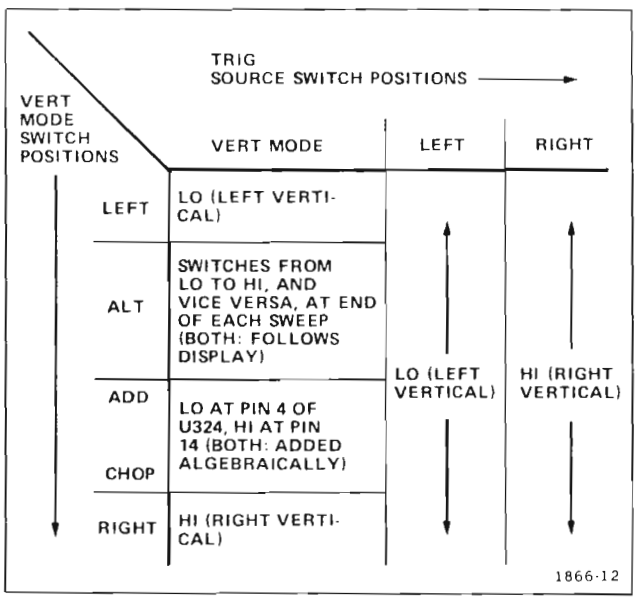


Figure 3-13. Input levels at pin 4 of U324 (source of triggering signal is shown in parentheses).

VERTICAL INTERFACE ③

The Vertical Interface circuit selects the vertical deflection signal from the output of the left vertical and/or the right vertical plug-in unit. Figure 3-15 shows a detailed block diagram of the Vertical Interface circuit. A schematic diagram of this circuit is shown on diagram 3 at the rear of this manual.

Vertical Channel Switch

The Vertical Channel Switch stage determines which input signal provides the vertical signal to the Delay-Line Buffer stage, as controlled by the Mainframe Channel Switch Signal from the Logic circuit. Resistors R200-R202 and R204-R206 establish the input resistance of this stage and provide a load for the left and right vertical units. Resistors R209-R211-R212 and R216-R218-R219 establish the operating levels for this stage. R209-R212 and R216-R219 set the current gain for each channel. C208-R208 and C215-R215 provide frequency compensation.

This stage is made up primarily of integrated circuit U214, which is the same type as used for the Trigger Channel Switch. An input/output table for U214 is shown in Figure 3-16. U214 provides a high-impedance differential input for the signal from the left vertical unit at pins 2 and 15, and the signal from the right vertical unit at pins 7 and 10. The output signal at pins 12 and 13 is a differential signal which is connected to the Delay-Line Buffer stage through R222-R224. The sum of the dc output currents at pins 12 and 13 is always equal to the sum of the dc input currents

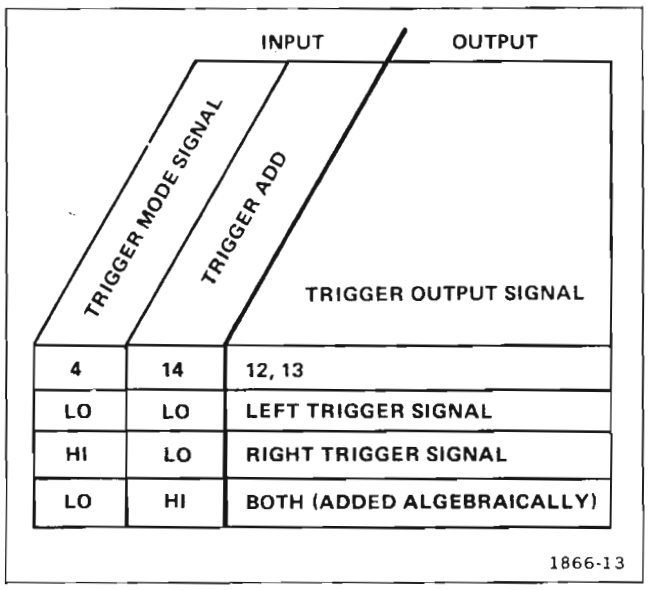


Figure 3-14. Input/Output table for Trigger Channel Switch stage (U324).

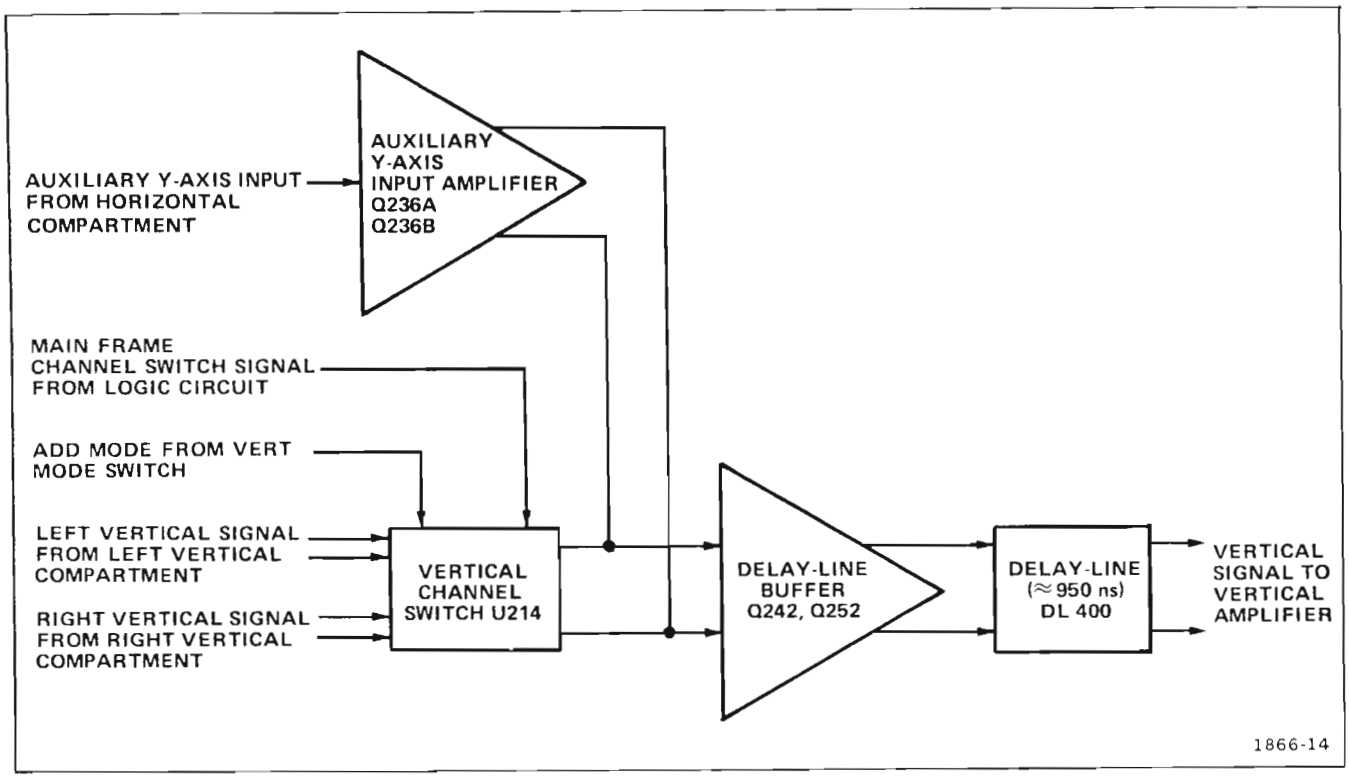


Figure 3-15. Vertical Interface detailed block diagram.

at pins 1, 8, 9, and 16 in all modes. This provides a constant dc bias to the following stage as the VERT MODE switch is changed.

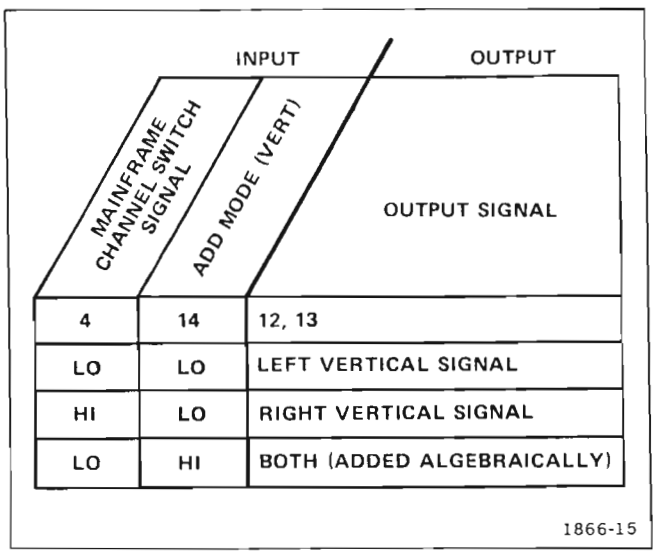


Figure 3-16. Input/Output table for Vertical Channel Switch stage (U214).

When the VERT MODE switch is set to LEFT, the level at pin 4 is LO. This level allows the signal from the left vertical unit to pass to the output while the signal from the right vertical unit is blocked. In the RIGHT position of the VERT MODE switch, the level at pin 4 is HI. Now, the signal from the right vertical unit is connected to the output while the signal from the left vertical unit is blocked.

When the VERT MODE switch is set to either ALT or CHOP, the Mainframe Channel Switch Signal at pin 4 switches between the LO and HI levels at a rate determined by either the Chop Counter or the Vertical Binary stages (see Logic description). This action allows the signal from the left vertical unit to be displayed when the Mainframe Channel Switch Signal is LO, and the signal from the right vertical unit is displayed when the Mainframe Channel Switch Signal is HI. When ADD vertical mode operation is selected, a HI level is applied to pin 14 and the level at pin 4 is LO as determined by the Vertical Mode Control stage in the Logic circuit. This allows both the right and left vertical signals to pass to the output pins. Now, the signal from both vertical units is algebraically added and the resultant signal determines the vertical deflection.

Auxiliary Y-Axis Input Amplifier

The Auxiliary Y-Axis Input Amplifier accepts an input from horizontal plug-in units having compatible features. Normally, this input is a positioning voltage to offset the display. The single-ended signal connected to the input of this stage is converted to a push-pull signal at the collectors of Q236A and Q236B. This signal is connected to the Delay-Line Buffer stage along with the output from the Vertical Channel Switch.

Delay-Line Buffer

The output of the Vertical Channel Switch stage, along with any signal from the Auxiliary Y-Axis Input Amplifier, is connected to the emitters of Q242-Q252. These transistors are connected as common-base amplifiers to provide a low-impedance current-summing point. The signal at the collectors of Q242-Q252 is connected to Delay Line DL400. Resistors R259-R261 provide reverse termination for the Delay Line.

Delay Line

Delay Line DL400 provides approximately 150 nanoseconds delay for the vertical signal, to allow the horizontal circuits time to initiate a sweep before the vertical signal reaches the vertical deflection plates of the crt. This allows the instrument to display the leading edge of the signal originating the trigger pulse when using internal triggering. The delay line used in this instrument has a characteristic impedance of about 50 ohms per side, or about 100 ohms differentially. It is of the coaxial type, which does not produce preshoot or phase distortion of the crt display.

VERTICAL AMPLIFIER ◈4

The Vertical Amplifier circuit provides final amplification for the vertical signal before it is applied to the vertical deflection plates of the crt. This circuit includes an input from the BEAM FIND switch to compress an overscanned display within the viewing area of the crt. Figure 3-7 shows a detailed block diagram of the Vertical Amplifier circuit. A schematic of this circuit is shown in diagram 4 at the rear of this manual.

Input Balance

Transistors Q407-Q415 act as a paraphase amplifier to provide input balance for the Vertical Amplifier by changing the dc levels at pins 2 and 4 of U450. Vertical Centering adjustment R403 determines the bias at the base of Q407. As this bias is changed, the levels at the collectors of Q407 and Q415 change due to paraphase action. This dc level is connected to pin 2 of U450 through R408-R423 and to pin 4 through R414-R424. R403 is adjusted so the trace is displayed at the center of the crt when the inputs to this circuit are at the same potential.

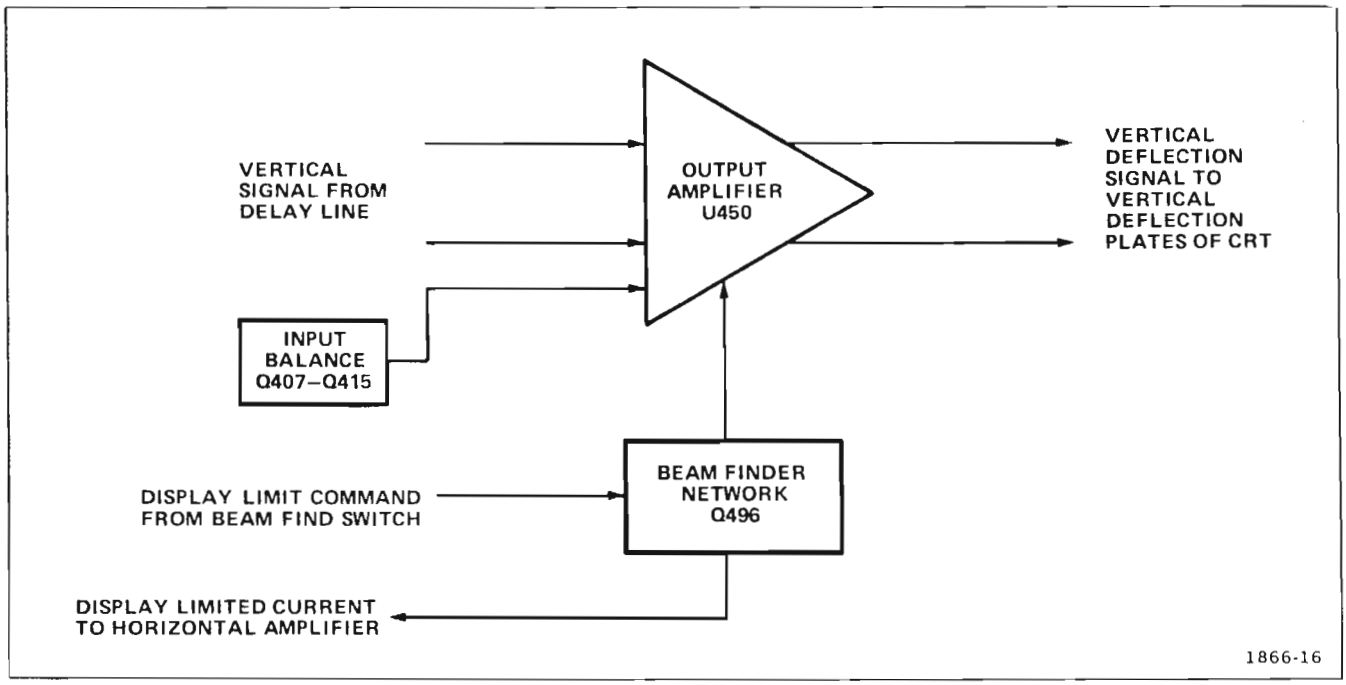


Figure 3-17. Vertical Amplifier circuit detailed block diagram.

Output Amplifier

Amplification of the vertical signal is accomplished by integrated circuit U450. The circuit is made up of three similar push-pull stages. Each stage has a pair of common-emitter transistors driving a pair of low input impedance common-base transistors. Frequency compensation is provided by the networks connected between pins 2 and 4 in the first amplifier stage and pins 7 and 8, 13 and 14 in the third amplifier stage. The resistive network connected to pins 3, 6, and 16 determines the gain of the Vertical Amplifier. Vert Gain adjustment R447 sets the gain of the second amplifier stage to determine the overall gain of the vertical deflection system and thereby provide a calibrated deflection factor. Bias adjustment R486 sets the voltage level at pin 10 of U450 (nominally 4.3 volts) to balance the third amplifier stage for maximum gain-bandwidth operation.

Beam Finder Network

The Beam Finder Network provides a means of locating a display which overscans the graticule area. Under normal operation, −15 volts is connected to the base of Q496 from the BEAM FIND switch (see diagram 6) to reverse it. Therefore, the normal operating levels for U450 are determined by the resistive network connected to pins 3, 6, and 16. When the BEAM FIND switch is pressed, the −15 volts is interrupted and the base of Q496 rises positive to turn it on. The resulting change in current of U450 unbalances the second amplifier stage so as to limit its gain. This action compresses the display vertically within the display area.

HORIZONTAL AMPLIFIER ⑤

The Horizontal Amplifier circuit amplifies the push-pull horizontal deflection signal from the plug-in unit in the horizontal compartment and drives the horizontal deflection plates of the crt. Figure 3-18 shows a detailed block diagram of the Horizontal Amplifier circuit. A schematic of this circuit is shown in diagram 5 at the rear of this manual.

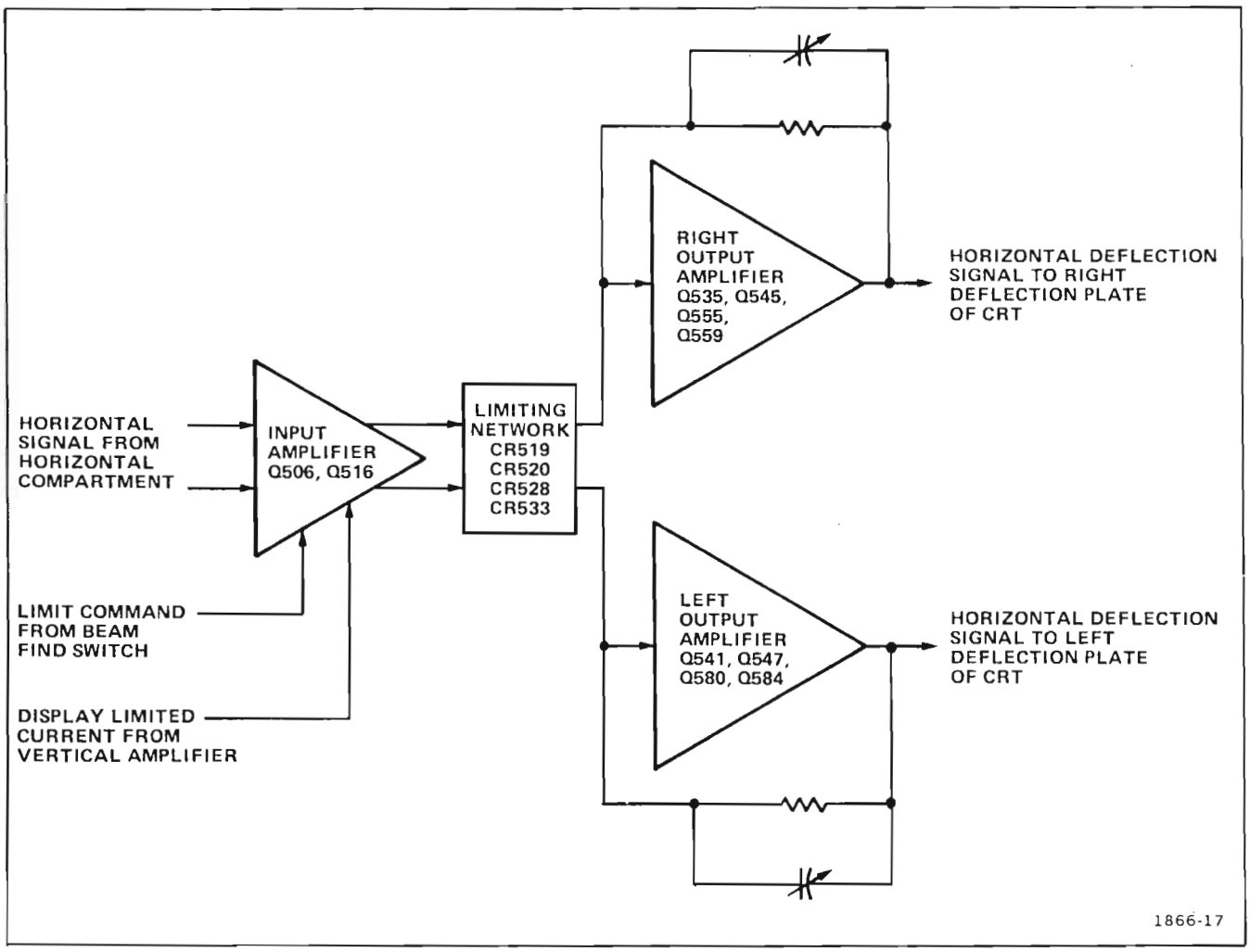


Figure 3-18. Horizontal Amplifier circuit detailed block diagram.

Input Amplifier

The signal from the horizontal compartment is connected to the bases of Q506 and Q516. Resistors R501-R503 set the input resistance of this stage and provide a load for the unit in the horizontal compartment. Resistors R508, R509, R510, R512, R513, and R514 provide degeneration between the emitters of R506-R516. Horizontal Gain adjustment R509 determines the amount of emitter degeneration to control the signal gain of this stage, thereby setting the overall gain of the Horizontal Amplifier circuit. Horizontal Centering adjustment R513 balances the quiescent current through Q506-Q516 to produce a centered trace on the crt when no signal is applied to the input.

For normal operation, −15 volts is connected to the variable arm of the Horizontal Centering potentiometer from the BEAM FIND switch (Limit Command input line). When the BEAM FIND switch is pressed, this voltage is interrupted to limit the emitter current of Q506-Q516. At the same time, current is added through CR522 and CR526 from the Vertical Amplifier (via the Display Limited Current line). This added current maintains approximately the same dc current through the output stages in both positions of the BEAM FIND switch.

Limiting Network

The signals at the collectors of Q506-Q516 are connected to the output stages through the Limiting Network stage. This stage limits the input to the Left and Right Output stages to always operate within their dynamic range, and not be overdriven by excessive current from the Input Amplifier stage. Since the output from the Input Amplifier is a current signal, very little voltage change occurs across the Limiting Network. For input signals that produce an on-screen display, CR528-CR533 remain forward biased and CR519-CR520 are reverse biased. Under these conditions, C519-R516 provide frequency compensation for the stage. However, if high-amplitude signals are applied to the circuit as a result of sweep magnification or high-amplitude external horizontal signals, either CR528 or CR533 is reverse biased. This results in a sufficient voltage change at the anode of CR519 or CR520 to provide forward bias. The forward-biased shunt diode then provides a current path for the signal current to limit the current to the Left or Right Output Amplifier during the over-drive condition.

Right Output Amplifier

Transistors Q535, Q545, Q555, and Q559 are connected as a current-driven feedback amplifier. The input current is converted to a voltage output signal to drive the right horizontal deflection plate of the crt. The signal at the collector of Q535 is connected to the emitters of output transistors Q555-Q559 through emitter follower Q545 and parallel paths R550-C550 and R553. The signal is connected to the emitter of Q559 through R553. The output transistors are connected in the complementary configuration to provide less resistive loading at the output. The output signal at the collectors of Q555-Q559 is connected to the right deflection plate of the crt through R567.

Negative feedback is provided from the collectors Q555-Q559 to the base of Q535 through feedback network R565-C564-R564-R562-C562-R561-C561. Variable capacitor C562 adjusts the transient response of the feedback network to provide good linearity at fast sweep rates.

Left Output Amplifier

Basic operation of the Left Output Amplifier stage is the same as just described for the Right Output Amplifier. Variable capacitor C587 provides linearity adjustment for the Left Output Amplifier at fast sweep rates. The output signal at the collectors of Q580-Q584 is connected to the left deflection plate of the crt through R591.

CALIBRATOR AND FRONT PANEL SWITCHING ◇6◇

The Calibrator and Front Panel Switching circuit provides output voltage to the front-panel switches and controls. Figure 3-19 shows a detailed block diagram of the Calibrator portion of this circuit. A schematic of the Calibrator and Front Panel Switching circuitry is shown on diagram 6 at the rear of this manual.

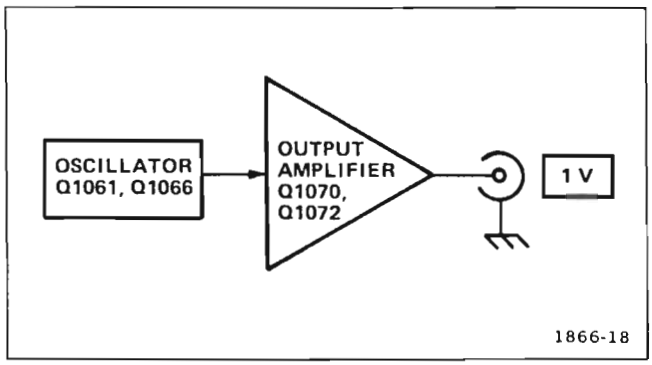


Figure 3-19. Calibrator detailed block diagram.

Mode Switch Logic

The VERT MODE switch determines the operating mode of the Vertical Interface circuit. The levels established by this switch are also used in various other circuits throughout this instrument. This switch is designed so it is self-cancelling (i.e., only one button can be pressed at a time). Specific operation of this switch is described in connection with the circuits that it controls.

The TRIG SOURCE switch controls the operation of the Trigger Selector circuit. This switch is also self-cancelling so only one of the buttons can be pressed at a time. Operation of this switch is discussed in connection with the Trigger Selector circuit.

Calibrator

GENERAL. The Calibrator circuit provides accurate voltage output at the front-panel CALIBRATOR output connector. Repetition rate of the output signal is about one kilohertz.

OSCILLATOR. Transistors Q1061 and Q1066 are connected as a square-wave oscillator to determine the repetition rate of the Calibrator circuit. Oscillation occurs as follows: Assume that Q1061 is conducting and Q1066 is off. The collector current of Q1061 through R1061 produces a voltage level which holds the base of Q1066 low. This keeps Q1066 turned off, and since there is no current through it, its collector goes positive to produce the positive portion of the square wave. At the same time, C1064 begins to charge toward −15 volts through R1069. The emitter of Q1066 goes negative also as C1064 charges, until it reaches a level about 0.6 volt more negative than the level at its base. Then, Q1066 is forward biased and its emitter rapidly rises positive. Since C1064 cannot change its charge instantaneously, the sudden change in voltage at the emitter of Q1066 pulls the emitter of Q1061 positive also, to reverse bias it. The current through Q1066 produces a voltage drop at its collector to produce the negative portion of the square wave.

Now, conditions are reversed. Since Q1061 is reverse biased, there is no current through it. Therefore, C1064 can begin to discharge through R1063. The emitter level of Q1061 follows the discharge of C1064 until it reaches about −0.6 volt. Then, Q1061 is forward biased and its collector drops negative to reverse bias Q1066. This interrupts the current through Q1066, and its collector goes positive again to complete the square wave. Once again, C1064 begins to charge through R1069 to start the second cycle. The signal produced at the collector of Q1066 has a repetition rate of about one kilohertz.

The Oscillator stage can be changed by jumper P1066. When this jumper is installed in the dc position, the Oscillator is disabled and the collector of Q1066 rises positive. This produces a positive dc voltage output to the front-panel CALIBRATOR output connector.

OUTPUT AMPLIFIER. Transistors Q1070 and Q1072 are connected as a comparator with the reference level at the base of Q1072 determined by the network R1073-R1074-R1076-R1077. The Cal Adj potentiometer, R1077, is adjusted to provide an accurate one-volt output at the CALIBRATOR output connector.

The output of the Oscillator stage is connected to the base of Q1070. This signal controls the conduction of comparator Q1070-Q1072. When the base of Q1070 is high, it is off and Q1072 is conducting. This produces a positive output voltage at the CALIBRATOR output and Q1072 is reverse biased. Now, the voltage level at the output connector drops to zero.

CRT CIRCUIT ⑦

The CRT Circuit produces the high-voltage potentials and provides the control circuits necessary for the operation of the crt (cathode ray tube). This circuit also includes the Z-Axis Amplifier stage to set the intensity of the crt display. Figure 3-20 shows a detailed block diagram of the CRT Circuit. A schematic of this circuit is shown on diagram 7 at the rear of this manual.

Z-Axis Amplifier

The Z-Axis Signal from the Logic circuit is applied to the bases of both Q607 and Q621 through network C604-R604. These transistors are complementary to provide best response to both positive-going and negative-going Z-Axis signals. Output transistors Q615 and Q619 are also complementary transistors connected in the collector-coupled configuration. The amplified signal at the collector of Q621 is connected to the emitter of Q619. These transistors maintain the low-frequency response of the input signal and provide a fast-falling edge on the output signal. Only the fast-changing portions of the amplified signal at the collector of Q607 are coupled to the emitter of Q615 through C613 and R613. Transistors Q607 and Q615 provide a fast-rising edge on the output signal. The signal at the collectors of Q615 and Q619 is connected to the Control-Grid Supply through R625. The Z-Axis Amplifier is frequency stabilized by feedback from the output to the input through C622, R622, and R623. Capacitor C622 is adjustable to provide a fast-rise unblanking gate output

signal with a minimum of overshoot and ringing. Otherwise, the crt display would vary in intensity level following sudden changes in blanking levels.

High-Voltage Oscillator

Power for operation of the high-voltage supply is provided between the +15-Volt Supply and ground. At the time of turn-on, diode CR716 disconnects the negative side of the supply voltage from the collector of Q716. This allows the starting base bias current for the High-Voltage Oscillator to be supplied from the +15-Volt Supply through R716-Q716 and the base feedback windings of transformer T738. As the output of the high-voltage supply increases to its required output level, the collector of Q716 goes negative until CR716 is forward biased. Then, the collector level of Q716 is clamped about 0.6 volt more negative than the ground potential. This configuration provides a controlled starting current for the High-Voltage Oscillator at turn-on, and at the same time allows the High-Voltage Regulator stage to control the current for the High-Voltage Oscillator after the stage reaches operating potentials to provide a regulated high-voltage output.

Transistors Q764-Q766 and the associated circuitry compose an oscillator to drive high-voltage transformer T738. When the instrument is turned on, assume that Q764 comes into conduction first. The collector current of Q764 produces a corresponding current increase in the base-feedback winding of T738 to further increase the bias on Q764. At the same time, the voltage developed across the base-feedback winding connected to Q766 holds Q766 reverse biased.

As long as the collector current of Q764 continues to increase, voltage is induced into the base-feedback windings of T738 which holds Q764 forward biased and Q766 reverse biased. However, when the collector current of Q764 stabilizes, the magnetic field built up in T738 begins to collapse. This collapsing field induces a reversed current to flow into the base windings which reverse biases Q764, but forward biases Q766. When the induced voltage at the base of Q766 exceeds the bias set by the High-Voltage Regulator, Q766 conducts and the amplified current at its collector adds to the current flowing through T738 due to the collapsing field. Then, as the current through T738

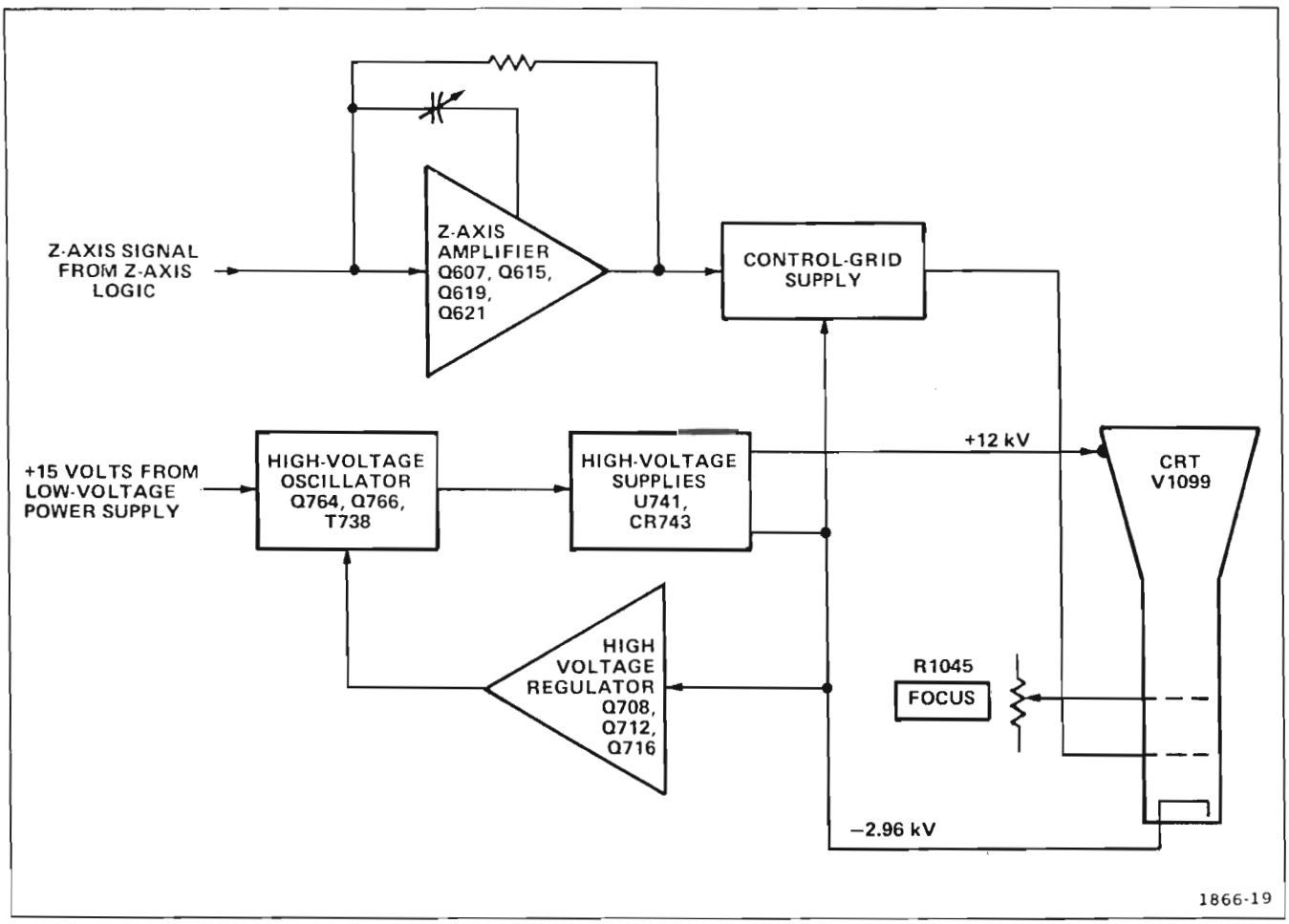


Figure 3-20. CRT Circuit detailed block diagram.

stabilizes again, the magnetic field around it once more begins to collapse. This reverses the conditions to start another cycle.

The signal produced across the primary of T738 is a sine wave at a frequency of 35 to 45 kilohertz. The amplitude of the oscillations in the primary of T738 is controlled by the High-Voltage Regulator to set the total accelerating potential for the crt. Filter network C722-L722 decouples high peak operating current from the +15-Volt Supply.

High-Voltage Regulator

A sample of the secondary voltage from T738 is connected to the High-Voltage Regulator stage through divider R700-R702A-R702B. Transistors Q708-Q712 are connected as an error amplifier to sense any change in the voltage level at the base of Q708. Ground potential, connected to the emitter of Q708 through R709, provides the reference level for this stage. The output voltage is set by the fixed values of the components in this circuit.

Regulation occurs as follows: If the output voltage at the −2960 V test point starts to go positive (less negative), a sample of this positive-going change is connected to the base of Q708 through R702B and R706. Both Q708 and Q712 are forward biased by this positive change, which in turn increases the conduction of Q716. This results in a greater bias current delivered to the bases of Q764-Q766 through Q716. Now, the bases of both Q764 and Q766 are biased closer to their conduction level so the feedback voltage induced into their base-feedback windings produces a larger collector current. This results in a larger induced voltage in the secondary of T738 to produce a more negative level at the −2960 V test point to correct the original error. In a similar manner, the circuit compensates for output changes in a negative direction. Since the amplitude of the voltage induced into the secondary of T738 also determines the output level of the positive High-Voltage Supply and the Control-Grid Supply, the total high-voltage output is regulated by sampling the output of the negative High-Voltage Supply.

High-Voltage Supplies

High-voltage transformer T738 has two output windings. One winding provides filament voltage for the crt. The other winding provides the negative and positive accelerating potentials for the crt and the bias voltage for the control grid. All of these voltages are regulated by the High-Voltage Regulator stage to maintain a constant output voltage as previously described.

Voltage quadrupler U741 supplies the positive accelerating potential for the crt anode. The voltage applied to the input of U741 from T738 secondary is about six kilovolts peak-to-peak resulting in an output of +12 kilovolts dc at the crt anode. The secondary winding of T738 also provides the negative accelerating potential for the crt cathode. Halfwave rectifier CR743 provides an output of about −2.96 kilovolts, which is connected to the crt cathode through R745. The cathode and filament are connected together through R765 to prevent cathode-to-filament breakdown due to a large difference in potential between these crt elements. A sample of the negative accelerating voltage is connected to the High-Voltage Regulator to maintain a regulated high-voltage output.

The network consisting of diodes CR750-CR752-CR756-CR757 provides the negative voltage for the control grid of the crt. The output level of this supply is set by CRT Grid Bias adjustment R759. Approximately 300 volts peak-to-peak from the secondary of T738 is connected to the Control-Grid Supply through C748 and R748. Diodes CR756 and CR758 clip this signal to determine the operating level at the control grid. CR756 limits the negative excursion of the signal. Quiescently, when the crt is blanked, the anode of CR756 is set at about +15 volts by the Z-Axis Amplifier stage. The positive clipping level at the cathode of CR757 is set by CRT Grid Bias adjustment R759. R759 is adjusted to bias the control grid of the crt just enough negative so the trace is blanked between sweeps. Under normal conditions, this biases the control grid about 80 volts more negative than the cathode.

The negative level at the crt cathode is connected to the cathode of CR752. This level is held constant by the High-Voltage Regulator as described previously. The clipped voltage developed by diodes CR756 and CR757 is superimposed on this negative voltage to result in a level at the grid of the crt which is more negative than the crt cathode level. C750 acts as a filter to provide a constant voltage output level. The unblanking gate level developed by the Z-Axis Amplifier stage is applied to the anode of CR756 through R625. The fast rising and falling portions of this signal are coupled directly to the output through C750. The overall effect of the unblanking gate is to further clip the negative excursions, thereby reducing the voltage difference between grid and cathode of the crt. This allows the cathode current of the crt to pass to the anode so the display can be viewed.

CRT Control Circuits

The focus of the display is determined by the setting of the FOCUS control R1045. This control is part of divider R702C, R1045, and R702D between the negative high-voltage supply and ground. Therefore, the voltage applied to the focus grid of the crt is more positive (less

negative) than the voltage on either the control grid or cathode. Astigmatism adjustment R636, which is used in conjunction with the FOCUS control to obtain a well-defined display, varies the positive level on the astigmatism grid. Geometry adjustment R630 varies the positive level on the horizontal deflection-plate shield to control the overall geometry of the display.

Two adjustments control the trace alignment by varying the magnetic field around the crt. The Y-Axis adjustment R633 controls the current through L1098, which affects the crt beam after vertical deflection, but before horizontal deflection. Therefore, it affects only the vertical (Y) components of the display. Trace Rotation adjustment R1025 controls the current through L1099 and affects both the vertical and horizontal rotation of the display.

LOW-VOLTAGE POWER SUPPLY ◈8◈

The Low-Voltage Power Supply circuit provides the operating power for this instrument from six regulated supplies. Electronic regulation is used to provide stable, low-ripple output voltages. Each supply contains a short-protection circuit to prevent instrument damage if a supply is inadvertently over-loaded or shorted to ground. Figure 3-21 shows a detailed block diagram of the Low-Voltage Power Supply circuit. A schematic of this circuit is shown on diagram 8 at the rear of this manual.

Power Input

Power is applied to the primary of transformer T801 through line fuses F1000 and F1001, thermal cutout S1000, and POWER switch S1001. The Voltage Selector Jumper P1001 (brown-colored plug), connects the two halves of the primary of T801 in parallel to select 115-volt (nominal) operation. Voltage Selector Jumper P1002 (red-colored plug), connects the two halves of the primary in series to select 230-volt (nominal) operation. Only one of the jumpers is connected into the primary circuit at any time; the remaining jumper becomes the spare jumper and should be stored on the spare-jumper pins provided on the Rectifier board. The line fuses, F1000 and F1001, must be changed to provide the correct protection for 230-volt nominal operation.

Each half of the primary of T801 has taps above and below the 115-volt or 230-volt nominal point. When the Voltage Selector Jumper is moved from Low to Med to Hi pin positions, more turns are effectively added to the primary winding and the turns ratio is decreased to compensate for the increased primary voltage. This configuration extends the regulating range of the Oscilloscope power supplies.

Thermal cutout S1000 provides thermal protection for this instrument. If the internal temperature of the instrument exceeds a safe operating level, S1000 opens to interrupt the applied power. When the temperature returns to a safe level, S1000 automatically closes to reapply the power.

–50-Volt Supply

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

The 50-Volt Rectifier assembly CR808 rectifies the output at the secondary of T801 to provide the unregulated voltage source for both the –50- and +50-volt supplies. Diode CR808 is connected as a bridge rectifier and its output is filtered by C808-C809. Transistors Q886, Q896, Q900 operate as a feedback-stabilized regulator circuit to maintain a constant –50-volt output level. Transistor Q886 is connected as a differential amplifier to compare the feedback voltage at the base of Q886B against the reference voltage at the base of Q886A. The error output at the collector of Q886B reflects the difference, if any, between these two inputs. The change in error-output level at the collector of Q886B is always opposite in direction to the change in the feedback input at the base of Q886B (out of phase).

Zener diode VR890 sets a reference level of about –9 volts at the base of Q886A. A feedback sample of the output voltage from this supply is connected to the base of Q886B through divider R880-R881-R882. Potentiometer R881 in this divider is adjustable to set the output level of this supply. Notice that the feedback voltage to this divider is obtained from a line labeled –50 Volt Sense. Figure 3-22 illustrates the reason for this configuration. The inherent resistance of the interconnecting wire between the output of the –50-Volt Supply and the load produces a voltage drop which is equal to the output current multiplied by the resistance of the interconnecting wire. Even though the resistance of the wire is small, it results in a substantial voltage drop due to the high output current of this supply. Therefore, if the feedback voltage were obtained ahead of this drop, the voltage at the load might not maintain close regulation. However, the –50 Volt Sense feedback configuration overcomes this problem since it obtains the feedback voltage from a point as close as practical to the load. Since the current in the –50 Volt Sense line is small and constant, the feedback voltage is an accurate sample of the voltage applied to the load.

Regulation occurs as follows: If the output level of this supply decreases (less negative) due to an increase in load

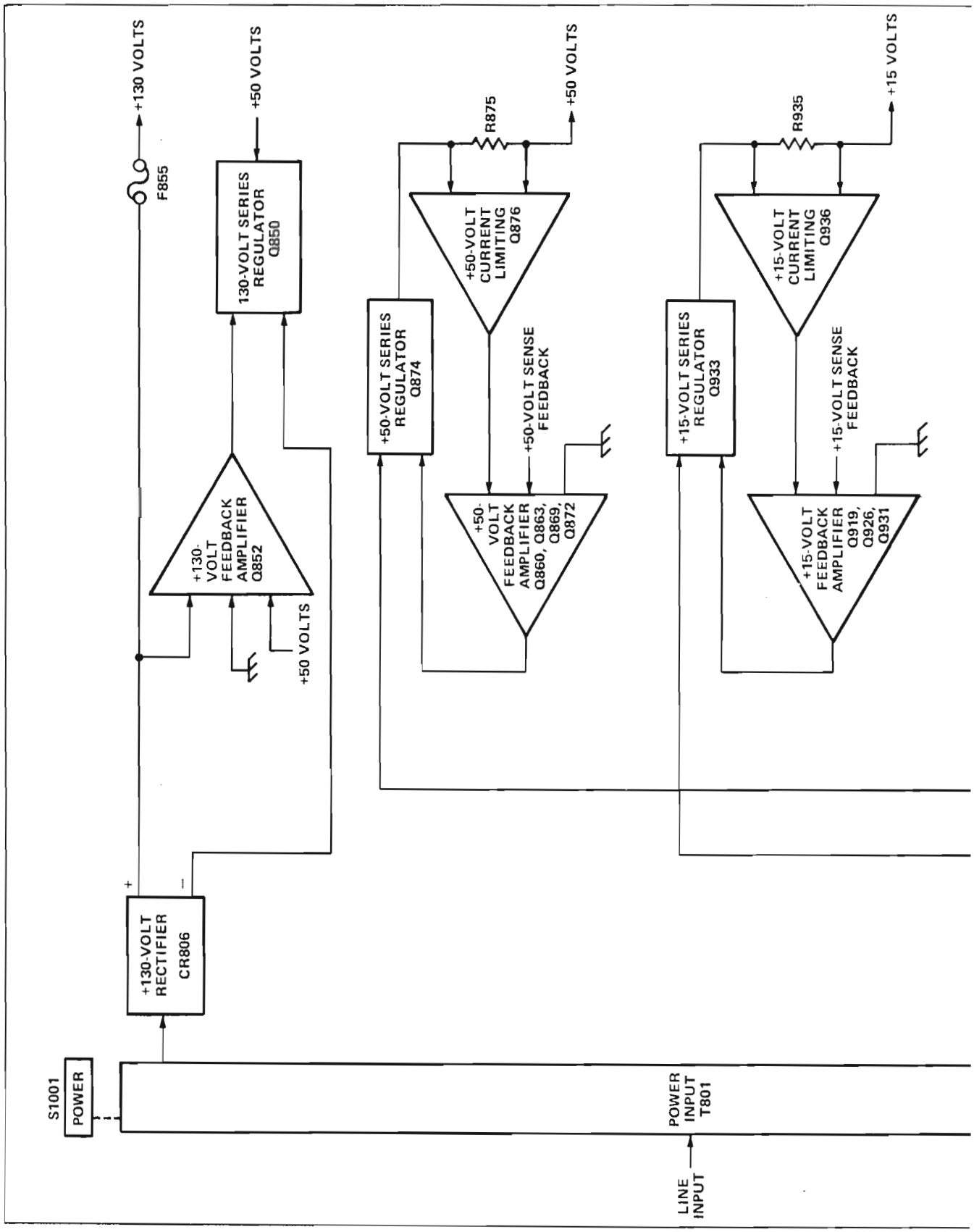


Figure 3-21. Low-Voltage Power Supply detailed block diagram.

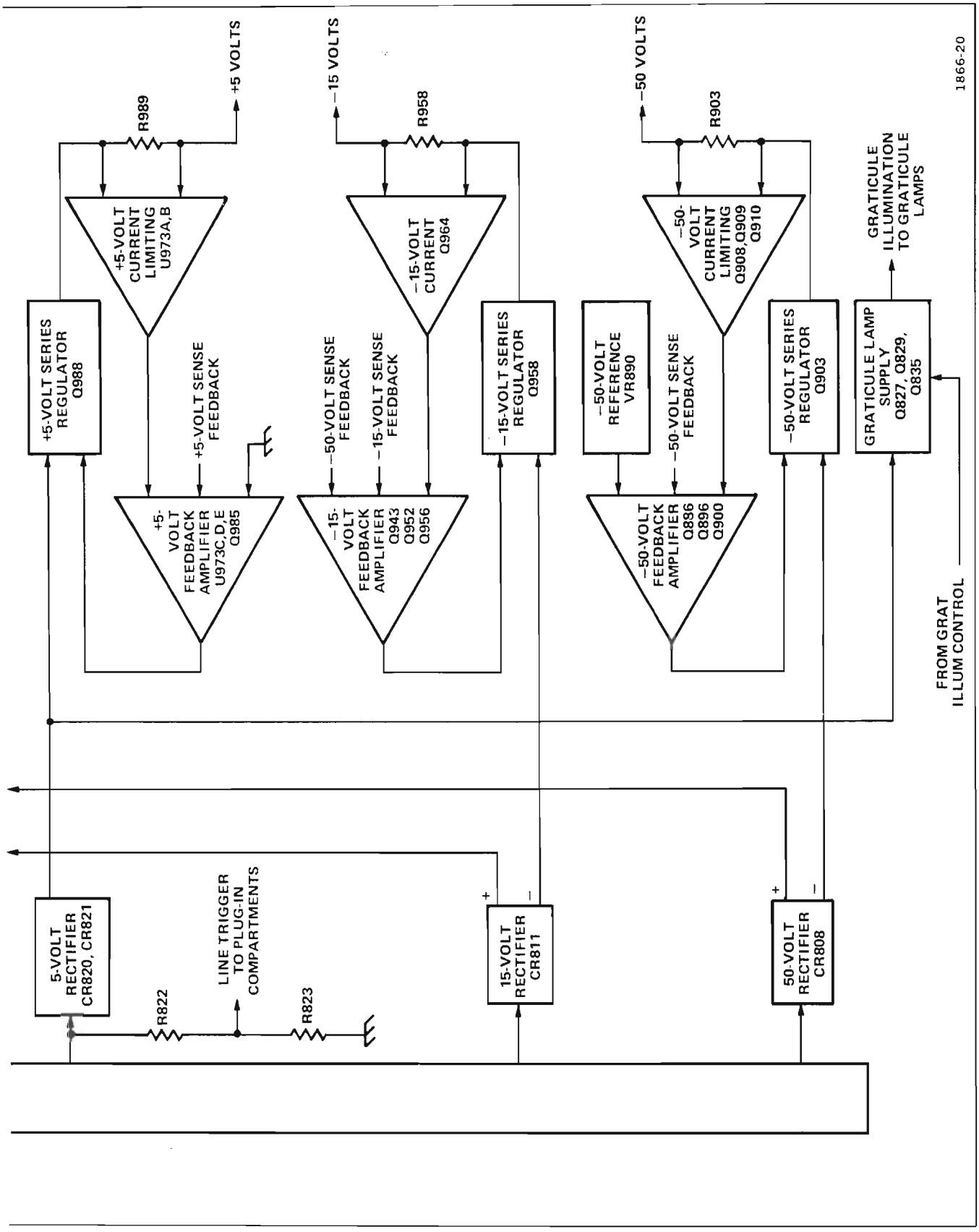


Figure 3-21 (cont.). Low-Voltage Power Supply detailed block diagram.

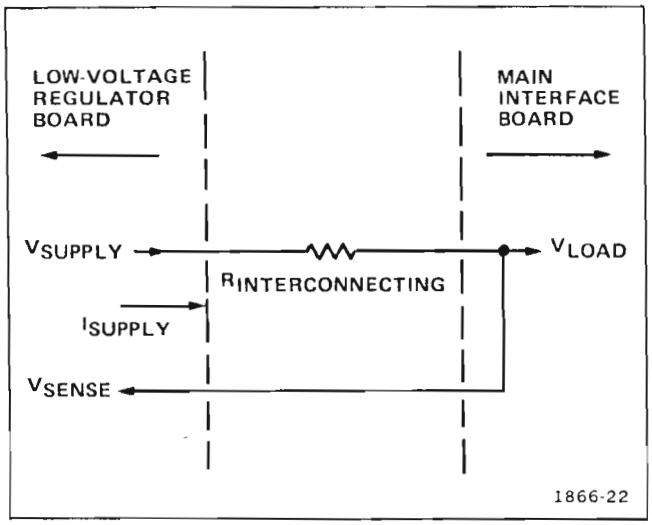


Figure 3-22. The voltage drop between the supply output and the load is overcome because feedback voltage is sensed at the load.

or a decrease in input voltage (as a result of line voltage changes or ripple), the voltage across divider R880-R881-R882 decreases also. This results in a more positive feedback level at the base of Q886B than that established by the −50 Volt Reference stage at the base of Q886A. Since the transistor with the more positive base controls the conduction of the differential amplifier, the output current at the collector of Q886B increases. This increase in output from Q886B allows more current to flow through Q896 and Q900 to result in increased conduction of −50 Volt Series Regulator Q903. The load current increases and the output voltage of this supply also increases (more negative). As a result, the feedback voltage from the −50 Volt Sense line increases and the base of Q886B returns to the same level as the base of Q886A. Similarly, if the output level of this supply increases (more negative), the output current of Q886B decreases. The feedback through Q896 and Q900 reduces the conduction of the −50 Volt Series Regulator to decrease the output voltage of this supply.

The −50 Volts adjustment, R881, determines the divider ratio to the base of Q886B and thereby determines the feedback voltage. This adjustment sets the output level of the supply in the following manner: If R881 is adjusted so the voltage at its variable arm goes less negative (closer to ground), this appears as an error signal at the base of Q886B. In the same manner as described previously, this positive-going change at the feedback input of the differential amplifier increases the conduction of the −50 Volt Series Regulator to increase current to the load, and thereby increase the output voltage of this supply. This places more voltage across divider R880-R881-R882, and the divider action returns the base of Q886B to about −9 volts. Notice that the feedback action of this supply forces a change in the output level which always returns the base of Q886B to the same level as the base of Q886A. In this manner, the output level of the −50-Volt Supply can be set to exactly −50 volts by correct adjustment of R881.

The −50 Volt Current Limiting stage, Q908-Q909-Q910, protects the −50-Volt Supply if excess current is demanded from this supply. All of the output current from the −50-Volt Supply flows through R903. Transistor Q908 senses the voltage at the collector of the −50 Volt Series Regulator Q903 and compares it against the −50 V output level at the base of Q909 which is obtained from the other side of R903. Under normal operation, Q908 is held in conduction and Q909 is off. However, when excess current is demanded from the −50 Volt Series Regulator due to a short circuit or similar malfunction at the output of this supply, the voltage drop across R903 increases until the base of Q908 goes more negative than the level at the base of Q909. Then Q909 takes over conduction of the comparator. The collector current of Q909 increases the voltage drop across R896 to reduce the conduction of Q896 in the −50 Volt Feedback Amplifier and limit the conduction of Q903. Transistor Q910 is connected as a constant current source for Q908-Q909.

−15-Volt Supply

Basic operation of all stages in the −15-Volt Supply is the same as for the −50-Volt Supply. Reference level for this supply is established by divider R945-R946 between ground and the −50 Volt Sense voltage. The divider ratio of R945-R946 sets a level of −15 volts at the base of Q943A. The level on the −50 Volt Sense line is held stable by the −50-Volt Supply as described previously. The −15 Volt Sense voltage is connected to the base of Q943B through R940. Any change at the output of the −15-Volt Supply appears at the base of Q943B as an error signal. The output voltage is regulated in the same manner as described for the −50-Volt Supply.

+5-Volt Supply

Basic operation of the +5-Volt Supply is the same as described for the previous supplies. Five-transistor array, U973, and the associated circuitry (except for Q985) compose the +5-Volt Current Limiting and +5-Volt Feedback Amplifier. Notice that both U973C and Q985 in the +5-Volt Feedback Amplifier are connected as emitter followers, since inversion is not necessary in the feedback path for positive output voltages. Reference voltage for the +5-Volt Feedback Amplifier stage is established by divider R970-R971 between the +5-Volt Sense and −50-Volt Sense Feedback voltages. This divider establishes a quiescent level of about 0 volt at the base of U973E.

+15-Volt Supply

The +15-Volt Supply operates in the same manner as described for the previous supplies. The reference level for the +15-Volt Feedback Amplifier is established by R915-R916 between the +15-Volt Sense and the −50-Volt Sense voltages. This divider provides a quiescent level of about 0 volts at the base of Q919B.

+50-Volt Supply

Operation of the +50-Volt Supply is the same as described for the previous supplies. The unregulated +130-Volt Supply, from the +130-Volt Rectifier CR806, is used to provide a positive starting voltage for the +50-Volt Supply.

+130-Volt Supply

The +130-Volt Rectifier CR806 provides the rectified voltage for the +130-Volt Supply. However, this secondary winding of T801 does not supply the full potential necessary to obtain the +130-volt output level. To provide the required output level, the +50-Volt Supply is connected in series with this supply through Q850. Basic regulation of the output voltage is provided by +130-Volt Feedback Amplifier Q852, and +130-Volt Series Regulator Q850.

The output voltage of this supply is connected across divider R855-R856. This divider provides a quiescent level of about +50 volts at the base of Q852. The reference level for this supply is provided by the +50-Volt Supply connected to the emitter of Q852. If the output of this supply changes, the change is sensed by Q852 and an amplified error signal is connected to the base of Q850. This error signal changes the conduction of the +130-Volt Series Regulator Q850 to correct the output error. Fuse F855 protects this supply if the output is shorted. However, since the response time of F855 is slow to a shorted condition, VR851 provides additional current to the base of Q850 to protect Q852 from damage. Diode CR852 limits the reverse bias on Q852 to about 0.6 volt when fuse F855 is blown.

Graticule Lamp Supply

Power for the graticule lamps is supplied by the Graticule Lamp Supply. Rectified voltage for this supply is provided by 5-Volt Rectifier CR820-CR821. Q835 operates as a series regulator transistor. Emitter follower Q829 determines the conduction of this series regulator as controlled by front-panel GRAT ILLUM control R1095. Current-limiting to protect this supply is provided by Q827. Under normal operation, divider R830-R831-R833 sets the base of Q827 below its conduction level. However, if excess current is demanded from this supply, the voltage drop across R837-R838 increases until Q827 comes into conduction. The collector of Q827 then limits the conduction of this supply to limit its output current.

Line Trigger

Divider R822-R823 provides a sample of the line voltage in the secondary of T801 to the plug-in unit. This provides a line-frequency reference to the plug-in units for internal triggering at line frequency or for other applications.

MAINTENANCE

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

CABINET REMOVAL

WARNING

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

The cabinet sides are held in place by six latches. To remove the cabinet sides, turn the latches 90 degrees and pull the sides away from the carrying handle. Then, lift the cabinet sides away from the instrument. The cabinet bottom is held in place with two latches and four screws.

The cabinet sides protect this instrument from dust in the interior, and also provide protection to personnel from the operating voltages present. They also reduce the electromagnetic radiation from this instrument or interference to the display due to other equipment.

A cover on the rear of the instrument, held in place with four screws, allows access to the power supply regulating transistors.

POWER-UNIT REMOVAL

The power unit can be pulled partially out of the back of the Oscilloscope to gain access to the Logic and Rectifier circuit boards and for power-unit maintenance. The power unit can remain connected to the rest of the instrument so that it can be operated in this position for troubleshooting. To remove the power unit, use the following procedure:

1. Remove the cabinet sides (see Cabinet Removal).

2. Remove the three screws securing each side of the power unit to the Oscilloscope chassis.

3. Slide the power unit rearward until interconnecting cable slack is removed or disconnect the cables and remove the power unit out of the Oscilloscope until it can be set down on the work surface (guide the cables so they do not catch on other parts of the instrument).

PREVENTIVE MAINTENANCE

GENERAL

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

CLEANING

The Oscilloscope 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 cabinet provides protection against dust in the interior of the instrument. Operation without the cabinet 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.

Exterior

Loose dust accumulated on the outside of the Oscilloscope 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.

Cathode-Ray Tube

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

The crt mesh filter 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 this 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 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 within the high-voltage shield and the area surrounding the post-deflection anode lead, should receive special attention. Excessive dirt in these areas may cause high-voltage arcing and result in improper instrument operation.

LUBRICATION

The reliability of potentiometers, switches, and other moving parts can be maintained if they are kept properly lubricated. However, over-lubrication is as detrimental as too little lubrication. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc. Order Part 003-0342-01.

VISUAL INSPECTION

The Oscilloscope should be inspected occasionally for such defects as broken connections, improperly seated semiconductors, damaged or improperly installed circuit boards, and heat-damaged parts. The corrective procedure for most visible defects is obvious; however, particular care must be

taken if heat-damaged 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 Oscilloscope are not recommended. The best cneck of semiconductor performance is actual operation in the instrument. More details on checking semiconductor operation are given under Troubleshooting in this section.

CALIBRATION

To ensure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or every 6 months if used infrequently. In addition, replacement of components may necessitate calibration of the affected circuits. The calibration procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed and/or corrected by calibration.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting of the Oscilloscope. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles, particularly where integrated circuits are used. See Section 3, Theory Of Operation, for complete information.

TROUBLESHOOTING AIDS

Circuit 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 the first page of the Diagrams section for definition of the reference designators and symbols used to identify components in this instrument. Important voltages and waveforms are also provided on circuit diagrams. See Table 4-1 for a listing of major circuits in the Oscilloscope and the series of component numbers assigned to each circuit.

Component Location Illustrations

In the Diagrams section, to aid in locating circuit components on circuit boards, a circuit board illustration is provided preceding the circuit diagram. Each electrical component of the circuit diagram is identified by its circuit number to facilitate rapid physical location and to aid in cross-referencing between diagrams and illustrations.

TABLE 4-1
Major Circuit Component Numbers

Circuit Number Series	Name of Circuit	Diagram Number
1 - 49, P90, P91	Main Interface	1
55 - 199	Logic and Output Signals	2
300 - 359	Trigger Selector	3
200 - 269	Vertical Interface	3
400 - 499	Vertical Amplifier	4
500 - 599	Horizontal Amplifier	5
1000 - 1099 (See LV Power Supply and CRT Circuit for more 1000-series numbers)	Calibrator and Front Panel Switching	6
600 - 799, R1025, L1099, R1099	CRT Circuit	7
800 - 999	LV Power Supply	8

Circuit Board Locations

Figure 7-2, located on the first page of the Diagrams section, shows the location of the circuit boards within this instrument along with their assembly numbers. The assembly numbers are used on the diagrams to aid in identifying circuit boards with their associated components.

Adjustment Location Illustrations

To aid in locating test points and adjustable components, Adjustment Location illustrations (normally used with the Calibration procedure) permit very rapid location of test points and adjustments. The Adjustment Locations pull-out pages will be found in the rear of the Diagrams section.

Semiconductor Lead Configurations

The lead configurations of most semiconductor devices used in this instrument are shown in Figure 7-1 on the first page of the Diagrams section.

Main Interface Connector Contact Locations

The Main Interface circuit board connects the amplifier and time-base plug-in units to the Oscilloscope. Diagram 1, in the Diagrams section, shows the locations of contacts on the Main Interface circuit board as viewed from the front of the instrument. When viewing the board from the rear, the left-hand vertical row of each plug-in connector corresponds to the (B) series of numbers indicated on Diagram 1. The right-hand row of each connector corresponds to the (A) series of numbers. The individual contacts are numbered beginning at the bottom of the instrument.

Resistor Color-Code

In addition to the brown composition resistors, some metal-film resistors are used in the Oscilloscope. The resistance values of composition resistors and metal-film resistors are color-coded on the components according to EIA standards. The color-code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes, which consist of two significant figures, a multiplier, and a tolerance value (see Figure 4-1). Metal-film resistors have five stripes consisting of three significant figures, a multiplier, and a tolerance value. Components not color-coded usually have the value printed on the body.

Capacitor Color Code

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

Diode Color Code

The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes, or a dot. For most silicon or germanium diodes with a series of stripes, the color code identifies the four significant digits of the JEDEC or vendor number using the resistor color-code system (e. g., a diode color coded yellow-brown-green-red indicates a IN-4152 diode).

Multi-Pin Connector Color Code

The multi-pin connectors used for interconnection between circuit boards are color coded to aid in circuit tracing. The color of the connector body matches the resistor color code for the last digit of the circuit number; e. g., P601 is brown, P603 is orange, etc.

TROUBLESHOOTING EQUIPMENT

The following equipment is useful for troubleshooting the Oscilloscope.

1. Semiconductor Tester

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

Purpose: To test the semiconductors used in this instrument.

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

2. Test Oscilloscope

Description: Frequency response, dc to 25 megahertz or greater; deflection factor, 5 millivolts to 5 volts/division; sweep rate, to at least 20 nanoseconds/division; input resistance, 1 megohm. A 10X, 10-megohm voltage probe should be used to reduce circuit loading for waveform measurements.

Purpose: To check operating waveforms in this instrument.

Recommended Type: Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System or equivalent. Use a Tektronix P6006 10X Probe.

COLOR CODE

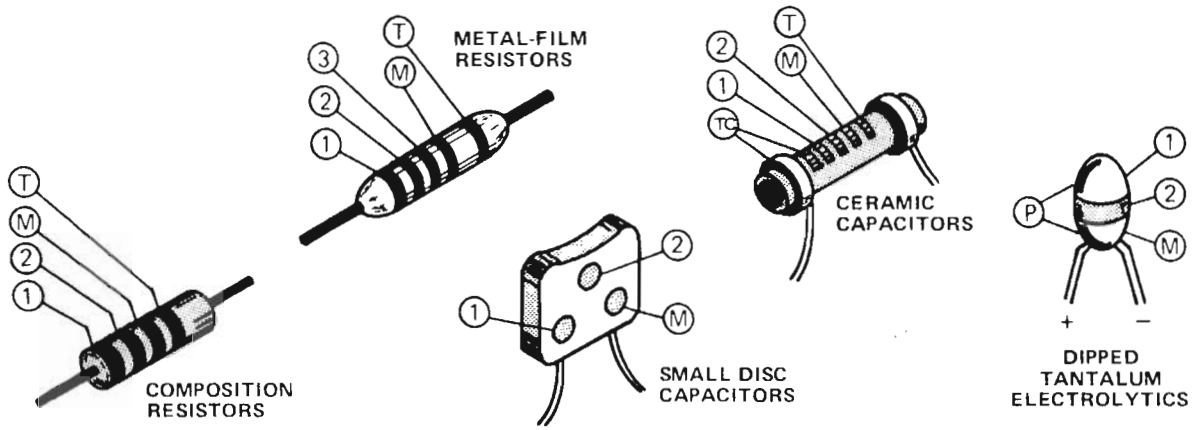
(1) (2) AND (3) - 1st, 2nd, AND 3rd SIGNIFICANT FIGS.

(M) - MULTIPLIER; (T) - TOLERANCE;

(TC) - TEMPERATURE COEFFICIENT.

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

(P) - POSITIVE (+) POLARITY AND VOLTAGE RATING.



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

(1862-74) 1866-57

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

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 in this instrument.

Recommended Type: Tektronix DM501 Digital Multimeter (requires a TM500-series power module).

4. Variable Autotransformer

Description: Output variable from 0 to 140 volts, 2 amperes minimum rating. Must have three-wire power cord, plug, and receptacle.

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

Recommended type: General Radio W10MT3W Variac Autotransformer.

TROUBLESHOOTING TECHNIQUES

This troubleshooting procedure is arranged in an order which 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 aid in locating the defective component. When the defective component is located, it should be replaced using the appropriate replacement procedure given under Corrective Maintenance in this section.

Troubleshooting

1. CHECK CONTROL SETTINGS. Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of this manual.

2. CHECK ASSOCIATED EQUIPMENT. Before proceeding with troubleshooting of the Oscilloscope, check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the probe (if used) is not defective. A plug-in unit can be checked for proper operation by substituting another unit which is known to be operating properly (preferably a similar unit). If the trouble persists after substitution, the Oscilloscope is probably at fault.

3. VISUAL CHECK. Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visible indications such as unsoldered connections, broken wires, damaged components, etc.

4. 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 a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in the Calibration section of this manual.

5. ISOLATE TROUBLE TO A CIRCUIT. To isolate a trouble to a particular circuit, note the trouble symptom. The symptom often indicates the circuit in which the trouble is located. For example, poor focus indicates that the crt circuit (includes the high-voltage supplies) is probably at fault.

When trouble symptoms appear, use the front-panel controls and the crt display to isolate the trouble to one circuit. Remember, the amplifier unit or the time-base unit may be responsible for the trouble. When trouble appears in more than one circuit, check all affected circuits by taking voltage and waveform measurements.

Power Supply. Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. A defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits. Table 4-2 lists the voltages and tolerances of the power supplies in this instrument. These voltages are measured between the power-supply test points and ground. 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.

If incorrect operation of the power supplies is suspected, connect the Oscilloscope to a variable autotransformer. Then, check for correct regulation with a dc voltmeter and correct ripple with a test oscilloscope while varying the autotransformer throughout the regulating range of this instrument. Table 4-2 lists the typical 120-hertz ripple of the power supplies in this instrument (measured peak-to-peak).

Figure 4-2 provides a guide for locating a defective circuit. Start at the top of the chart and perform the checks given on the left side of the page until a step is found that does not produce the indicated results, then perform the checks

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

TABLE 4-2

Power Supply Voltage, Tolerance, and Ripple

Power Supply	Test Point Location[1]	Output Voltage and Tolerance	Typical 120 Hz Ripple (P-P)
−50 V	P901-Pin 1 (on Regulator Board)	−50 ± 0.1 V	5 mV
−15 V	P901-Pin 2	−15 ± 0.3 V	2 mV
+5 V	P901-Pin 3	+5 ± 0.15 V	2 mV
+15 V	P901-Pin 4	+15 ± 0.3 V	2 mV
+50 V	P901-Pin 5	+50 ± 0.6 V	5 mV
+130 V	F855 (under carrying-handle frame, rear)	+130 ± 5.2 V	300 mV

6. CHECK VOLTAGES AND WAVEFORMS. Often the defective component(s) can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given on the diagrams in the Diagrams section.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the voltages and waveforms page with each schematic diagram. On this page, note the recommended test equipment, front-panel control settings, voltage and waveform conditions, and test equipment cable connection instructions.

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

[1] For test point locations, see ADJUSTMENT LOCATIONS 1 pullout page.

CAUTION

Power must be disconnected from the instrument before removing or replacing components to avoid damage to any components.

Transistors. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can be checked by substituting a new component 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 (such as a Tektronix 576 Curve Tracer).

When troubleshooting transistors 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 the device is open, no voltage will be developed across resistances in series with it unless current is being supplied by a parallel path.

Integrated Circuits. Integrated circuits (IC's) should not be replaced unless they are actually defective. The best method for checking these devices is by direct substitution with a new component or one which is known to be good. Be sure that the circuit conditions are not such that a replacement component might be damaged. 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. 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. The lead configurations of most semiconductor devices used in this instrument are shown in Figure 7-1 on the first page of the Diagrams section.

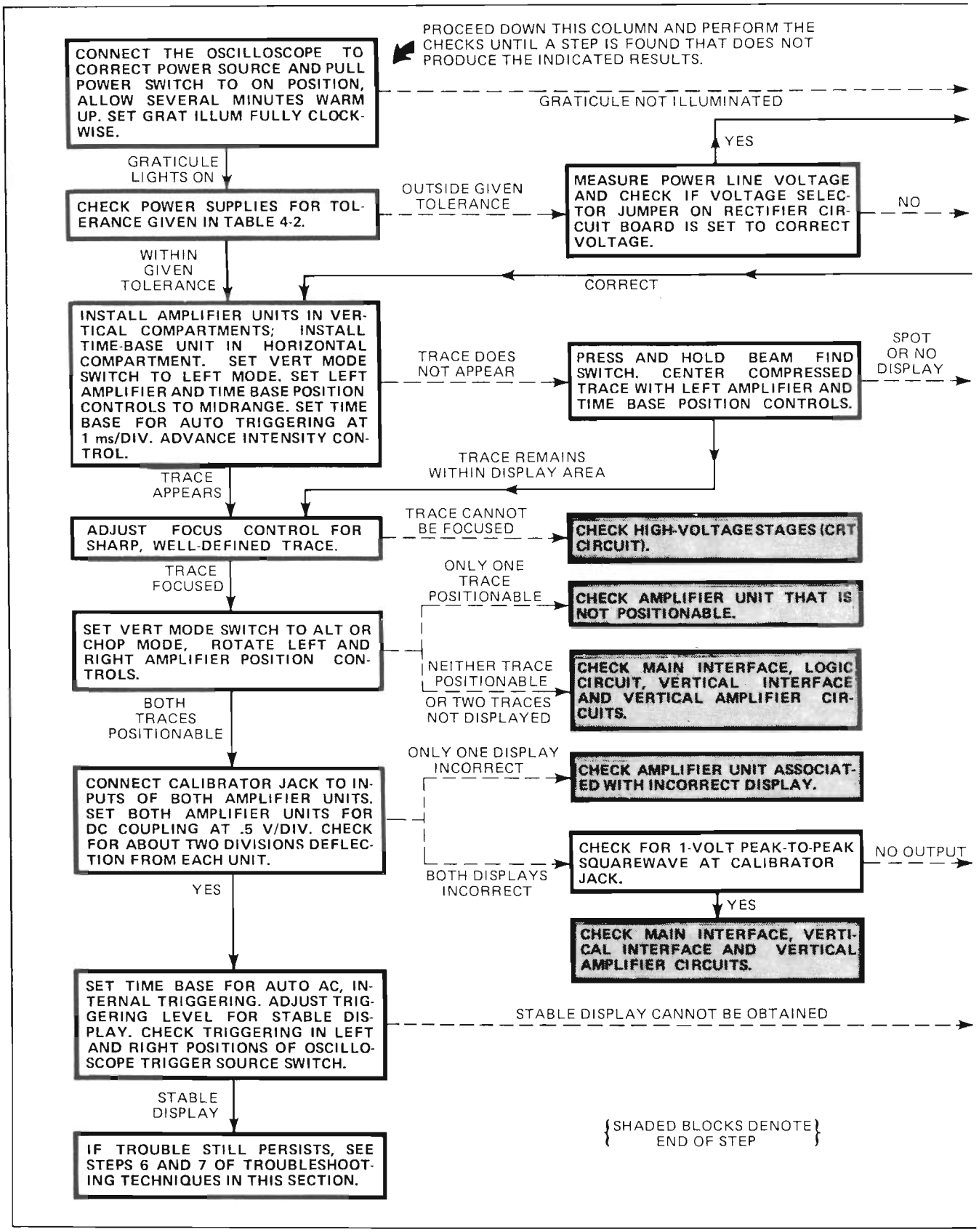


Figure 4-2. Oscilloscope troubleshooting chart.

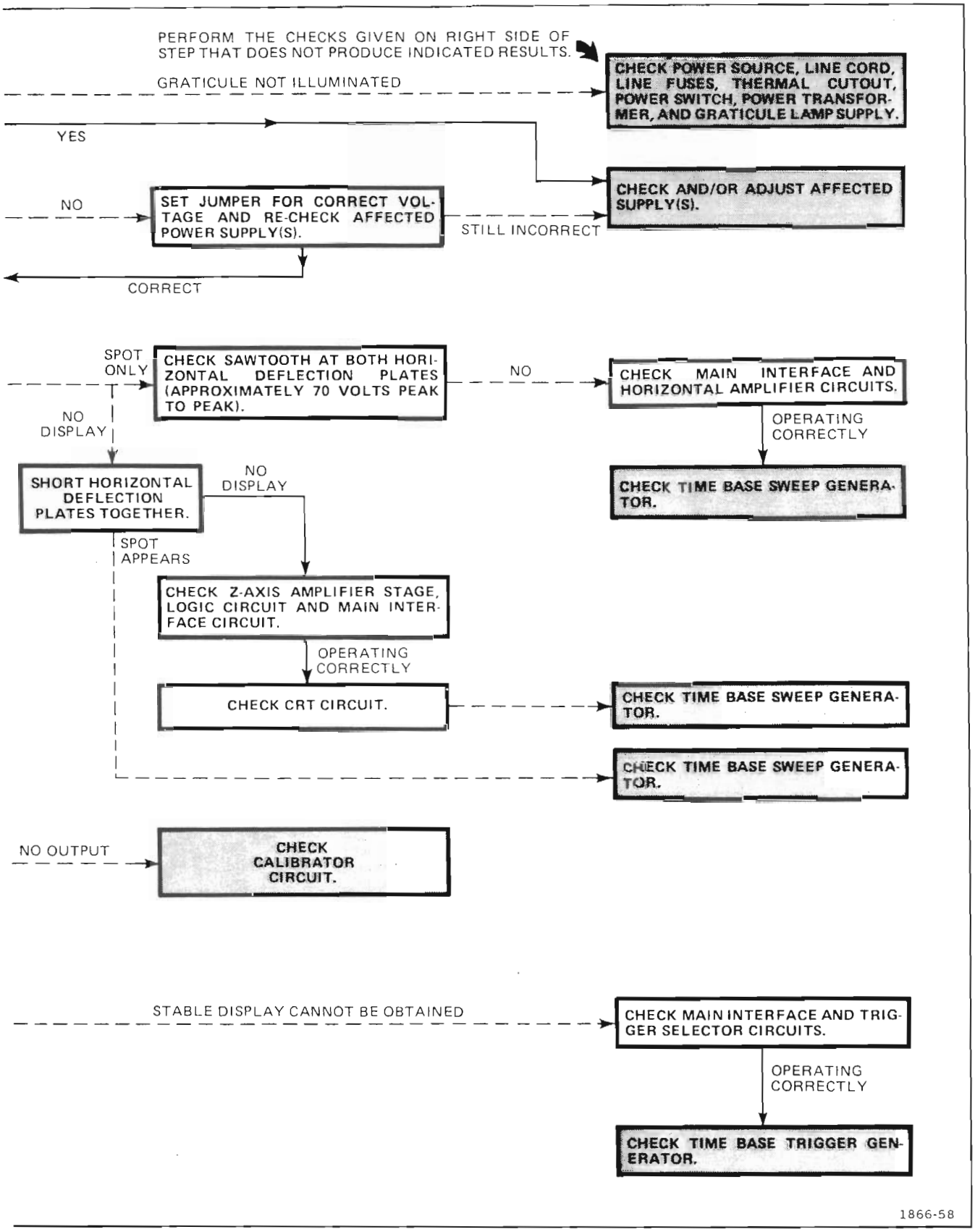


Figure 4-2 (Continued). Oscilloscope troubleshooting chart.

Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals after disconnecting one end from the circuit. With an ohmmeter set to the R x 1k scale, the resistance should be very high in one direction and very low when the leads are reversed.

Voltmeter checks on diodes can be performed in much the same manner as on transistor emitter-to-base junctions. Silicon diodes should have 0.6 to 0.8 volt across the junction when conducting. Higher reading indicate that they are either back biased or defective, depending on polarity.

Resistors. Check the resistors with an ohmmeter after disconnecting one end from the circuit. Check the Replaceable Electrical Parts list in Section 6 for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

Capacitors. A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter, on the highest scale, after dsiconnecting one end from the circuit. Do not exceed the voltage rating of the capacitor (some ohmmeters use 30 volts as source voltage). The resistance reading should be high after initial charge of the capacitor. An open capacitor can also be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

CAUTION

Observe ohmmeter polarity when checking electrolytic capacitors. Wrong polarity may damage the capacitor under test.

8. REPAIR AND ADJUST THE CIRCUIT. If any defective parts are located, use the appropriate replacement procedures given in this section under Corrective Maintenance. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced. Calibration of the affected circuit may be necessary.

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 the Oscilloscope can be obtained through your local Tektronix Field Office or representative. However, many of the 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 Replaceable Electrical Parts list in Section 6 for value, tolerance, rating and description. To determine the manufacturer of a part, note the number listed under Mfr. Code in the Parts List and refer to a Cross Index Mfr. Code Number to Manufacturer listing at the beginning of the Parts List.

NOTE

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

Special Parts

In addition to the standard electronic components, some special parts are used in this instrument. These parts are manufactured or selected by 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,, it is imperative that all of the following information be included in the order to ensure receiving the proper parts.

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include the circuit number).
4. Tektronix Part number.

SOLDERING TECHNIQUES

WARNING

High voltage and current levels are present in this instrument. To avoid electrical shock, 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 15- 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 circuit boards in this instrument are multi-layer boards with a conductive path(s) laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to the center conductor(s); only experienced maintenance personnel should attempt repair on these boards.

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

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board, as it may damage the board.

2. When the solder begins to melt, pull the lead out gently. If unable to pull the lead without using force, try removing the other end of the component as it may be more easily removed.

NOTE

The reason that some component leads seem troublesome to remove is due to a bend placed on each lead during machine insertion of the component in the manufacturing process. The purpose of the bent leads is to hold the component in place during a flow-soldering manufacturing process that solders all components at once.

If a component lead is extremely difficult to remove, it may be helpful to straighten the leads on the back side of the board with a small screwdriver or pliers while heating the soldered connection.

Unsolder the component from the circuit board, using heat on the component lead so that the solder will stay behind on the board. If it is desired to remove solder from a circuit-board hole for easier installation of a new component, use a vacuum-type desoldering tool or a solder-removing wick.

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

6. Clean the area around the solder connection with a flux-remover solvent. Be careful not to remove information printed on the board.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

To avoid electrical shock, disconnect the instrument from the power source before replacing components.

Semiconductors

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

CAUTION

Power must be disconnected before removing or replacing semiconductors to avoid component damage.

Replacement semiconductors should be of the original type or a direct replacement. The lead configuration of most semiconductors used in this instrument are shown in Figure 7-1 on the first page of the Diagrams section. 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 used for metal-case 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 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 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 the pins may be damaged.

Interconnecting Pins

Two methods of interconnection are used in this instrument to connect the circuit boards with other boards and components. Some interconnections are made with a pin soldered onto the board. Two types of mating connections are used for these interconnecting pins. If the mating connector is mounted on a plug-on circuit board, a special socket is soldered into the board. If the mating connector is on the end of a lead, an end-lead pin connector is used which mates with the interconnecting pin. The following information provides the replacement procedure for the various interconnecting methods.

CIRCUIT-BOARD PINS. A circuit-board pin replacement kit including necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order Tektronix Part 040-0542-00. Replacement of circuit-board pins on multilayer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.

To replace a pin which is mounted on a circuit board, first disconnect any pin connectors. Unsolder the damaged pin and pull it out of the circuit board with a pair of pliers (see Soldering Techniques, in this section, for recommended soldering and unsoldering procedures). Be careful not to damage the wiring on the board with too much heat. The ferrule on the pin may or may not disconnect from the hole with the damaged pin. If the ferrule remains in the circuit board, remove the ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the original ferrule is removed with the damaged pin, clean out the hole using soldering-iron heat, a solder-removing wick, and a scribe. Press the replacement pin with attached ferrule into the circuit-board hole. Position the replacement pin in the same manner as the removed pin. Solder the pin to the circuit board on each side of the board. If the removed pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

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

CAUTION

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

END-LEAD PIN CONNECTORS. The pin connectors used to connect wires to the inter-connecting 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 appears on the circuit board 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.

MAIN INTERFACE CONNECTOR PINS. The individual contacts of the interface connectors can be replaced. However, it is recommended that the entire Main Interface board be replaced if a large number of contacts are damaged. An alternative solution is to refer the maintenance of the Main Interface board to your local Tektronix Field Office or representative. Use the following procedure to replace an individual contact of the interface connector.

1. Remove the Main Interface circuit board from the instrument as described under Circuit Board Replacement—Main Interface Circuit Board.

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

3. Unsolder and remove the damaged contact.

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

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

6. Replace the Main Interface board.

Circuit Boards

If a circuit board is damaged beyond repair, the entire assembly including all soldered-on components should be replaced. Part numbers are given in Section 6 (Replaceable Electrical Parts) for the completely wired board.

To aid in identifying and locating circuit boards in the instrument, see Figure 7-2 on the first page of the Diagrams section for board locations, names, and assembly numbers. Determine the circuit board to be removed or replaced, find the name of the board listed within this procedure, and follow the removal and replacement instructions. To aid in identifying small components described in this procedure, use the diagrams in Section 8--Replaceable Mechanical Parts.

Most of the circuit boards in this instrument are mounted on the chassis; pin connectors are used for interconnection with other circuits. Use the following procedure to remove the chassis-mounted circuit boards (removal instructions for the exceptions will be given later).

CHASSIS-MOUNTED BOARDS. To replace a circuit board:

1. Disconnect any pin connectors on the board or connected to other portions of the instrument. Note the order of these connectors so they can be correctly replaced.

2. Remove the securing screws.

3. Remove the board.

4. To replace the board, reverse the order of removal. Match the arrows on the multi-pin connectors to the arrows on the board. Correct location of the pin connectors is shown in the circuit board illustrations in the Diagrams section.

TRIGGER SELECTOR AND VERTICAL INTERFACE CIRCUIT BOARDS. The Trigger Selector and Vertical Interface circuit boards plug onto the front of the Main Interface circuit board. Use the following procedure to replace either board:

1. Remove the securing screws.

2. Pull out on the edges of the board until the board clears the interconnecting terminals. Hold the board parallel to the Main Interface board until the board is free, so as not to bend the interconnecting terminals.

3. To replace the circuit board, position it so the interconnecting pins and sockets mate properly.

4. Gently press the circuit board against the mounting surface. Be sure that all the interconnecting pins and sockets mate properly.

5. Replace the securing screws.

LOGIC CIRCUIT BOARD. To remove the circuit board:

1. Slide out the power unit as described under Power-Unit Removal at the beginning of this section.

2. Disengage the plastic retainers which secure the sides of the board.

3. Pull out on the edges of the board until the board clears the interconnecting terminals. Hold the board parallel to the Main Interface board until the board is free, so as not to bend the interconnecting terminals.

4. To replace the Logic board, position it so the guide holes in the board mate with the guide posts. Check that all the interconnecting pins and sockets mate properly.

5. Gently press the board against the Main Interface board until the plastic retainers secure the board.

MAIN INTERFACE CIRCUIT BOARD. To remove the circuit board:

1. Slide out the power unit as described under Power-Unit Removal at the beginning of this section.

2. Remove all of the plug-on circuit boards from the Main Interface board.

3. Disconnect the multi-pin connectors from the rear of the Main Interface board. Note the order of these connectors so they can be correctly replaced.

4. Remove the three screws from inside each plug-in compartment which hold the plug-in interface connectors to the chassis (total of nine screws). Also, remove the hexagonal posts which secure the ground straps to the Main Interface board.

5. Remove the Main Interface board assembly through the rear of the instrument.

6. To replace the Main Interface board, reverse the order of removal. Match the arrows on the multi-pin connectors to the arrows on the board. Correct location of the pin connectors is shown in the circuit board illustration in the Disgrams section.

REGULATOR CIRCUIT BOARD. To remove the circuit board:

1. Remove the four screws which secure the protective cover to the rear frame of the instrument.

2. Remove the four screws that secure the heat radiator to the sides of the rear frame.

3. Disconnect and tag the connectors on the front of the circuit board.

4. Remove and tag (as to location) each power transistor from the heat radiator. (Upon removal of the power transistors, the Regulator board is released from the heat sink.)

5. To replace the Regulator board, reverse the order of removal.

NOTE

After replacing the power transistors, check that the transistor cases are not shorted to the heat radiator before applying power.

RECTIFIER BOARD. To replace the Rectifier board, proceed as follows:

1. Slide out the power unit as described under Power-Unit Removal at the beginning of this section.

2. Disconnect and tag the pin connectors from the board.

3. Disconnect and tag the wires soldered to the top of the board that connect the board to the power transformer and other circuits.

4. Remove the screws holding each corner of the board to the power unit, then remove the board. Remove the solder from all holes in the circuit board where wires were removed, to ease installation.

5. To replace the Rectifier board, reverse the order of removal. Be sure that all of the transformer wires are properly placed before soldering. Match the arrows on the multi-pin connectors to the arrows on the board.

CALIBRATOR AND MODE SWITCHES BOARD. To remove the circuit board:

1. Remove the FOCUS, INTENSITY, BEAM FIND, and GRAT ILLUM control knobs.

2. Remove the securing nuts that hold the INTENSITY and GRAT ILLUM control to the front panel.

3. Disengage the power switch actuating rod at the coupler adjacent to the high-voltage assembly and remove the rod and plastic bushing through the front of the instrument.

4. Remove the front panel.

5. Remove the two screws holding the VERT MODE switch to the front sub-panel.

6. Remove the nylon screw holding the board to the support on the crt shield.

7. Pull the board out only far enough to allow the multi-pin connectors and wire leads to be disconnected (note the placement of the connectors or tag them).

8. Remove the board.

9. To replace the circuit board, reverse the removal procedure. Match the arrows on the multi-pin connectors to the arrows on the circuit board.

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.

REMOVAL. To remove the crt, proceed as follows:

1. Remove the heat radiator/Regulator circuit board assembly as described previously under Circuit Board Replacement-Regulator Board.

2. Remove the two screws with springs, and a plate that hold the crt base socket in place.

3. Remove the crt base socket from rear of crt.

4. Disconnect the deflection plate connectors (two at top and two at side near midpoint of crt length.

5. Disconnect crt anode lead at the connector fastened to the front of the high-voltage assembly; immediately ground this lead to dissipate any stored charge.

6. Remove the two screws securing the crt bezel to the front panel; remove the bezel and light filters.

7. Hold one hand on the crt faceplate and push forward on the crt base with the other. As the crt starts out of the shield, grasp it firmly. Guide the anode lead through the cutout in the crt shield as the crt is removed.

INSTALLATION. To replace the crt, proceed as follows:

1. Insert the crt into the shield. Guide the anode lead through the hole in the crt shield.

2. Clean the crt faceplate and the light filter with denatured alcohol.

3. Install the crt bezel, mesh filter, and light filter. Firmly tighten the two screws.

4. Push forward on the crt base to be certain that the crt is as far forward as possible. Then install the crt base socket, retaining plate, springs, and screws of the crt clamp assembly.

5. Position and tighten down the crt clamp until the springs are compressed and the faceplate of the crt is tight against the implosion shield.

6. Reconnect the crt anode plug.

7. Install the heat radiator/Regulator circuit board assembly.

8. Carefully connect the deflection-plate connectors. After each connector is installed, lightly pull on its lead to be sure that it will remain in its socket.

9. Check the calibration of the complete instrument. The Calibration procedure is given in Section 5.

Graticule-Bulbs

To remove a graticule bulb, first remove the two screws securing the crt bezel to the front panel. Remove the plastic light shield and retaining spring. Now, firmly grasp the defective bulb and pull straight out. Push the replacement bulb straight into the socket as far as it will go. Replace the retaining spring, light shield, and crt bezel.

Power Transformer

Replace the power transformer only with a direct replacement transformer. When removing the transformer, tag the leads with the corresponding terminal numbers to aid in connecting the new transformer. After the transformer has been replaced, check the performance of the complete instrument using the procedure given in the Calibration section.

High-Voltage Assembly Components

The components located within the High-Voltage Assembly can be reached for maintenance or replacement by using the following procedure.

NOTE

All solder joints in the High-Voltage Assembly should have smooth surfaces. Any protusions may cause high-voltage arcing at high altitudes.

1. Remove the heat radiator/Regulator circuit board assembly as described previously under Circuit Board Replacement--Regulator Board.

2. Disconnect the crt clamp and crt base socket.

3. Disconnect the crt anode plug and discharge it to the chassis. Using an insulated probe or wire, discharge the jack portion of the crt anode connector to chassis ground.

4. Disconnect the multi-pin connectors on the Z-Axis Amplifier board and tag the connectors.

5. Remove the screws securing the High-Voltage Assembly Shield to the Oscilloscope frame (two screws at top, one on bottom, and two at front).

6. Guide the High-Voltage Assembly Shield away from the instrument chassis. Be careful not to damage any of the components or the pin connectors on the High-Voltage or Z-Axis Amplifier circuit boards. Disconnect the multi-pin connectors from the High-Voltage board.

7. Using an insulated shorting strap, discharge the exposed connections to chassis ground.

8. Remove the two power transistors and the four screws which secure the High-Voltage board to the High-Voltage Assembly. Now, all of the high-voltage circuitry can be reached for maintenance or replacement except the components in the encapsulated high-voltage multiplier.

9. To replace the encapsulated high-voltage multiplier, remove four screws located on the bottom of the High-Voltage circuit board (remove board to reach screws).

10. To replace the High-Voltage Assembly, reverse the above procedure. Be careful not to pinch any of the interconnecting wires when attaching the high-voltage compartment to the chassis.

Fuse Replacement

Table 4-3 gives the rating, location, and function of the fuses used in this instrument.

TABLE 4-3

Fuse Rating, Location, and Function

Circuit Number	Rating	Location	Function
F1000	2 A Slow	Rear Panel	115-volt line
F1001	2 A Slow	Rear Panel	115-volt line
F855	0.15 A Fast	Carrying-handle frame (rear)	+130 volts

CALIBRATION AFTER REPAIR

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits. Since the low-voltage power supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the low-voltage supplies or if the power transformer has been replaced. See Section 5, Calibration, for a complete calibration procedure.

PACKAGING FOR SHIPMENT

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

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

If the original packing is unfit for use or not available, package 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 Table 4-4 for carton test strength requirements.

TABLE 4-4

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

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 the carton and the instrument, allowing three inches on all sides.

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

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

CALIBRATION

This section contains a performance check procedure and a calibration procedure. Completion of either procedure ensures that the instrument is correctly adjusted and operating within its published specifications. Refer to the following discussion for instructions on performing complete or partial performance check and calibration procedures.

Any reference to Oscilloscope throughout this section refers to the OS-245(P)/U Oscilloscope mainframe. Also, any reference to amplifier unit or time-base unit refers to the plug-in units used as test equipment with the Oscilloscope mainframe.

PRELIMINARY INFORMATION

Incoming Inspection

To perform an initial check of electrical operation, see Operating Checkout in the Operating Instructions section of this manual. The Operating Checkout is intended to determine the acceptability of newly purchased instruments. This procedure does not check every facet of instrument calibration; rather it is concerned primarily with those portions of the instrument that are essential to correct operation.

Calibration Interval

To ensure instrument accuracy, check the calibration of the Oscilloscope every 1000 hours of operation, or every 6 months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section of this manual.

Tektronix Field Service

Tektronix, Inc. provides complete instrument repair and calibration at local Field Service Centers and the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Using This Procedure

This procedure provides several features to facilitate calibration and checking the Oscilloscope. These are:

INDEX. An index is given preceding the calibration procedure to aid in locating performance check and calibration procedure steps. A check mark symbol (√) preceding a step title indicates that a check of instrument performance is made during the procedure of that step.

PERFORMANCE CHECK PROCEDURE. The performance of the Oscilloscope can be checked, without removing the cabinet sides or making internal adjustments, by performing the calibration procedure and omitting the ADJUST— parts of the steps. A check mark symbol (√) preceding a step title indicates a check of performance will be made later in the procedure of the step. The (√) symbol preceding a CHECK— part of the step indicates a check of performance against a tolerance listed as a performance requirement in the Specification section of this manual. Limits and tolerances given in other Check— steps (Check— steps without the √ symbol) are calibration guides and should not be interpreted as instrument specifications. Operator front-panel adjustments are adjusted as part of the performance check procedure. If the tolerance given for a √ CHECK— part cannot be met, and an ADJUST— part immediately follows, a partial adjustment can be quickly performed when internal adjustments are accessible.

CALIBRATION PROCEDURE. Completion of each step in the calibration procedure ensures that the instrument is correctly adjusted and meets the electrical specifications listed in the Specification section of this manual. Where possible, instrument performance is checked before an adjustment is made. The recommended calibration philosophy is to adjust a specific internal control only when test indications show that part of a step is not within the specified limits. Do not attempt to bring the adjustment to the desired level if the indications are within the limits. Adherence to this philosophy will extend the life of the Oscilloscope. In areas of the calibration procedure where the best electrical measurement accuracy is desired, the ADJUST— part of the step may be made to the exact setting, even if the preceding Check— part is within the allowable tolerance. It will be necessary to remove the cabinet sides in order to have full access to the internal adjustments and test points.

PARTIAL PROCEDURES. A partial performance check or calibration may be desirable after replacing components, or to improve the adjustment of a portion of the instrument between major calibrations. To check or adjust only part of the instrument, refer to the Equipment Required list, the plug-in installation instructions and the Control Settings which precedes that portion to be performed. To prevent unnecessary calibration of other parts of the instrument, adjust only if the tolerance given in the Check— part of the step is not met. If adjustment is necessary, also check the calibration of any steps listed in the INTERACTION— part of the step.

If the applications for which you will use the Oscilloscope do not require the full available performance from the Oscilloscope and plug-in units, the procedures and the Equipment Required list can be shortened accordingly. For example, the basic low-frequency measurement capabilities of the Oscilloscope system can be verified by just checking vertical deflection accuracy and basic horizontal timing. Also, if the Oscilloscope-plug-in combination is to be used as a fixed system without the need to interchange plug-in units, the important measurement capabilities can be verified with the fixed system and applicable test signals instead of using the Calibration Fixture Signal Standardizer (see Table 5-1, Test Equipment Required).

COMPLETE PROCEDURES. The ideal way to calibrate or performance check this instrument is to perform a complete procedure from beginning to end, using the exact sequence provided. The procedures are carefully arranged so that interaction of control settings and adjustments have the least affect on overall instrument accuracy. No concern to interaction (other than the interactions mentioned in the calibration procedure) is necessary when all instructions are performed in the procedures.

If all the recommended test equipment is used and all front-panel control settings are strictly followed when performing a complete procedure, the Control Settings list of the following subsection may not need to be completely checked. Notice the controls that are high-lighted in a bold-face type (new setting) and set those controls as recommended.

Also, at the beginning of each major portion of the calibration procedure (i.e., A. POWER SUPPLY), you will notice a reference to an Adjustment Locations pullout page located in the Diagrams section of this manual. This page is normally used when performing the calibration procedure. Fold out the designated page so that the Adjustment Locations illustrations on the page are always in view for rapid location of test points and adjustments.

TEST EQUIPMENT REQUIRED

All of the following test equipment and accessories, or their equivalents, are required for a complete performance check or calibration of the Oscilloscope. Specifications given in Table 5-1 for the test equipment are the minimum required to meet those specifications listed in the Specification section of this manual. Therefore, some of the specifications listed here may differ from the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed minimum specifications. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the test equipment instruction manuals if more information is needed. The fast sweep-speed characteristics of the Oscilloscope and time-base unit must be checked and adjusted as a system. The calibration of the plug-in units should first be checked according to the procedure given in their respective instruction manuals before performing the Oscilloscope procedures.

Special Calibration Fixtures

Special Tektronix calibration fixtures are used only where they facilitate instrument calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number from Tektronix Field Offices or representatives.

Calibration Equipment Alternatives

Test equipment listed in the Examples of Applicable Test Equipment column, Table 5-1, is required to check and calibrate this instrument. The performance check/calibration procedures are based on the first item of equipment given as an example. If other equipment is substituted, control settings or calibration setups may need to be altered slightly to meet the requirements of the substitute equipment. If the exact item of test equipment given as an example is not available, first check the Minimum Specifications column carefully to see if any other equipment is available which might suffice. Then, check the Purpose column to see what this item is used for. If used for a check or adjustment that is of little or no importance to your measurement requirements, the item and corresponding step(s) can be deleted.

National Stock Numbers

The Examples of Applicable Test Equipment column in Table 5-1, lists the National Stock Number for each item having an assigned number. The numbers are provided for convenience and ease in purchasing test equipment.

Signal Connections

Detailed signal-connection information is not always provided except when critical for a particular test. Signals should be interconnected to other equipment using RG-58/U, 50-ohm BNC cables. When simultaneously connecting a signal to two inputs, use a BNC T-connector. For test equipment signal-connection and termination information, refer to the test equipment instruction manuals.

TABLE 5-1
Test Equipment Required

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Amplifier plug-in unit (2 identical units required)	Tektronix 7A-series; combined bandwidth of amplifier unit and Oscilloscope, 65 MHz; input resistance, 1 MΩ.	Provides vertical input for the Oscilloscope.	a. Tektronix AM-6565/U Amplifier. National Stock Number 6625-00-106-9625. b. Tektronix 7A15A Amplifier. c. Tektronix 7A16A Amplifier. National Stock Number 6625-00-217-0418. d. Tektronix 7A18 Dual Trace Amplifier. National Stock Number 6625-00-185-7817. e. Tektronix 7A26 Dual Trace Amplifier. National Stock Number 6625-00-361-5318.
2. Time-base plug-in unit	Tektronix 7B-series; sweep rate, to at least 5 ns/div. Horizontal amplifier mode.	Provides a sweep for the Oscilloscope.	a. Tektronix TD-1085/U Dual Time Base. National Stock Number 6625-00-106-9624.
3. Calibration Fixture Signal Standardizer	Produces gain-check and pulse-response waveforms.	Standardizes the instrument so plug-in units can be interchanged without complete recalibration.	a. Tektronix 067-0587-01 Calibration Fixture Signal Standardizer. National Stock Number 6625-00-115-6711. b. Calibrated plug-in units with suitable signal sources may be substituted if lower performance is acceptable.
4. Test oscilloscope system with 10X probes (2 identical probes required)	Dual-channel with chopped vertical mode; bandwidth, 25 MHz; sweep rate, to at least 0.05 μs/div.	Z-axis compensation adjustment. Horizontal limit centering adjustment. Output signals check.	a. Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope system with standard accessories (AN/USM-281C). National Stock Number 6625-00-106-9622. b. Any oscilloscope system that meets minimum specifications. Two identical 10X probes with 25 MHz bandwidth are required. c. Refer to the Tektronix catalog for compatible oscilloscope systems.
5. Digital voltmeter	Range, 0 to 150 V; accuracy, within 0.2%.	Power supply voltages check and adjustment. Z-axis dc levels checks. Calibrator output accuracy check and adjustment.	a. Tektronix DM 501 Digital Multimeter.[1] National Stock Number 6625-00-500-6640. b. Any digital voltmeter that meets minimum specifications.

[1] Requires a TM 500-series power module.

TABLE 5-1 (CONT.)
Test Equipment Required

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
6. Dc voltmeter	Range, 0 to 3000 V or higher; accuracy, calibrated to within 1% at −2960 V.	High-voltage power supply check.	a. Triplett Model 630-NA. b. Simpson Model 262.
7. Sine-wave generator	Frequency, variable from 250 kHz to 120 MHz; reference frequency, 50 kHz; output amplitude, from 15 mV to 4 V into 50 Ω; amplitude accuracy, constant within 3% of reference as output frequency changes.	Vertical bandwidth and isolation checks. Horizontal bandwidth check.	a. Tektronix SG 503 Leveled Sine-Wave Generator.[1] National Stock Number 6625-00-520-5143. b. Any sine-wave generator that meets minimum specifications.
8. Time-mark generator	Marker outputs, 10 ns to 0.1 s; accuracy, within 0.1%.	Horizontal timing checks and adjustment.	a. Tektronix TG 501 Time-Mark Generator.[1] National Stock Number 6625-00-520-5199. b. Tektronix TG 501 Opt. 1 Time-Mark Generator.[1] National Stock Number 6625-00-534-2638. c. Tektronix 2901 Time-Mark Generator. National Stock Number 6625-00-483-2619. d. Tektronix Type 184 Time-Mark Generator. National Stock Number 6625-00-982-1543.
9. Low-frequency generator	Frequency, 35 kHz and 50 kHz; output amplitude, variable from 250 mV to 5 V into 50 Ω.	X-Y phase shift check.	a. Tektronix FG 501 Function Generator.[1] National Stock Number 6625-00-140-7817. b. Tektronix FG 503 Function Generator.[1]
10. Cable (2 required)	Impedance, 50 Ω; type RG-58/U; length, 42 in.; connectors, BNC.	Signal interconnection.	a. Tektronix Part 012-0057-01. National Stock Number 6625-00-498-4834. b. Any cable that meets minimum specifications.
11. Cable (2 required)	Impedance, 50 Ω; type RG-58/U; length, 18 in.; connectors, BNC.	Signal interconnection.	a. Tektronix Part 012-0076-00. National Stock Number 6125-00-916-8025. b. Any cable that meets minimum specifications.

[1] Requires a TM 500-series power module.

TABLE 5-1 (CONT.)
Test Equipment Required

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
12. Termination	Impedance, 50 Ω; accuracy, within 2%; connectors, BNC.	Signal termination.	a. Tektronix Part 011-0049-01. National Stock Number 5985-00-087-4954.
13. T-connector	Connectors, BNC.	Signal interconnection.	a. Tektronix Part 103-0030-00. National Stock Number 5935-00-284-1962 (2 supplied as standard accessories).
14. Screwdriver	Length, 3-in. shaft; bit size, 3/32 in.	Adjust variable resistors.	a. Xcelite R3323.
15. Low-capacitance screwdriver	Length, approximately 4 in.; bit size, 3/32 in.	Adjust all variable capacitors.	a. J.F.D. Electronics Adjustment Tool Part 5284.

PERFORMANCE CHECK/CALIBRATION PROCEDURES

The following performance check procedure (calibration procedure with ADJUST— parts omitted) can be used for periodic checks of the instrument to confirm that the Oscilloscope is operating within acceptable limits. This procedure is concerned with those portions of the Oscilloscope which are essential to measurement accuracy, and checks the instrument against the tolerances given as Performance Requirements in the Specification section of this manual. It is not necessary to remove the cabinet sides to perform the procedure, since all checks are made from the front panel. Read the information given previously under Performance Check Procedure to be sure all considerations are well understood.

The following calibration procedure, when performed in its entirety, returns the Oscilloscope to correct calibration. All limits and tolerances given in this procedure are calibration guides, and should not be interpreted as instrument specifications except when listed as Performance Requirements in the Specification section of this manual.

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√Performance Requirement check; see introductory information.

@

PRELIMINARY PROCEDURE FOR PERFORMANCE CHECK

NOTE

The performance of this instrument should be checked within an ambient temperature range of +15° to +35° C to allow application of the most exact specifications listed in the performance check procedure. This instrument can be checked within an ambient temperature range of 0° to +50° C.

1. Connect the Oscilloscope to a power source which meets the voltage and frequency requirements of the instrument (refer to Operating Voltage in the Operating Instructions section of this manual).

NOTE

If the correct line voltage is not available, use a variable autotransformer to provide the correct input voltage.

2. Assemble the plug-in units and Oscilloscope together as directed under Install Plug-In Units preceding the subsection to be performed.

3. Set the controls as given under Control Settings preceding the same subsection.

4. Turn on the Oscilloscope, and allow at least 20 minutes warmup before proceeding with the performance check.

NOTE

Titles for external controls of the Oscilloscope are capitalized in this procedure (e.g., INTENSITY, VERT MODE).

PRELIMINARY PROCEDURE FOR CALIBRATION

NOTE

The Oscilloscope must be adjusted within an ambient temperature range of +20° to +30° C for best overall accuracy and to meet the electrical characteristic tolerances given as Performance Requirements in the Specification section of this manual.

1. Remove the cabinet sides from the Oscilloscope (refer to Cabinet Removal in the Maintenance section of this manual).

2. Connect the Oscilloscope to a power source which meets the voltage and frequency requirements of the instrument (refer to Operating Voltage in the Operating Instructions section of this manual).

NOTE

If the correct line voltage is not available, use a variable autotransformer to provide the correct input voltage.

3. Assemble the plug-in units and Oscilloscope together as directed under Install Plug-In Units preceding the subsection to be performed.

4. Set the controls as given under Control Settings preceding the same subsection.

5. Turn on the Oscilloscope and allow at least 20 minutes warmup before proceeding.

NOTE

Titles for external controls of the Oscilloscope are capitalized in this procedure (e.g., GRAT ILLUM, POWER). Internal adjustments are initial capitalized only (e.g., Crt Grid Bias, Vertical Centering).

A. POWER SUPPLY

NOTE

No performance checks in this Portion (A) of the calibration procedure.

Equipment Required

1. Digital voltmeter
2. Dc voltmeter (vom)
3. Screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 1** in the pullout pages.

Do Not Install Plug-In Units

Plug-in units should not be electrically connected to the Oscilloscope throughout this portion (A) of the calibration procedure.

Control Settings

Oscilloscope

INTENSITY . . . . . Counterclockwise (off)
FOCUS . . . . . Midrange
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

A1. CHECK –50-VOLT POWER SUPPLY

a. Connect the digital voltmeter between pin 1 of P901 on the Regulator circuit board, and chassis ground. See Figure 7-14 for voltage test point location.

b. Check—For a meter reading of –49.9 to –50.1 volts.

NOTE

If the –50-volt supply is within the specified tolerance, proceed with step A2. If the –50-volt adjustment is to be made, all circuits will be affected and the entire calibration procedure should be performed to verify the accuracy of all adjustments in the instrument.

c. ADJUST— –50 Adj R881 for a meter reading of exactly –50 volts. See Figure 7-14 for adjustment location.

A2. CHECK REMAINING POWER SUPPLY VOLTAGES

a. Check—Each supply with the digital voltmeter to ensure that all output voltages are within the limits given in Table 5-2. See Figure 7-14 for voltage test point locations.

TABLE 5-2
Power Supply Voltage Limits

Power Supply	Test Point Location	Output Voltage Limits
–50 V (Previously Checked)	P901-Pin 1 (on Regulator Board)	–49.9 to –50.1 V
–15 V	P901-Pin 2	–14.7 to –15.3 V
+5 V	P901-Pin 3	+4.85 to +5.15 V
+15 V	P901-Pin 4	+14.7 to +15.15 V
+50 V	P901-Pin 5	+49.4 to +50.6 V
+130 V	F855 (under carrying-handle frame, rear)	+124.8 to +135.2 V

NOTE

Ripple and regulation of the individual supplies can be checked using the procedure given under Troubleshooting Techniques in the Maintenance section of this manual.

b. Disconnect the digital voltmeter.

A3. CHECK HIGH-VOLTAGE POWER SUPPLY

a. Press the POWER switch to turn off the Oscilloscope.

b. Remove the plastic plug button from the high-voltage test-point access hole on the high-voltage assembly (pry gently on the plug if necessary). See Figure 7-15 for plug button location.

c. Set the dc voltmeter (vom) to measure at least −3000 volts and connect it between H.V. Test Point and chassis ground. See Figure 7-15 for test point location.

d. Pull the POWER switch to turn the Oscilloscope on.

e. Check—For a meter reading of −2871 to −3049 volts.

f. Press the POWER switch to turn off the Oscilloscope before disconnecting the voltmeter.

g. Disconnect the dc voltmeter and insert the plastic plug button in the high-voltage assembly.

h. Pull the POWER switch to turn the Oscilloscope on.

B. Z-AXIS AND CRT DISPLAY

Equipment Required

1. Amplifier plug-in unit
2. Time-base plug-in unit
3. Digital voltmeter
4. Test oscilloscope system with one 10X probe
5. Calibration Fixture Signal Standardizer
6. Sine-wave generator or low-frequency generator
7. 42-inch, 50-ohm BNC cable (2 required)
8. 50-ohm BNC termination
9. BNC T-connector
10. Screwdriver
11. Low-capacitance screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 1** in the pullout pages.

Install Plug-In Units

Install an amplifier unit in the left vertical compartment. Install the time-base unit in the horizontal compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . Counterclockwise (off)
FOCUS . . . . . Midrange
GRAT ILLUM . . Counterclockwise (off, new setting)
VERT MODE . . . . . .LEFT
TRIG SOURCE. . . . . VERT MODE
POWER . . . . . .On

Amplifier Unit

Position . . . . . Midrange
Input coupling . . . . . .Dc
Polarity . . . . . + Up
Mag X1
Volts/division . . . . . 1 V
Variable volts/division . . . . . .Cal detent

Time-Base Unit

Main triggering
Slope . . . . . .+
Level 0
Mode . . . . . Auto
Coupling . . . . . .Ac
Source . . . . . .Int

Dlyd trig
Level . . . . . .Runs after dly time
Slope . . . . . .+
Coupling . . . . . .Ac
Source . . . . . .Int
Position . . . . . .As desired
Mag X1
Time/div or dly time . . . . . .Ampl
Dly'd time/division . . . . . Ampl (knobs locked)
Variable. . . . . .Cal detent
Delay time mult 1.00

B1. CHECK Z-AXIS DC LEVELS

a. Connect the digital voltmeter between P772 on the Z-Axis Amplifier board, and chassis ground. See Figure 7-15 for test point location.

b. Note the voltmeter reading. The Oscilloscope INTENSITY control should be fully counterclockwise (off) for this reference voltage measurement.

c. Turn the INTENSITY control slowly clockwise until the voltmeter reading is 4 volts more positive than the reference voltage noted previously in part b. Note this new voltmeter reading.

d. Check—For a spot display that is just extinguished. It may be helpful to increase the level of INTENSITY momentarily, to locate the spot. Then as INTENSITY is decreased, the spot display should just extinguish as the voltmeter reading returns to the reference level plus 4-volt level.

e. ADJUST—Crt Grid Bias R759 (through the hole in the high-voltage shield) until the spot display is just extinguished with the INTENSITY control set at the reference level plug 4-volt level on the voltmeter. See Figure 7-15 for adjustment location.

f. Set the amplifier unit position control fully counterclockwise to move the spot display vertically off the crt screen.

g. Set the FOCUS control fully counterclockwise, then set INTENSITY fully clockwise (maximum intensity).

h. Check—For a voltmeter reading of +80 to +100 volts.

i. Set INTENSITY fully counterclockwise (off).

j. Disconnect the digital voltmeter.

B2. CHECK Z-AXIS COMPENSATION

a. Set the time-base unit for a sweep rate of 0.5 microsecond/division.

b. Set the test oscilloscope: Time/division to 0.5 microsecond, volts/division to 0.5 volt, input coupling to ac and vertical position for a free-running trace near graticule center.

c. Connect a 10X probe (properly compensated) from the test oscilloscope to P772 on the Z-Axis Amplifier board (same signal point used previously for Z-axis dc levels). See Figure 7-15 for test point location. Connect the probe ground lead to a convenient chassis ground.

d. Set INTENSITY for a positive step amplitude of 6 divisions (30 volts) on the test oscilloscope and center the display on the graticule. See Figure 5-1.

e. Check—For a flat-top waveform with approximately 1 volt or less (0.2 division) of aberration at leading corner. See Figure 5-1.

f. ADJUST—Z-Axis Compensation C622, using a low-capacitance screwdriver, for optimum square leading corner with approximately 1 volt or less (0.2 division) of aberration. See Figure 7-15 for adjustment location.

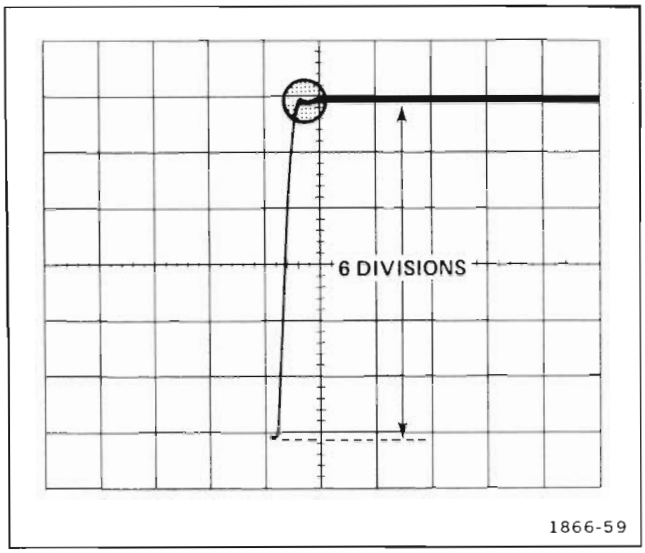

Figure 5-1. Typical display when Z-Axis Compensation is properly adjusted. Circle surrounds compensated portion of waveform.

g. Disconnect the 10X probe.

h. Set the amplifier unit position control to midrange. Adjust FOCUS and INTENSITY controls for a focused trace of normal intensity.

√ B3. CHECK GRATICULE ILLUMINATION OPERATION

a. Turn the GRAT ILLUM control through its range.

√ b. CHECK—For control of graticule illumination from minimum to maximum settings.

c. Set GRAT ILLUM control to the desired setting.

B4. ADJUST ASTIGMATISM

a. Set the time-base unit for a sweep rate of 10 microseconds/division.

b. Remove the amplifier unit from the left vertical compartment and install the Calibration Fixture Signal Standardizer in this compartment.

c. Set the Calibration Fixture to Vert or Horiz + Step Resp, set Rep Rate switch to 100 kHz and adjust Amplitude and Position controls for approximately 2 divisions of display centered on the graticule.

d. Set FOCUS control for the best display focus.

√ **Performance Requirement check; see introductory information.**

√ e. CHECK—For well-defined front corners on the displayed waveform.

f. ADJUST—A (Astigmatism) R636 and FOCUS control together, to obtain the best defined front corners on the displayed waveform. See Figure 7-15 for adjustment location.

√ B5. ADJUST TRACE ALIGNMENT

a. Set the Calibration Fixture Test switch to Aux In and position the trace to the center horizontal graticule line.

√ b. CHECK—That the trace is aligned with the center horizontal graticule line.

√ c. ADJUST—TRACE ROT (front-panel screwdriver adjustment) to align the trace exactly with the center horizontal graticule line.

B6. ADJUST Y-AXIS ALIGNMENT

a. Interchange the time-base unit and the Calibration Fixture.

b. Set the vertical trace on the center vertical graticule line using the Calibration Fixture Position control.

c. Check—That the trace aligns with the center vertical graticule line within 0.1 division.

d. ADJUST—Y (Y Axis) R633 to align the trace exactly with the center vertical graticule line. See Figure 7-15 for adjustment location.

B7. ADJUST GEOMETRY

a. Set the Calibration Fixture Test switch to Vert or Horiz Gain and Rep Rate to 100 kHz.

b. Check—The display for no more than 0.1 division of bowing or tilt of the vertical traces at left and right edges of the graticule.

c. ADJUST—G (Geometry) R630 for minimum bowing or tilt of the vertical traces at left and right edges of the graticule. Adjustment may have to be compromised to obtain less than 0.1 division bowing and tilt everywhere within the graticule area. See Figure 7-15 for adjustment location.

√ B8. CHECK BEAM FINDER OPERATION

a. Press the BEAM FIND push button.

√ b. CHECK—For a reduced-size display, compressed in the vertical and horizontal directions.

c. Release the BEAM FIND push button.

d. Remove the plug-in units.

√ B9. CHECK EXTERNAL Z-AXIS OPERATION

a. Install an amplifier unit in the left vertical compartment. Set the deflection factor for 1 volt/division.

b. Install the time-base unit in the horizontal compartment. Set the sweep rate for 20 microseconds/division.

c. Connect the sine-wave generator or the low-frequency generator output to a 42-inch 50-ohm BNC cable, 50-ohm BNC termination, and BNC T-connector to the amplifier unit.

d. Set the generator for a 2-division display of 50 kilohertz signal.

e. Connect a 42-inch 50-ohm BNC cable from the BNC T-connector to the EXT Z AXIS connector on the rear panel of the Oscilloscope.

√ f. CHECK—That the top portion of the displayed waveform is blanked out.

g. Disconnect all signal cables.

√ Performance Requirement check; see introductory information.

C. VERTICAL SYSTEM

Equipment Required

1. Time-base plug-in unit
2. Calibration Fixture Signal Standardizer
3. Sine-wave generator
4. Amplifier plug-in units (2 identical units required)
5. 42-inch, 50-ohm BNC cable
6. 18-inch, 50-ohm BNC cable (2 required)
7. 50-ohm BNC termination
8. BNC T-connector
9. Screwdriver
10. Low-capacitance screwdriver

BEFORE YOU BEGIN CALIBRATION, see ADJUSTMENT LOCATIONS 2 in the pullout pages.

Install Plug-In Units

Install the time-base unit in the horizontal compartment. Install the Calibration Fixture Signal Standardizer in the left vertical compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

Calibration Fixture Signal Standardizer

Position . . . . . Midrange
Amplitude . . . . . Midrange
Test switch . . . . . Vert or Horiz Gain
Rep Rate . . . . . 100 kHz

Time-Base Unit

Main triggering
- Slope . . . . . +
- Level 0
- Mode . . . . . Auto
- Coupling . . . . . Ac
- Source . . . . . Int

Dlyd trig
- Level . . . . . Runs after dly time
- Slope . . . . . +
- Coupling . . . . . Ac
- Source . . . . . Int

Position . . . . . As desired
Mag X1
Time/div or dly time . . . . . 20 μs
Dly'd time/division . . . . . 20 μs (knobs locked)
Variable . . . . . Cal detent
Delay time mult 1.00

C1. ADJUST VERTICAL AMPLIFIER BIAS

a. With the Calibration Fixture Position control, align the bright center trace of the display with the center horizontal graticule line.

b. ADJUST—B (Bias) R486 for maximum deflection between the traces (maximum overall gain of the display). See Figure 7-16 for adjustment location.

C2. CHECK VERTICAL AMPLIFIER CENTERING

a. Set the Calibration Fixture Test switch to Vert or Horiz Com Mode.

b. Check—That the displayed trace is within 0.3 division of the center horizontal graticule line.

c. ADJUST—Vertical Centering R403 to position the trace to the center horizontal graticule line. See Figure 7-16 for adjustment location.

√ C3. CHECK VERTICAL AMPLIFIER GAIN

a. Set the Calibration Fixture Test switch to Vert or Horiz Gain.

b. Position the display with the Calibration Fixture position control to align the bright center trace of the display with the center horizontal graticule line.

√ c. CHECK—That the deflection over the center 7 traces is 6 divisions within 0.06 division. Note the exact deflection for part g of this step if adjustment of vertical gain is not necessary and the following part d of this step will not be performed.

d. ADJUST—Vertical Gain R447 for exactly 6 divisions of deflection over the center 7 traces. See Figure 7-16 for adjustment location.

e. Remove the Calibration Fixture from the left vertical compartment and install it in the right vertical compartment.

f. Set the VERT MODE switch to RIGHT.

√ g. CHECK—That the deflection over the center 7 traces is the same deflection noted in previous part c within 0.06 division (6 divisions within 0.06 division if vertical gain was adjusted in previous part d).

h. INTERACTION—Of gain adjustments between vertical compartments. If necessary, readjust Vertical Gain R447 for the optimum gain setting compromise for both vertical compartments. If readjustment is performed, recheck parts c through g.

√ C4. CHECK VERTICAL LINEARITY

a. Note the exact amplitude of the center 2 divisions of display.

√ b. CHECK—The display over any 2 division vertical interval within the graticule area for less than 0.1 division of compression or expansion from the exact amplitude noted in part a.

c. Remove the Calibration Fixture from the right vertical compartment and install it in the left vertical compartment.

d. Set the VERT MODE switch to LEFT.

e. Note the exact amplitude of the center 2 divisions of display.

√ f. CHECK—The display over any 2 division vertical interval within the graticule area for less than 0.1 division of compression or expansion from the exact amplitude noted in part e.

C5. CHECK VERTICAL HIGH-FREQUENCY COMPENSATION

a. Set the Calibration Fixture Test switch to Vert or Horiz + Step Resp and Rep Rate switch to 1 MHz. Adjust Amplitude and Position controls for a 6-division display centered vertically on the graticule.

b. Set the time-base unit for a calibrated sweep rate of 0.05 microsecond/division and triggering for auto mode, ac coupled from the internal source. Adjust trigger level and position controls for a stable display triggered on the rising portion of the pulse and center the pulse horizontally on the graticule.

c. Check—For optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed +0.1 or −0.1 division with total peak-to-peak aberrations not to exceed 0.1 division.

d. ADJUST—Vertical compensations C420, R421, R425, C425, C427 and R427, in the order given, for optimum square leading corner and flat top with aberrations within the limits given in part c. See Figure 7-16 for adjustment locations. Use a low-capacitance screwdriver to adjust the variable capacitors. Repeat the complete adjustment procedure as necessary to obtain optimum response.

e. Remove the Calibration Fixture from the left vertical compartment and install it in the right vertical compartment.

f. Set the VERT MODE switch to RIGHT.

g. Check—For optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed +0.1 or −0.1 division with total peak-to-peak aberrations not to exceed 0.1 division.

√ Performance Requirement check; see introductory information.

h. INTERACTION—Of waveform front-corner aberrations between vertical compartments. If necessary, compromise the adjustment of C420, R421, R425, C425, C427 and R427 to obtain the best corner appearance with aberrations within the limits specified for both left and right vertical compartments.

i. To verify correct high-frequency compensation, perform the bandwidth check as given in the next step.

√ C6. CHECK VERTICAL AMPLIFIER BANDWIDTH

a. Set the Calibration Fixture Test switch to Vert or Horiz Freq Resp and turn the Amplitude control fully clockwise.

b. Set the time-base unit for a sweep rate of 1 millisecond/division.

c. Connect the sine-wave generator output through a 42-inch 50-ohm BNC cable to the Cw In connector of the Calibration Fixture.

d. Set the sine-wave generator for an 8-division display at a frequency of 3 megahertz.

e. Set the Calibration Fixture Position and Amplitude controls to obtain a centered, 6-division display.

NOTE

The Calibration Fixture Cw Leveled light must be on and the sine-wave generator must be properly connected for a valid check. It may be helpful to refer to the Calibration Fixture and sine-wave generator manuals.

f. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to 4.2 divisions.

√ g. CHECK—The generator for a reading that equals or exceeds the frequency listed below for the appropriate ambient temperature range:

+15° to +35° C, 120 megahertz

0° to +50° C, 100 megahertz

−28° to +65° C, 90 megahertz

NOTE

The frequencies specified in the preceding (part g) are typical of the vertical system bandwidth for the 067-0587-01 Calibration Fixture Signal Standardizer and OS-245(P)/U Oscilloscope. If an amplifier plug-in unit is used with the Oscilloscope to verify vertical bandwidth, select the appropriate frequency from Table 2-4 in the Specification section of this manual and substitute for the frequency given in part g. (Insert a 50-ohm BNC termination to signal cable at amplifier input if the amplifier has a one-megohm input impedance.)

h. Remove the Calibration Fixture from the right vertical compartment and install it in the left vertical compartment (leave the signal cable connected).

i. Set the VERT MODE switch to LEFT.

j. Set the sine-wave generator frequency to 3 megahertz.

√ k. Repeat parts e through g for the left vertical compartment.

l. Disconnect the signal cable.

√ C7. CHECK VERTICAL AMPLIFIER ISOLATION

a. Remove the Calibration Fixture from the left vertical compartment and install an amplifier unit in this compartment.

b. Connect the sine-wave generator output through a 42-inch 50-ohm BNC cable and 50-ohm BNC termination to the amplifier unit.

c. Set the sine-wave generator for an 8-division display at a frequency of 100 megahertz.

d. Set the VERT MODE switch to RIGHT.

√ e. CHECK—The display for 0.08 division or less of 100 megahertz signal. Do not include the trace width (line thickness) in this measurement.

√ Performance Requirement check; see introductory information.

f. Remove the amplifier unit from the left vertical compartment and install it in the right vertical compartment (leave the signal cable setup connected).

g. Set the sine-wave generator for an 8-division display of the 100 megahertz input signal.

h. Set the VERT MODE switch to LEFT.

√ i. CHECK—The display for 0.08 divisions or less of 100 megahertz signal. Do not include the trace width (line thickness) in this measurement.

j. Disconnect the signal cable setup.

√ C8. CHECK VERTICAL MODES

a. Install identical amplifier units in the left and right vertical compartments.

b. Set both amplifier units for a deflection factor of 0.5 volt/division.

c. Connect the 1 V CALIBRATOR signal to the inputs of the amplifier units with a BNC-T connector and two 18-inch 50-ohm BNC cables.

d. Set the time-base unit for a sweep rate of 0.5 millisecond/division.

e. Center the display with the left amplifier unit position control and note the vertical deflection.

f. Set the VERT MODE switch to RIGHT.

g. Center the display with the right amplifier unit position control and note the vertical deflection.

h. Set the VERT MODE switch to ADD.

√ i. CHECK—The resultant display for a vertical deflection approximately equalling the algebraic sum of the deflections noted in parts e and g of this step. For example, if the deflections were 2 divisions each, the resultant deflection will be approximately 4 divisions.

j. Disconnect the signal cable setup.

k. Set the VERT MODE switch to ALT.

√ l. CHECK—That traces from both vertical compartments are displayed.

m. Position the traces about 2 divisions apart.

n. Set the time-base unit for a sweep rate of 50 milliseconds/division.

√ o. CHECK—That the traces alternate between the left and right amplifier units.

p. Set the VERT MODE switch to CHOP.

√ q. CHECK—That the traces are displayed simultaneously.

√ **Performance Requirement check; see introductory information.**

D. TRIGGERING SYSTEM

NOTE

No adjustments in this Portion (D) of the calibration procedure.

Equipment Required

1. Time-base plug-in unit
2. Amplifier plug-in unit
3. Calibration Fixture Signal Standardizer
4. 18-inch, 50-ohm BNC cable

Install Plug-In Units

Install the time-base unit in the horizontal compartment. Install an amplifier unit in the left vertical compartment. Install the Calibration Fixture Signal Standardizer in the right vertical compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT (new setting)
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

Amplifier Unit

Position . . . . . Midrange
Input coupling . . . . . Dc
Polarity . . . . . + Up
Mag X1
Volts/division . . . . . 0.5 V
Variable volts/division . . . . . Cal detent

Calibration Fixture Signal Standardizer

Position . . . . . Midrange
Amplitude . . . . . Midrange
Test switch . . . . . Vert or Horiz + Step Resp (new setting)
Rep Rate . . . . . 1 kHz (new setting)

Time-Base Unit

Main triggering
Slope . . . . . +
Level 0
Mode . . . . . Auto
Coupling . . . . . Ac
Source . . . . . Int
Dlyd trig
Level . . . . . Runs after dly time
Slope . . . . . +
Coupling . . . . . Ac
Source . . . . . Int
Position . . . . . As desired
Mag X1
Time/div or dly time . . . . . 0.5 ms (new setting)
Dly'd time/division . . . . . 0.5 ms (knobs locked, new setting)
Variable . . . . . Cal detent
Dly time mult 1.00

√ D1. CHECK TRIGGER SOURCE MODES

a. Connect the 1 V CALIBRATOR signal to the amplifier unit with an 18-inch 50-ohm BNC cable.

b. Move the calibrator-waveform display to the upper half of the graticule area.

c. Set the VERT MODE switch to RIGHT.

d. Set the Calibration Fixture Amplitude and Position controls for a 2-division display in the lower half of the graticule area.

e. Set the VERT MODE switch to ALT and the TRIG SOURCE switch to LEFT.

√ **Performance Requirement check, see introductory information.**

√ f. CHECK–That only the calibrator waveform is stable (triggered).

g. Set the TRIG SOURCE to RIGHT.

√ h. CHECK–That only the Calibration Fixture waveform is stable (triggered).

i. Disconnect the signal cable.

√ Performance Requirement check, see introductory information.

E. HORIZONTAL SYSTEM

Equipment Required

1. Time-base plug-in unit
2. Calibration Fixture Signal Standardizer
3. Test-oscilloscope system with 10X probes (2 identical probes required)
4. Amplifier plug-in units (2 identical units required)
5. Time-mark generator
6. Low-frequency generator
7. Sine-wave generator
8. 42-inch, 50-ohm BNC cable
9. 18-inch, 50-ohm BNC cable
10. 50-ohm BNC termination
11. BNC T-connector
12. Screwdriver
13. Low-capacitance screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 2 in the pullout pages.**

Install Plug-In Units

Install the time-base unit in the left vertical compartment. Install the Calibration Fixture Signal Standardizer in the horizontal compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT (new setting)
TRIG SOURCE. . . . . VERT MODE (new setting)
POWER . . . . . On

Time-Base Unit

Main triggering
- Slope . . . . . +
- Level 0
- Mode . . . . . Auto
- Coupling . . . . . Ac
- Source . . . . . Int

Dlyd trig
- Level . . . . . Runs after dly time
- Slope . . . . . +
- Coupling . . . . . Ac
- Source . . . . . Int

Position . . . . . Display centered vertically
Mag X1
Time/div or dly time . . . . . 0.1 μs (new setting)
Dly'd time/division . . . . . 0.1 μs (knobs locked, new setting)
Variable . . . . . Cal detent
Delay time mult 1.00

Calibration Fixture Signal Standardizer

Position . . . . . Midrange
Amplitude . . . . . Midrange
Test switch. . . . . Vert or Horiz Gain (new setting)
Rep Rate . . . . . 100 kHz (new setting)

E1. CHECK HORIZONTAL AMPLIFIER GAIN

a. With the Calibration Fixture Position control, align the bright center trace of the display with the center vertical graticule line.

b. Check—That the deflection over the center 9 traces is 8 divisions within 0.08 division.

c. ADJUST—Horizontal Gain R509 for exactly 8 divisions of deflection over the center 9 traces. See Figure 7-17 for adjustment location.

d. INTERACTION—If Horizontal Gain R509 was adjusted, check the following steps E2, E3, and E4.

√ E2. CHECK LOW-FREQUENCY LINEARITY

a. Note the exact horizontal amplitude of the center 2 divisions of display.

√ b. CHECK–The display over any 2 division horizontal interval within the graticule area for less than 0.1 division of compression or expansion from the exact amplitude noted in part a.

E3. CHECK HORIZONTAL AMPLIFIER CENTERING

a. Set the Calibration Fixture Test switch to Vert or Horiz Com Mode.

b. Check–That the displayed trace is within 0.3 division of the center vertical graticule line.

c. ADJUST–Horizontal Centering R513 to position the trace to the center vertical graticule line. See Figure 7-17 for adjustment location.

d. INTERACTION–If Horizontal Centering R513 was adjusted, recheck the previous steps E2 and E3.

E4. CHECK HORIZONTAL AMPLIFIER LIMIT CENTERING

a. Interchange the time-base unit and the Calibration Fixture.

b. Set time-base unit: sweep rate for 0.2 millisecond/division, position the trace start to the left vertical graticule line, then set the magnifier switch to X10.

c. Set both vertical amplifiers of the test oscilloscope for dc input coupling. Connect a 10X probe from each vertical amplifier input to a convenient square-wave signal and check the compensation of the probes. Disconnect the probe tips from the square-wave signal.

d. Set both vertical amplifiers of the test oscilloscope for a vertical deflection factor of 0.5 volt/division (5 volts/division at probe tips) in the vertical dual-trace chopped mode. Set the test oscilloscope for a sweep rate of 0.5 millisecond/division, internally triggered from the amplifier in the right compartment.

e. Connect the probe tips to a convenient ground, and position both traces to the center horizontal line of the graticule. Do not change the test oscilloscope position controls after establishing this ground reference.

f. Connect the test oscilloscope probes to the horizontal deflection output signals of the Horizontal Amplifier board in the following manner: Connect left amplifier probe to the left deflection output signal; connect right amplifier probe to the right deflection output signal. See Figure 7-17 for deflection output signal locations.

g. Check–The base lines of the displayed triangular waveforms for dc level match within 0.2 division. See Figure 5-2.

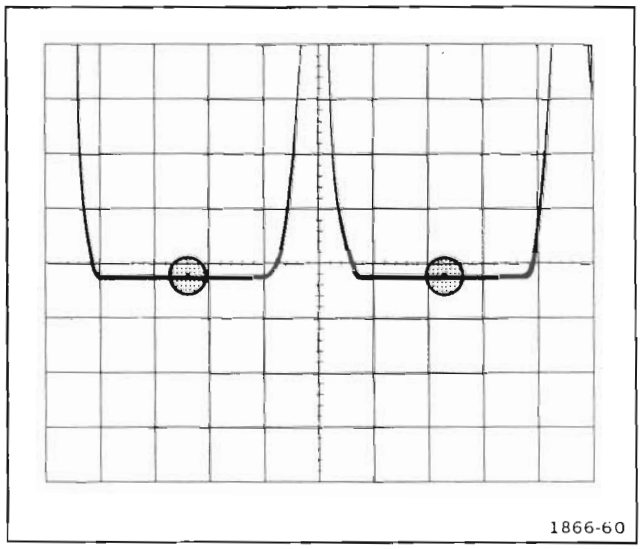

Figure 5-2. Typical display when horizontal limit centering is properly adjusted. Circles indicate the baseline areas for dc level match.

h. ADJUST–Limit Centering R531 to match the dc levels of both waveform base lines. See Figure 7-17 for adjustment location.

i. INTERACTION–If Limit Centering R531 was adjusted, recheck the previous steps E1 and E3.

j. Disconnect the probes from the Horizontal Amplifier board.

E5. CHECK HIGH-FREQUENCY TIMING

a. Remove the Calibration Fixture from the left vertical compartment and install an amplifier unit in this compartment.

b. Set the time-base unit magnifier switch to X1 and set time/division for a sweep rate of 1 millisecond/division.

√ **Performance Requirement check, see introductory information.**

c. Set the time-mark generator for 1-millisecond time marks and connect through a 42-inch 50-ohm BNC cable and 50-ohm BNC termination to the amplifier unit. Set the deflection factor of the amplifier unit so the markers are at least 2 divisions in amplitude.

d. Position the first marker to the extreme left vertical graticule line.

e. Set the time-base unit front-panel adjustment, Swp Cal, for 1 time-mark/division and coincidence of the second and tenth time marks exactly with their respective graticule lines (position the display as necessary).

NOTE

Unless otherwise stated, always adjust and check timing accuracy using the center eight divisions of timing waveform and graticule (always exclude the first and last divisions of unmagnified sweep).

f. Set the time-base unit for a sweep rate of 0.05 microsecond/division, then set magnifier switch to X10.

g. Set the time-mark generator for 10-nanosecond time marks. Maintain a display of at least 2 divisions in amplitude with stable triggering.

h. Check—The displayed waveform over the center 8 graticule divisions for 1 marker every 2 divisions within 0.28 division.

i. ADJUST—C562 and C587 for 1 marker every 2 divisions and best linearity over the center 8 divisions of display using a low-capacitance screwdriver. See Figure 7-17 for adjustment locations.

j. Disconnect the signal cable setup.

√ E6. CHECK X-Y PHASE SHIFT

a. Remove the time-base unit from the horizontal compartment and install identical amplifier units in the left vertical and horizontal compartments.

b. Set both amplifier units for a deflection factor of 50 millivolts/division and dc input coupling.

c. Connect the low-frequency generator output through a 42-inch 50-ohm BNC cable, 50-ohm termination, and a BNC T-connector, to an amplifier unit. Connect an 18-inch 50-ohm BNC cable from the BNC T-connector to the other amplifier unit.

d. Set the low-frequency generator for 8 divisions of vertical and horizontal deflection at a frequency of 35 kilohertz.

e. Center the resultant Lissajous display on the graticule as shown in Figure 5-3.

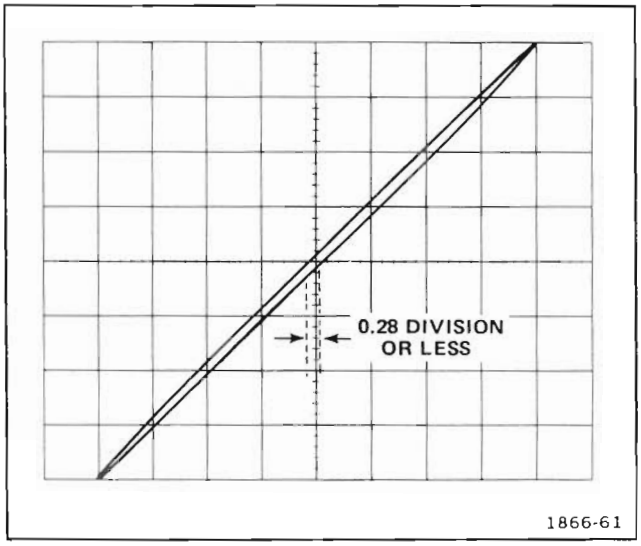

Figure 5-3. Typical display when checking X-Y phase shift.

√ f. CHECK—For 0.28 division or less of opening at center of the Lissajous display (measured horizontally). See Figure 5-3.

g. Disconnect the signal cable setup.

√ E7. CHECK HORIZONTAL BANDWIDTH

a. Install the time-base unit in the right vertical compartment.

b. Set the VERT MODE switch to RIGHT.

c. Set the time-base unit magnifier switch to X1, then set time/division control for a sweep rate of 0.5 millisecond/division.

√ **Performance Requirement check, see introductory information.**

d. Connect the sine-wave generator output through a 42-inch 50-ohm BNC cable and 50-ohm BNC termination to the amplifier unit in the horizontal compartment.

e. Set the sine-wave generator for an 8-division horizontal display at a 50-kilohertz reference frequency.

f. Without changing the output amplitude, increase the generator frequency to 2 megahertz.

√ g. CHECK—The display for at least 5.6 divisions of signal amplitude.

h. Disconnect the signal cable setup.

√ Performance Requirement check, see introductory information.

F. CALIBRATOR AND REAR PANEL OUTPUT SIGNALS

Equipment Required

1. Amplifier plug-in unit
2. Time-base plug-in unit
3. Digital voltmeter
4. Test oscilloscope
5. 42-inch, 50-ohm BNC cable
6. 18-inch, 50-ohm BNC cable
7. Screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 3** in the pullout pages.

Install Plug-In Units

Install an amplifier unit in the left vertical compartment. Install the time-base unit in the horizontal compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT (new setting)
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

Amplifier Unit

Position . . . . . Midrange
Input coupling . . . . . Dc
Polarity . . . . . + Up
Mag X1
Volts/division . . . . . 0.5 V (new setting)
Variable volts/division . . . . . Cal detent

Time-Base Unit

Main triggering
- Slope . . . . . +
- Level 0
- Mode . . . . . Auto
- Coupling . . . . . Ac
- Source . . . . . Int

Dlyd trig
- Level . . . . . Runs after dly time
- Slope . . . . . +
- Coupling . . . . . Ac
- Source . . . . . Int

Position . . . . . As desired
Mag X1
Time/div or dly time . . . . . 1 ms (new setting)
Dly'd time/division . . . . . 1 ms (knobs locked, new setting)
Variable . . . . . Cal detent
Delay time mult . . . . . 0.00 (new setting)

√ F1. CHECK CALIBRATOR OUTPUT VOLTAGE

a. Move the jumper on the Calibrator and Mode Switches board to the dc output position. See Figure 7-18 for jumper location and placement.

b. Connect the digital voltmeter between the center conductor and shell of the front-panel CALIBRATOR connector.

√ c. CHECK—The voltmeter for a reading within the tolernace listed below for the appropriate ambient temperature range:

+15° to +35° C, 0.988 to 1.012 volts.
0° to +50° C, 0.978 to 1.022 volts.
−28° to +65° C, 0.958 to 1.042 volts.

d. ADJUST—Cal Adj R1077 for a reading of exactly 1 volt. See Figure 7-18 for adjustment location.

e. Disconnect the digital voltmeter.

√ Performance Requirement check, see introductory information.

f. Return the jumper on the Calibrator and Mode Switches board to the 1 kHz output position. See Figure 7-18 for jumper location and placement.

F2. CHECK CALIBRATOR 1 kHz REPETITION RATE

a. Connect an 18-inch 50-ohm BNC cable from the CALIBRATOR output connector to the amplifier unit.

b. Position the start of the square-wave display to the extreme left graticule line.

c. Check—The display for approximately 1 cycle/division.

d. Disconnect the signal cable.

√ F3. CHECK REAR PANEL OUTPUT SIGNALS

NOTE

Sweep, gate, and trigger waveforms are available at the rear panel only when the Oscilloscope is used with a TD-1085/U Dual Time Base unit. When the Oscilloscope is used with some other 7000-series time-base units, a sawtooth signal may be available at the MAIN SWP OUTPUT connector.

a. Set the time-base unit for a sweep rate of 0.2 millisecond/division.

b. Connect MAIN SWP OUTPUT (output connector on rear panel of the Oscilloscope) to the vertical input of the test oscilloscope through a 42-inch 50-ohm BNC cable.

c. Set the test oscilloscope: Vertical deflection factor for 2 volts/division in the single-trace mode, sweep rate for 1 millisecond/division, position and triggering for a stable triggered waveform near graticule center.

√ d. CHECK—The test oscilloscope display for a sawtooth waveform amplitude of at least 2.5 divisions (5 volts).

e. Move the Oscilloscope cable to the DELAYED SWP OUTPUT connector.

f. Pull the time-base unit delayed time/division switch outward to activate the intensified-sweep mode function.

√ g. CHECK—The test oscilloscope display for a sawtooth waveform amplitude of at least 2.5 divisions (5 volts).

h. Move the Oscilloscope cable to MAIN SWP GATE OUTPUT connector.

√ i. CHECK—The test oscilloscope display for a gate-waveform amplitude of at least 1 division (2 volts).

j. Move the Oscilloscope cable to the DELAYED SWP GATE OUTPUT connector.

√ k. CHECK—The test oscilloscope display for a gate-waveform amplitude of at least 1 division (2 volts).

l. Move the Oscilloscope cable to the DELAYED TRIG OUTPUT connector.

m. Press in the time-base unit delayed time/division switch (to lock the time/division knobs together), then set for a sweep rate of 1 microsecond/division. Pull the delayed time/division switch outward for the intensified-sweep mode.

n. Set the test oscilloscope for a vertical deflection factor of 0.5 volt/division and a sweep rate of 0.5 microsecond/division.

√ o. CHECK—The test oscilloscope display for a pulse-waveform amplitude of at least 2 divisions (1 volt) with a duration of at least 0.1 division.

p. Disconnect all test equipment.

This completes the performance check/calibration procedures of the Oscilloscope. If complete calibration was performed to this point, install the cabinet sides on the Oscilloscope.

√ Performance Requirement check, see introductory information.

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 CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P. O. BOX 5012	DALLAS, TX 75222
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04222	AVX CERAMIC CORP.	P.O. BOX 867	MURTLE BEACH, SC 29577
04239	GENERAL ELECTRIC CO., CHEMICAL AND METALLURGICAL VENTURES, OPN MAGNETIC MATERIALS PRODUCT	P. O. BOX 72	EDMORE, MI 48829
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPT.	NELA PK.	CLEVELAND, OH 44112
12040	NATIONAL SEMICONDUCTOR CORP.	COMMERCE DRIVE	DANBURY, CT 06810
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON ST.	DOVER, NH 03820
12954	DICKSON ELECTRONICS CORP.	8700 E. THOMAS RD.	SCOTTSDALE, AZ 85252
12969	UNITRODE CORP.	580 PLEASANT ST.	WATERTOWN, MA 02172
13715	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	4300 REDWOOD HWY.	SAN RAFAEL, CA 94903
14433	ITT SEMICONDUCTORS, A DIV. OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORP.	3301 ELECTRONICS WAY	WEST PALM BEACH, FL 33401
15818	TELEDYNE SEMICONDUCTOR	1300 TERRA BELLA AVE.	MOUNTAIN VIEW, CA 94040
21845	SOLITRON DEVICES, INC., TRANSISTOR DIV.	1177 BLUE HERON BLVD.	RIVIERA BEACH, FL 33404
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SAN YSIDRO WAY	SANTA CLARA, CA 95051
28480	HEWLETT-PACKARD CO., CORPORATE HQ.	1501 PAGE MILL RD.	PALO ALTO, CA 94304
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787	MUSKEGON, MI 49443
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.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
80294	BOURNS, INC., INSTRUMENT DIV.	6135 MAGNOLIA AVE.	RIVERSIDE, CA 92506
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
83003	VARO, INC.	800 W. GARLAND AVE.	GARLAND, TX 75040
86684	RCA CORP., ELECTRONIC COMPONENTS	415 S. 5TH ST.	HARRISON, NJ 07029
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NB 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. MANSFIELD PLANT	P. O. BOX 1007	MANSFIELD, OH 44903

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1529-00			CKT BOARD ASSY:MAIN INTERFACE	80009	670-1529-00
A2	670-1530-00			CKT BOARD ASSY:LOGIC	80009	670-1530-00
A3	670-1371-03			CKT BOARD ASSY:TRIGGER SELECTOR	80009	670-1371-03
A4	670-1373-06			CKT BOARD ASSY:VERTICAL INTERFACE	80009	670-1373-06
A5	670-1958-01			CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-1958-01
A6	670-1378-02			CKT BOARD ASSY:HORIZONTAL AMPLIFIER	80009	670-1378-02
A7	670-1379-02			CKT BOARD ASSY:CALIBRATOR AND MODE SW	80009	670-1379-02
A8	670-1383-02			CKT BOARD ASSY:Z-AXIS AMPLIFIER	80009	670-1383-02
A9	670-1380-02			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-1380-02
A10	670-1996-00			CKT BOARD ASSY:RECTIFIER	80009	670-1996-00
A11	670-1376-08			CKT BOARD ASSY:REGULATOR	80009	670-1376-08
C1	290-0271-00			CAP.,FXD,ELCTLT:9UF,+20-15%,125V	56289	109D905C2125F2
C3	290-0302-00			CAP.,FXD,ELCTLT:100UF,10%,20V	12954	D100D20KI
C5	290-0302-00			CAP.,FXD,ELCTLT:100UF,10%,20V	12954	D100D20KI
C7	290-0302-00			CAP.,FXD,ELCTLT:100UF,10%,20V	12954	D100D20KI
C9	290-0271-00			CAP.,FXD,ELCTLT:9UF,+20-15%,125V	56289	109D905C2125F2
C44	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C47	281-0638-00			CAP.,FXD,CER DI:240PF,5%,500V	72982	301000Z5D241J
C55	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C58	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C59	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C60	281-0564-00			CAP.,FXD,CER DI:24PF,5%,500V	72982	301-000C0G0240J
C65	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C89	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C93	281-0524-00			CAP.,FXD,CER DI:150PF,+/-30PF,500V	04222	7001-1381
C135	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C136	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C137	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C145	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C146	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C147	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C152	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C165	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C166	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C188	281-0552-00			CAP.,FXD,CER DI:25PF,5%,500V	72982	301-000P2G0250J
C193	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C195	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C196	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C198	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C207	281-0538-00			CAP.,FXD,CER DI:1PF,20%,500V	80009	281-0538-00
C208	281-0528-00			CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C215	281-0589-00			CAP.,FXD,CER DI:170PF,5%,500V	72982	301000Z5D171J
C217	281-0537-00			CAP.,FXD,CER DI:0.68PF,20%,600V	80009	281-0537-00
C220	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C227	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C260	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C301	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C305	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C322	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D
C329	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D
C342	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C348	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C401	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C418	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000C0G0330J
C420	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C421	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C425	281-0160-00			CAP.,VAR,CER DI:7-25PF,350V	72982	538-011B7-25
C427	281-0160-00			CAP.,VAR,CER DI:7-25PF,350V	72982	538-011B7-25
C433	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C455	283-0100-00			CAP.,FXD,CER DI:0.0047UF,10%,200V	56289	273C3
C456	283-0119-00			CAP.,FXD,CER DI:2200PF,5%,200V	72982	855-535B222J
C458	283-0116-00			CAP.,FXD,CER DI:820PF,5%,500V	72982	801-547B821J
C465	283-0211-00			CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N227C104K
C466	283-0187-00			CAP.,FXD,CER DI:0.047UF,10%,400V	72982	8131N401X5R473K
C468	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131-250651103P
C480	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C486	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C492	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C494	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C496	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C509	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C513	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C519	281-0564-00			CAP.,FXD,CER DI:24PF,5%,500V	72982	301-000C0G0240J
C546	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C550	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C559	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C561	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C562	281-0092-00			CAP.,VAR,CER DI:9-35PF	72982	538-011E2P094R
C564	281-0526-00			CAP.,FXD,CER DI:1.5PF,+/-0.5PF,500V	72982	301-000S2K0159D
C569	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C573	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C575	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C586	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C587	281-0097-00			CAP.,VAR,CER DI:9-35PF	72982	538-006E2P094R
C588	281-0526-00			CAP.,FXD,CER DI:1.5PF,+/-0.5PF,500V	72982	301-000S2K0159D
C593	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C595	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C596	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C597	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C604	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C611	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C613	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C617	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C618	303-0203-00			RES.,FXD,CMPSN:20K OHM,5%,1W	01121	GB2035
C619	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C622	281-0053-00			CAP.,VAR,PLSTC:0.35-1.37PF	72982	535-060 0.7-3
C630	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C636	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C639	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C700	290-0410-00			CAP.,FXD,ELCTLT:15UF,+50-10%,100V	56289	30D156F100DD4
C702	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	72982	878Y5S102M
C704	283-0189-00			CAP.,FXD,CER DI:0.1UF,20%,400V	72982	8151N401X5R104M
C705	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075651224M
C711	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C720	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C722	290-0312-00			CAP.,FXD,ELCTLT:47UF,10%,35V	56289	150D476X9035S2
C743	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C745	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C746	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C748	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C750	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C752	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	72982	878Y5S102M
C757	290-0305-01			CAP.,FXD,ELCTLT:3UF,10%,150V	56289	109D305X9150C2
C760	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	72982	878Y5S102M
C806	290-0468-00			CAP.,FXD,ELCTLT:250UF,+75-10%,150V	56289	68D10470
C808	290-0507-00			CAP.,FXD,ELCTLT:1800UF,+75-10%,75V	56289	68D10472
C809	290-0507-00			CAP.,FXD,ELCTLT:1800UF,+75-10%,75V	56289	68D10472
C810	285-0555-00			CAP.,FXD,PLSTC:0.1UF,20%,100V	56289	410P10401
C811	290-0581-00			CAP.,FXD,ELCTLT:14,000UF,+75-10%,25V	56289	68D10489
C813	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C814	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C820	285-0555-00			CAP.,FXD,PLSTC:0.1UF,20%,100V	56289	410P10401
C821	290-0508-00			CAP.,FXD,ELCTLT:18,000UF,+100-10%,15V	56289	68D10444
C823	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C858	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C866	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C880	283-0638-00			CAP.,FXD,MICA D:130PF,1%,100V	00853	D151E131F0
C889	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C923	281-0591-00			CAP.,FXD,CER DI:5600PF,20%,200V	72982	3930-01Z5V0562Z
C950	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C979	281-0591-00			CAP.,FXD,CER DI:5600PF,20%,200V	72982	3930-01Z5V0562Z
C985	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C1064	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P112
C1079	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
CR26	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR27	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR33	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR42	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR84	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR85	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR124	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR125	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR126	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR130	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR140	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR155	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR160	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR190	152-0071-00			SEMICOND DEVICE:GERMANIUM,15V,40MA	14433	G865
CR238	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR341	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR349	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR460	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR461	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR496	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR519	152-0322-00			SEMICOND DEVICE:SILICON,15V	28480	5082-2672
CR520	152-0322-00			SEMICOND DEVICE:SILICON,15V	28480	5082-2672
CR522	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR526	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR528	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	13715	FD7003
CR533	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	13715	FD7003
CR538	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR539	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR543	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	13715	FD7003
CR700	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR716	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR743	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG-12X
CR750	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR752	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR756	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR757	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR806	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR808	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR811	152-0406-00			SEMICOND DEVICE:SILICON,200V,3A	83003	W601
CR820	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR821	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR852	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR861	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR867	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR868	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR875	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR883	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR885	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR888	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR891	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR894	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR896	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR903	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR920	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR924	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR925	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR935	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR941	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR950	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR951	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR952	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR958	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR961	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR980	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR981	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR989	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR1021	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1023	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1024	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1026	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
DL400	119-0288-02			DELAY LINE,ELEC:	80009	119-0288-02
DS1090	150-0047-00			LAMP,INCAND:6.3V,0.2A	08806	398
DS1091	150-0047-00			LAMP,INCAND:6.3V,0.2A	08806	398
DS1092	150-0047-00			LAMP,INCAND:6.3V,0.2A	08806	398
F855	159-0083-00			FUSE,CARTRIDGE:0.15A,250V,FAST-BLOW	71400	AGC 15/100

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F1000	159-0023-00			FUSE,CARTRIDGE:3AG,2A,250V,SLOW-BLOW	71400	MDX 2
F1001	159-0023-00			FUSE,CARTRIDGE:3AG,2A,250V,SLOW-BLOW	71400	MDX 2
F1002	159-0023-00			FUSE,CARTRIDGE:3AG,2A,250V,SLOW-BLOW	71400	MDX 2
FL1000	119-0113-05			FILTER,RFI:	72982	9604-000-9000
L193	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L195	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L197	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L198	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L425	108-0707-00			COIL,RF:150NH	80009	108-0707-00
L474	276-0528-00			SHIELDING BEAD,:0.1UH	80009	276-0528-00
L478	276-0528-00			SHIELDING BEAD,:0.1UH	80009	276-0528-00
L482	108-0331-00			COIL,RF:0.75UH	80009	108-0331-00
L722	108-0646-00			COIL,RF:80UH	80009	108-0646-00
L1098	108-0732-00			COIL,TUBE DEFL:	80009	108-0732-00
L1099	119-0288-02			DELAY LINE,ELEC:	80009	119-0288-02
LR473	108-0715-00			COIL,RF:255NH	80009	108-0715-00
LR477	108-0715-00			COIL,RF:255NH	80009	108-0715-00
Q132	151-0199-00			TRANSISTOR:SILICON,PNP	04713	MPS3640
Q142	151-0199-00			TRANSISTOR:SILICON,PNP	04713	MPS3640
Q147	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q150	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q162	151-0199-00			TRANSISTOR:SILICON,PNP	04713	MPS3640
Q167	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q223	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q236	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q238	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q242	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q252	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q314	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q344	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q346	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q407	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q415	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q496	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q506	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q516	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q535	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q541	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q545	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q547	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q555	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q559	151-0274-00			TRANSISTOR:SILICON,NPN	04713	SS7394
Q580	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q584	151-0274-00			TRANSISTOR:SILICON,NPN	04713	SS7394
Q607	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q615	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q619	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q621	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q708	151-0126-00			TRANSISTOR:SILICON,NPN	15818	2N2484
Q712	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q716	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495

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Q764	151-0140-00			TRANSISTOR:SILICON,NPN	02735	36568
Q766	151-0140-00			TRANSISTOR:SILICON,NPN	02735	36568
Q827	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q829	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q835	151-0334-00			TRANSISTOR:SILICON,NPN	80009	151-0334-00
Q850	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q852	151-0276-00			TRANSISTOR:SILICON,PNP	04713	2N5087
Q860	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q863	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q869	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q872	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q874	151-0336-00			TRANSISTOR:SILICON,NPN	21845	93SX288
Q876	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q886	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q896	151-0228-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q900	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q903	151-0336-00			TRANSISTOR:SILICON,NPN	21845	93SX288
Q908	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q909	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q910	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q919	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q926	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q931	151-0260-02			TRANSISTOR:SILICON,NPN	04713	2N5859
Q933	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q936	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q952	151-0134-00			TRANSISTOR:SILICON,PNP	04713	SM3195
Q956	151-0260-02			TRANSISTOR:SILICON,NPN	04713	2N5859
Q958	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q964	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q985	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q988	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q1061	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q1066	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q1070	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q1072	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
R12	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	75042	CEAT0-4991F
R14	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	75042	CEAT0-4991F
R28	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R29	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R33	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R42	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R44	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R46	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R47	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R55	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R56	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R57	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R58	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R59	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R60	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R63	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R65	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	75042	CEAT0-6810F
R82	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105

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R83	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R84	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R85	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R86	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R88	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	75042	CEAT0-2051F
R89	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R90	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R92	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEAT0-2001F
R93	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R95	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R96	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R97	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R98	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R99	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R101	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R102	311-1393-00			RES.,VAR,NONWIR:5K X 5 MEG OHM,20%,0.5W	12697	CM39702
R115	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R123	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R124	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R125	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R126	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R130	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R132	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R133	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R134	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R135	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R136	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R137	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R138	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R140	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R141	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R142	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R143	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R144	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R145	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R146	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R147	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R148	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R149	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R150	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R152	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R154	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R155	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R157	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R159	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R160	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R161	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R162	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R163	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R164	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R165	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R166	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R168	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725

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R170	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R172	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R173	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R174	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R176	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R177	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R178	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R179	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R180	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R182	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R183	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R184	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R186	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R187	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R188	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R189	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R190	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R191	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R192	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R200	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R202	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R204	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R206	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R208	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R209	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R211	322-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.25W	75042	CEBT0-1101F
R212	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R214	322-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.25W	75042	CEBT0-1581F
R215	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R216	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R218	322-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.25W	75042	CEBT0-1101F
R219	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R222	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R224	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R225	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R226	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R228	321-0060-00			RES.,FXD,FILM:41.2 OHM,1%,0.125W	75042	CEAT0-41R20F
R230	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	75042	CEAT0-2801F
R232	321-0060-00			RES.,FXD,FILM:41.2 OHM,1%,0.125W	75042	CEAT0-41R20F
R234	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R326	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R238	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R240	323-0149-00			RES.,FXD,FILM:348 OHM,1%,0.50W	75042	CECT0-3480F
R241	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	75042	CEAT0-1581F
R246	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R250	323-0149-00			RES.,FXD,FILM:348 OHM,1%,0.50W	75042	CECT0-3480F
R251	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	75042	CEAT0-1581F
R259	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R261	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R301	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R303	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R305	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R307	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F

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R308	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R310	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R312	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R314	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R315	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R317	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R319	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R320	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	75042	CEAT0-1821F
R321	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R322	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R323	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R324	322-0184-00			RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBT0-8060F
R326	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R327	322-0184-00			RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBT0-8060F
R328	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R329	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R330	321-0052-00			RES.,FXD,FILM:34 OHM,1%,0.125W	75042	CEAT0-34R00F
R335	321-0052-00			RES.,FXD,FILM:34 OHM,1%,0.125W	75042	CEAT0-34R00F
R340	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	75042	CEAT0-1651F
R341	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R342	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R343	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R344	321-0040-00			RES.,FXD,FILM:25.5 OHM,1%,0.125W	75042	CEAT0-25R5F
R345	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R346	321-0040-00			RES.,FXD,FILM:25.5 OHM,1%,0.125W	75042	CEAT0-25R5F
R348	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R349	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R350	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	75042	CEAT0-1651F
R352	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R401	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R403	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	80294	3386F-T04-103
R404	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R405	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R407	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R408	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R409	323-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.50W	75042	CECT0-2871F
R411	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	75042	CEAT0-2801F
R413	323-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.50W	75042	CECT0-2871F
R414	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R415	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R416	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R417	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R418	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R420	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R421	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	80294	3329P-L58-501
R423	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R424	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R425	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	62PT-345-0
R427	311-1007-00			RES.,VAR,NONWIR:20 OHM,20%,0.50W	80294	3329HG48-200
R429	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	75042	CEAT0-1500F
R433	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R440	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	75042	CEAT0-7500F
R442	321-0092-00			RES.,FXD,FILM:88.7 OHM,1%,0.125W	75042	CEAT0-88R70F

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R443	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	75042	CEAT0-1211F
R444	321-0092-00			RES.,FXD,FILM:88.7 OHM,1%,0.125W	75042	CEAT0-88R70F
R446	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	75042	CEAT0-63R40F
R447	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	80294	3329P-L58-501
R448	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	75042	CEAT0-63R40F
R450	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	75042	CEAT0-7500F
R452	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R453	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R455	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R456	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R458	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R459	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R460	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R461	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R462	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R463	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R465	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R466	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R468	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R474	310-0701-00			RES.,FXD,WW:430 OHM,1%,8W	80009	310-0701-00
R478	310-0701-00			RES.,FXD,WW:430 OHM,1%,8W	80009	310-0701-00
R480	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R484	321-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.125W	75042	CEAT0-1101F
R486	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	62PT-345-0
R488	323-0054-00			RES.,FXD,FILM:35.7 OHM,1%,0.50W	75042	CECT0-35R70F
R490	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R491	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R492	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R495	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R496	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R501	321-1068-01			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT0-50R50D
R502	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R503	321-1068-01			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT0-50R50D
R505	323-0187-00			RES.,FXD,FILM:866 OHM,1%,0.50W	75042	CECT0-8660F
R506	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R508	321-0160-00			RES.,FXD,FILM:453 OHM,1%,0.125W	75042	CEAT0-4530F
R509	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	80294	3386F-T04-102
R510	321-0157-00			RES.,FXD,FILM:422 OHM,1%,0.125W	75042	CEAT0-4220F
R512	323-0190-00			RES.,FXD,FILM:931 OHM,1%,0.50W	75042	CECT0-9310F
R513	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	80294	3386F-T04-101
R514	323-0190-00			RES.,FXD,FILM:931 OHM,1%,0.50W	75042	CECT0-9310F
R516	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R517	323-0187-00			RES.,FXD,FILM:866 OHM,1%,0.50W	75042	CECT0-8660F
R519	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R522	323-0206-00			RES.,FXD,FILM:1.37K OHM,1%,0.50W	75042	CECT0-1371F
R524	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R526	323-0206-00			RES.,FXD,FILM:1.37K OHM,1%,0.50W	75042	CECT0-1371F
R528	321-0320-00			RES.,FXD,FILM:21K OHM,1%,0.125W	75042	CEAT0-2102F
R529	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	75042	CEAT0-6191F
R531	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	80294	3386F-T04-102
R532	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	75042	CEAT0-6191F
R533	321-0320-00			RES.,FXD,FILM:21K OHM,1%,0.125W	75042	CEAT0-2102F
R535	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	75042	CEAT0-2151F

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R537	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R538	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	75042	CEAT0-1001F
R539	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R541	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	75042	CEAT0-2151F
R543	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R546	303-0470-00			RES.,FXD,CMPSN:47 OHM,5%,1W	01121	GB4705
R550	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R551	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R553	323-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.50W	75042	CECT0-47R50F
R555	323-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.50W	75042	CECT0-2491F
R556	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R558	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R559	323-0097-00			RES.,FXD,FILM:100 OHM,1%,0.50W	75042	CECT0-1000F
R561	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	75042	CEAT0-9090F
R562	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R564	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R565	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R567	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R569	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	75042	CEAT0-4021F
R570	321-0830-03			RES.,FXD,FILM:2.41K OHM,0.25%,0.125W	75042	CEAT2-2411C
R572	321-0273-00			RES.,FXD,FILM:6.81K OHM,1%,0.125W	75042	CEAT0-6811F
R573	323-0352-00			RES.,FXD,FILM:45.3K OHM,1%,0.50W	75042	CECT0-4532F
R575	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R576	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R578	323-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.50W	75042	CECT0-47R50F
R580	323-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.50W	75042	CECT0-2491F
R581	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R583	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R584	323-0097-00			RES.,FXD,FILM:100 OHM,1%,0.50W	75042	CECT0-1000F
R586	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	75042	CEAT0-9090F
R587	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R588	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R589	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R591	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R593	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R595	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R597	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R599	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R602	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R604	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R605	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R609	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R611	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R613	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R615	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R617	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R620	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R622	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R623	323-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.50W	75042	CECT0-1742F
R625	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R630	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3386F-T04-104
R633	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	80294	3386F-T04-502
R636	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3386F-T04-104

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R638	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R639	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R700	315-0434-00			RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R701	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R702	307-0359-00			RES.,FXD,FILM:HV DIVIDER	80009	307-0359-00
R705	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R706	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R708	315-0395-00			RES.,FXD,CMPSN:3.9M OHM,5%,0.25W	01121	CB3955
R709	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R713	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R714	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R716	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R745	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R748	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R754	301-0915-00			RES.,FXD,CMPSN:9.1M OHM,5%,0.50W	01121	EB9155
R758	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R759	311-1134-00			RES.,VAR,NONWIR:50K OHM,20%,0.5W	73138	72XW-51-0-503M
R763	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R765	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R805	307-0113-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
R806	302-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.50W	01121	EB4731
R808	302-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.50W	01121	EB2231
R809	302-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.50W	01121	EB2231
R811	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R814	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R821	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R822	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R823	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R824	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R826	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R827	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R830	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R831	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R833	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R837	307-0054-00			RES.,FXD,CMPSN:3.6 OHM,5%,0.50W	01121	EB36GB
R838	307-0054-00			RES.,FXD,CMPSN:3.6 OHM,5%,0.50W	01121	EB36GB
R853	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R855	323-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.50W	75042	CECT0-1622F
R856	323-0289-00			RES.,FXD,FILM:10K OHM,1%,0.50W	75042	CECT0-1002F
R858	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R859	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R860	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R862	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R864	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R866	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R867	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R870	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R872	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R875	308-0677-00			RES.,FXD,WW:1 OHM,5%,2W	75042	BWH-1R000J
R876	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R877	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R878	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R879	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R880	323-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.50W	75042	CECT0-6651F
R881	311-1223-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	80294	3386F-T04-251
R882	323-0206-00			RES.,FXD,FILM:1.37K OHM,1%,0.50W	75042	CECT0-1371F
R883	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	75042	CEAT0-2051F
R884	323-0306-00			RES.,FXD,FILM:15K OHM,1%,0.50W	75042	CECT0-1502F
R886	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R889	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R890	323-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.50W	75042	CECT0-5491F
R891	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R892	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R894	315-0245-00			RES.,FXD,CMPSN:2.4M OHM,5%,0.25W	01121	CB2455
R896	301-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.50W	01121	EB3635
R898	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R901	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R903	308-0677-00			RES.,FXD,WW:1 OHM,5%,2W	75042	BWH-1R000J
R904	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R906	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R907	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R908	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R910	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R911	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R912	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R915	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	75042	CEAT9-1202B
R916	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R918	301-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.50W	01121	EB6835
R921	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R922	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R923	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R924	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R927	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R932	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R935	308-0678-00			RES.,FXD,WW:0.1 OHM,5%,2W	75042	BWH-R1000J
R936	301-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.50W	01121	EB2735
R937	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R938	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R939	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R940	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R942	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R945	321-0332-07			RES.,FXD,FILM:28K OHM,0.1%,0.125W	75042	CEAT9-2802B
R946	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	75042	CEAT9-1202B
R948	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	01121	CB9145
R950	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R952	301-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.50W	01121	EB3035
R954	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R956	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R957	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R958	308-0678-00			RES.,FXD,WW:0.1 OHM,5%,2W	75042	BWH-R1000J
R959	308-0680-00			RES.,FXD,WW:0.045 OHM,10%,3W	91637	LVR2-DR0450K
R961	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R963	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R966	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R967	315-0364-00			RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
R970	321-0926-07			RES.,FXD,FILM:4K OHM,0.1%,0.125W	75042	CEAT9-4001B

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R971	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R973	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R975	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R977	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R979	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R980	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R983	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R985	304-0470-00			RES.,FXD,CMPSN:47 OHM,10%,1W	01121	GB4701
R986	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R989	308-0678-00			RES.,FXD,WW:0.1 OHM,5%,2W	75042	BWH-R1000J
R991	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R993	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R994	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R995	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1018	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1019	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1020	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R1022	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R1025	311-0566-00			RES.,FXD,NONWIR:5K OHM,20%,0.5W	71590	BA147-011
R1045	311-1393-00			RES.,FXD,NONWIR:5K X 5 MEG OHM,20%,0.5W	12697	CM39702
R1061	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1062	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1063	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R1066	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R1067	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R1069	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R1071	323-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.50W	75042	CECT0-4991F
R1073	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1074	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1076	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1077	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	80294	3386F-T04-502
R1079	321-0102-00			RES.,FXD,FILM:113 OHM,1%,0.125W	75042	CEAT0-1130F
R1087	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R1095	311-1055-00			RES.,VAR,NONWIR:1K OHM 20%,0.50W	12697	381-CM40034
RT417	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
RT418	307-0126-00			RES.,THERMAL:100 OHM,10%	04239	2D204
RT459	307-0126-00			RES.,THERMAL:100 OHM,10%	04239	2D204
RT461	307-0181-00			RES.,THERMAL:100K OHM,10%,4MW/DEG C	50157	JP-51J2
S1000	260-0907-00			SWITCH,THRMSTC:OPEN 97.8,CL 75.6,10A,240V	93410	110228
S1001	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
S1011	260-1379-00			SWITCH,PUSH:TRIG SOURCE	71590	2KBC120000-595
S1021	260-1378-00			SWITCH,PUSH:VERT MODE	71590	2KBC140000-608
S1030	311-1055-00			RES.,VAR,NONWIR:1K OHM 20%,0.50W	12697	381-CM40034
T738	120-0823-00			XFMR,PWR,SDN AND SU:	80009	120-0823-00
T801	120-0730-00			XFMR,PWR,STPDN:	80009	120-0730-00
T1000	120-0794-00			XFMR,TORIOD:6 TURNS	80009	120-0794-00
U55	155-0011-00			MICROCIRCUIT,DI:ML,CLOCK AND CHOP BLANKING	80009	155-0011-00
U99	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	86684	CA3046
U123	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U156	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U180	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	86684	CA3046
U214	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHANNEL SW	80009	155-0022-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U324	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHANNEL SW	80009	155-0022-00
U450	155-0080-00			MICROCIRCUIT,LI:HYBRID	80009	155-0080-00
U741	119-0401-00			MULTIPLIER,HV:	80009	119-0401-00
U973	156-0065-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	80009	156-0065-00
V1099	154-0672-00			ELECTRON TUBE:P31	80009	154-0672-00
VR244	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR254	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR851	152-0283-00			SEMICOND DEVICE:ZENER,0.4W,43V,5%	04713	1N976B
VR890	152-0124-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	1N938A

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

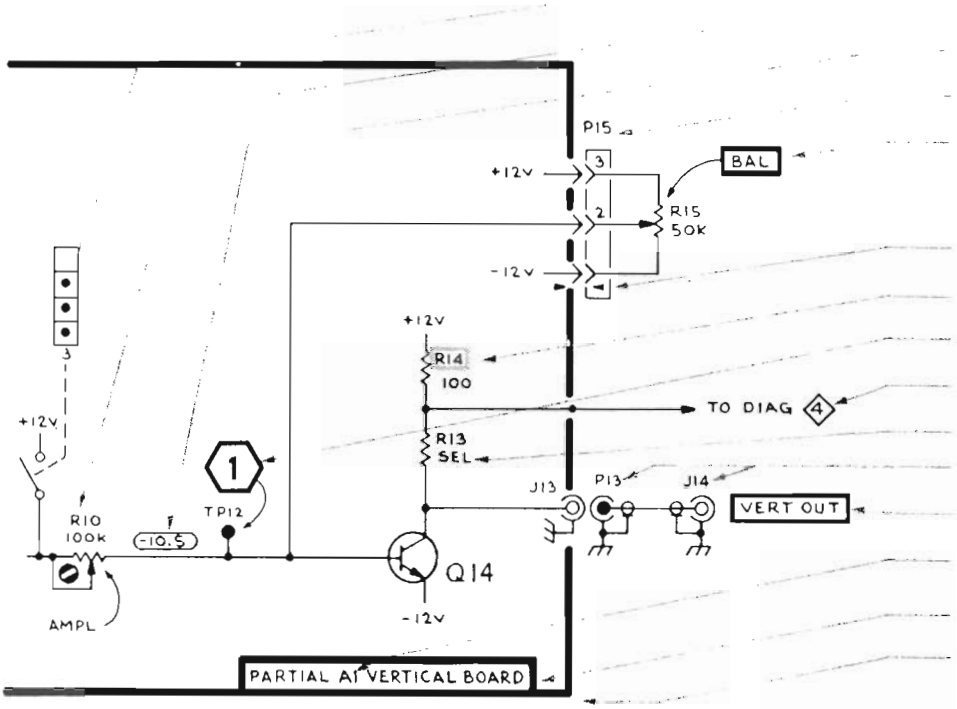
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following 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.)	RT	Thermistor
AT	Attenuator, fixed or variable	HR	Heater	S	Switch
B	Motor	HY	Hybrid circuit	T	Transformer
BT	Battery	J	Connector, stationary portion	TC	Thermocouple
C	Capacitor, fixed or variable	K	Relay	TP	Test point
CB	Circuit breaker	L	Inductor, fixed or variable	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	V	Electron tube
DL	Delay line	M	Meter	VR	Voltage regulator (zener diode, etc.)
DS	Indicating device (lamp)	P	Connector, movable portion	Y	Crystal
E	Spark Gap	Q	Transistor or silicon-controlled rectifier	Z	Phase shifter
F	Fuse				
FL	Filter	R	Resistor, fixed or variable		

The following special symbols are used on the diagrams:



VERTICAL AMPLIFIER 2 CMO 1274

Cam Switch Closure Chart

Internal Screwdriver Adjustment

Test Voltage

Plug to E.C. Board

Panel Adjustment

Plug Index

Modified Component—See Parts Lis

Refer to Waveform

Refer to Diagram Number

SEL Value Selected at Factory

Coaxial Connector

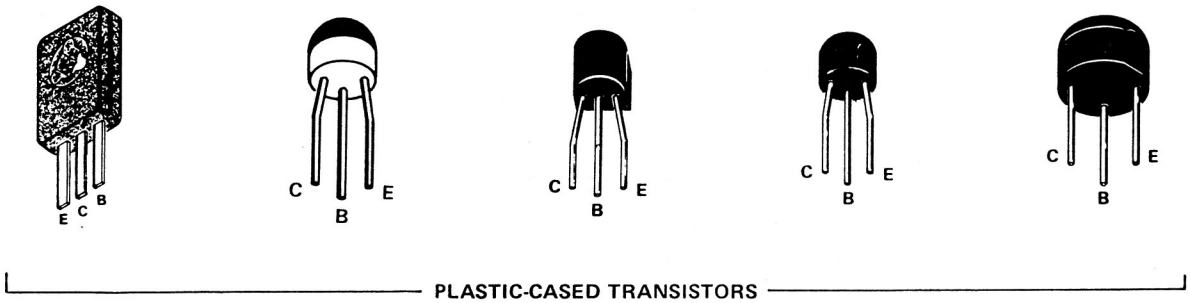
Panel Connector

Assembly Number

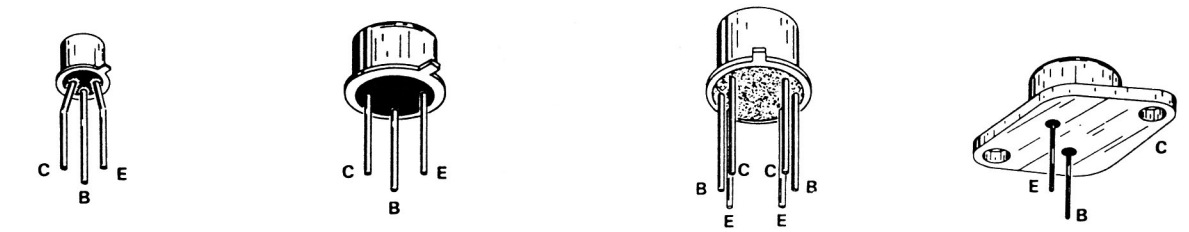
Board Name

Etched Circuit Board Outlined in Black

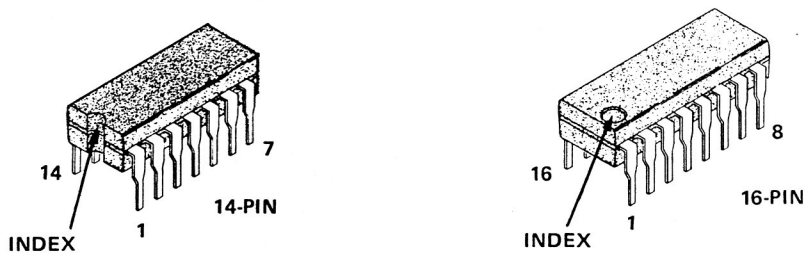
Schematic Name and Number



PLASTIC-CASED TRANSISTORS



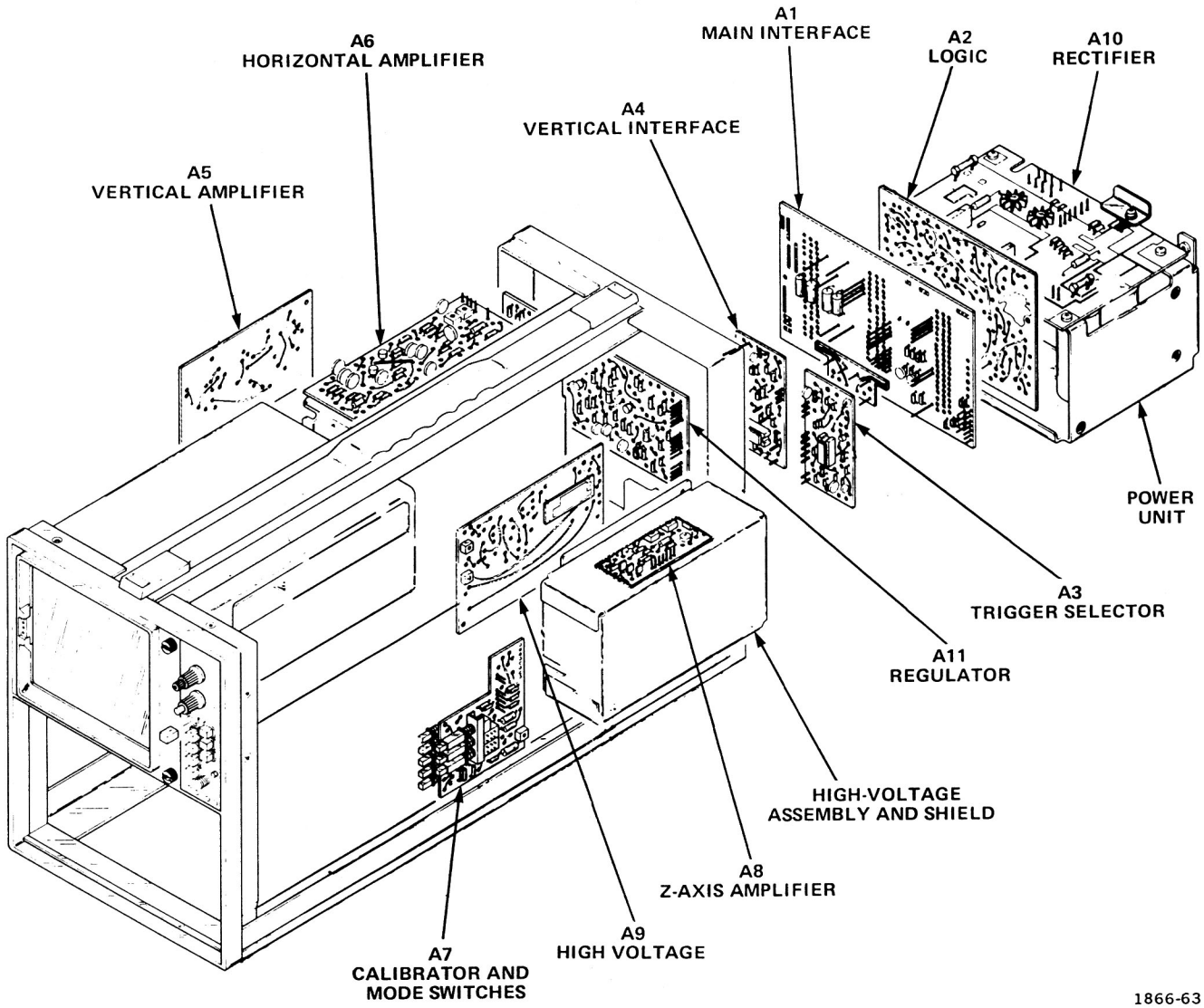
METAL-CASED TRANSISTORS



INTEGRATED CIRCUITS

1866-62

Figure 7-1. Semiconductor lead configurations.



66-62

Figure 7-2. Locations of circuit boards and assemblies in the Oscilloscope.

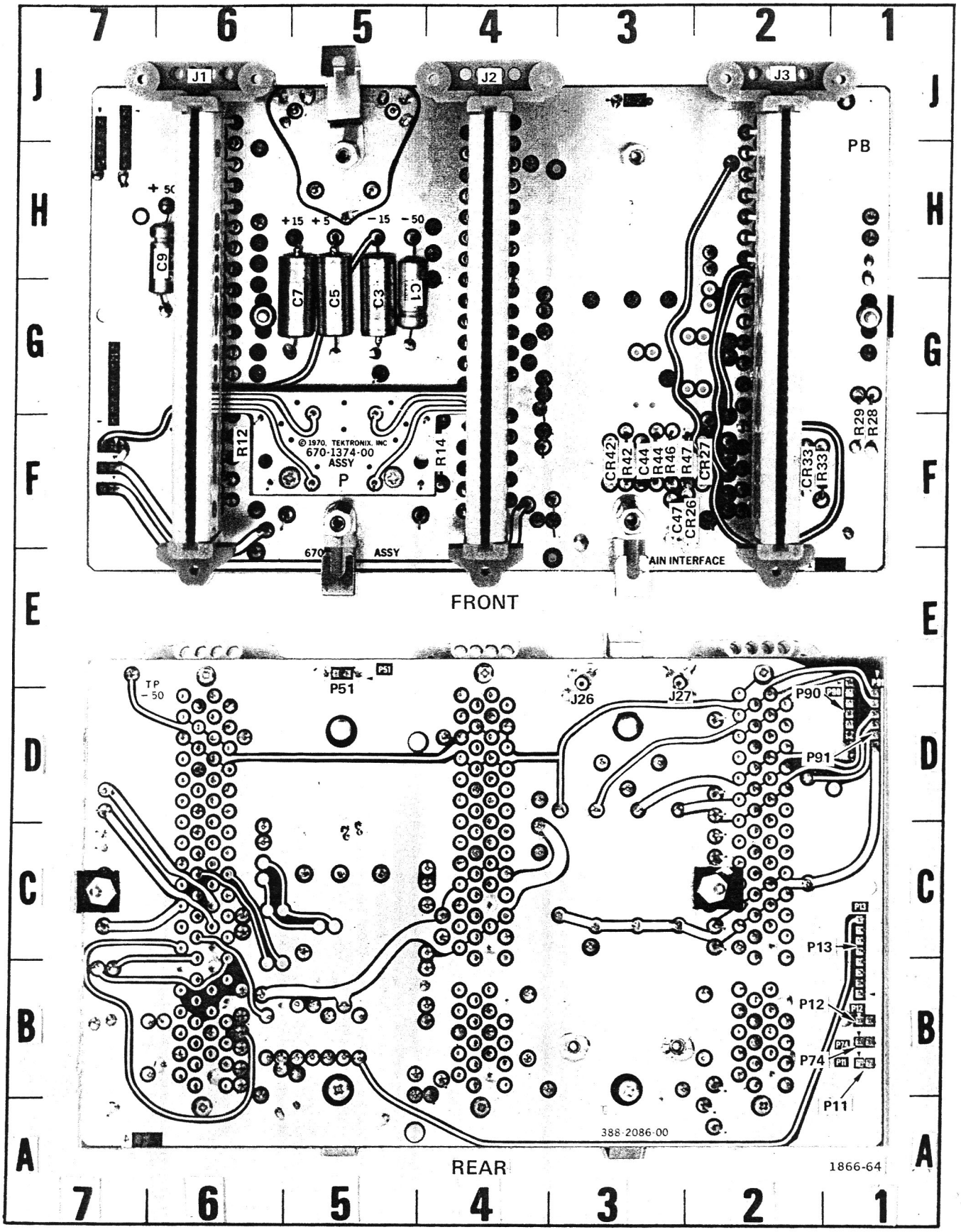
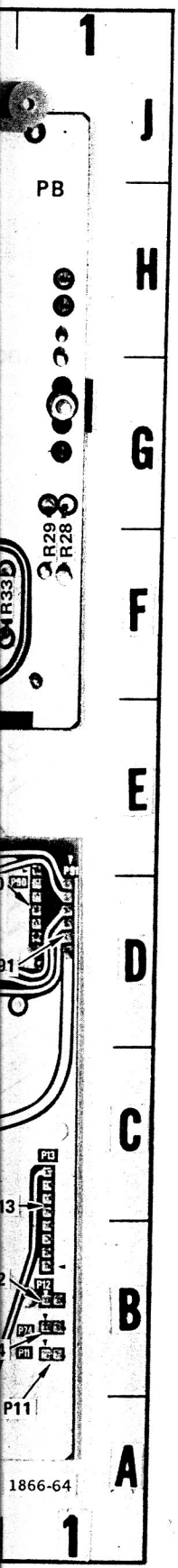
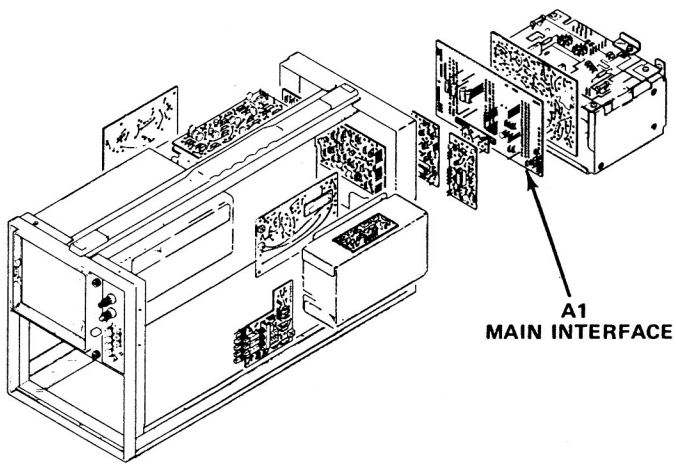


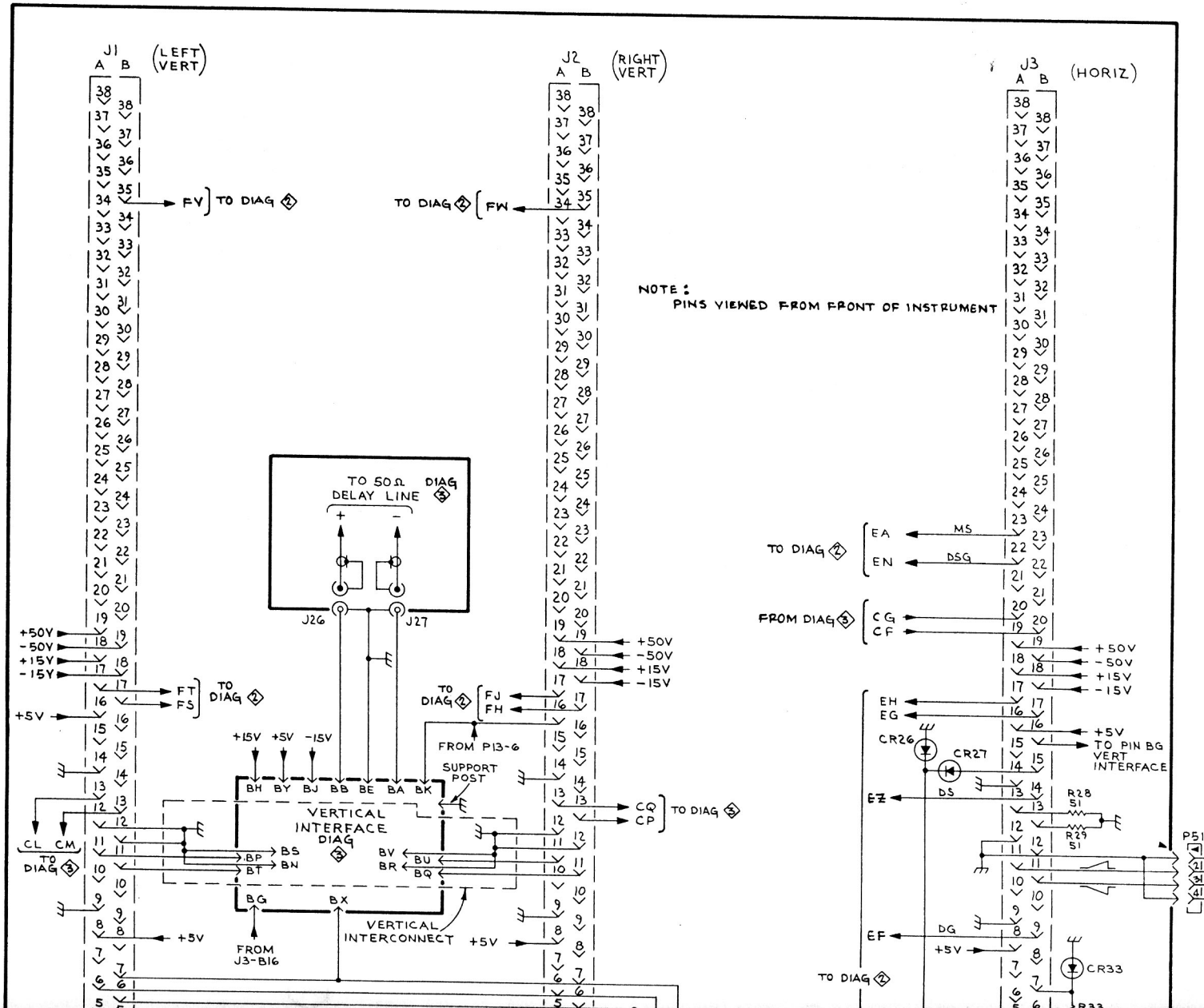
Figure 7-3. A1-Main Interface circuit board assembly.

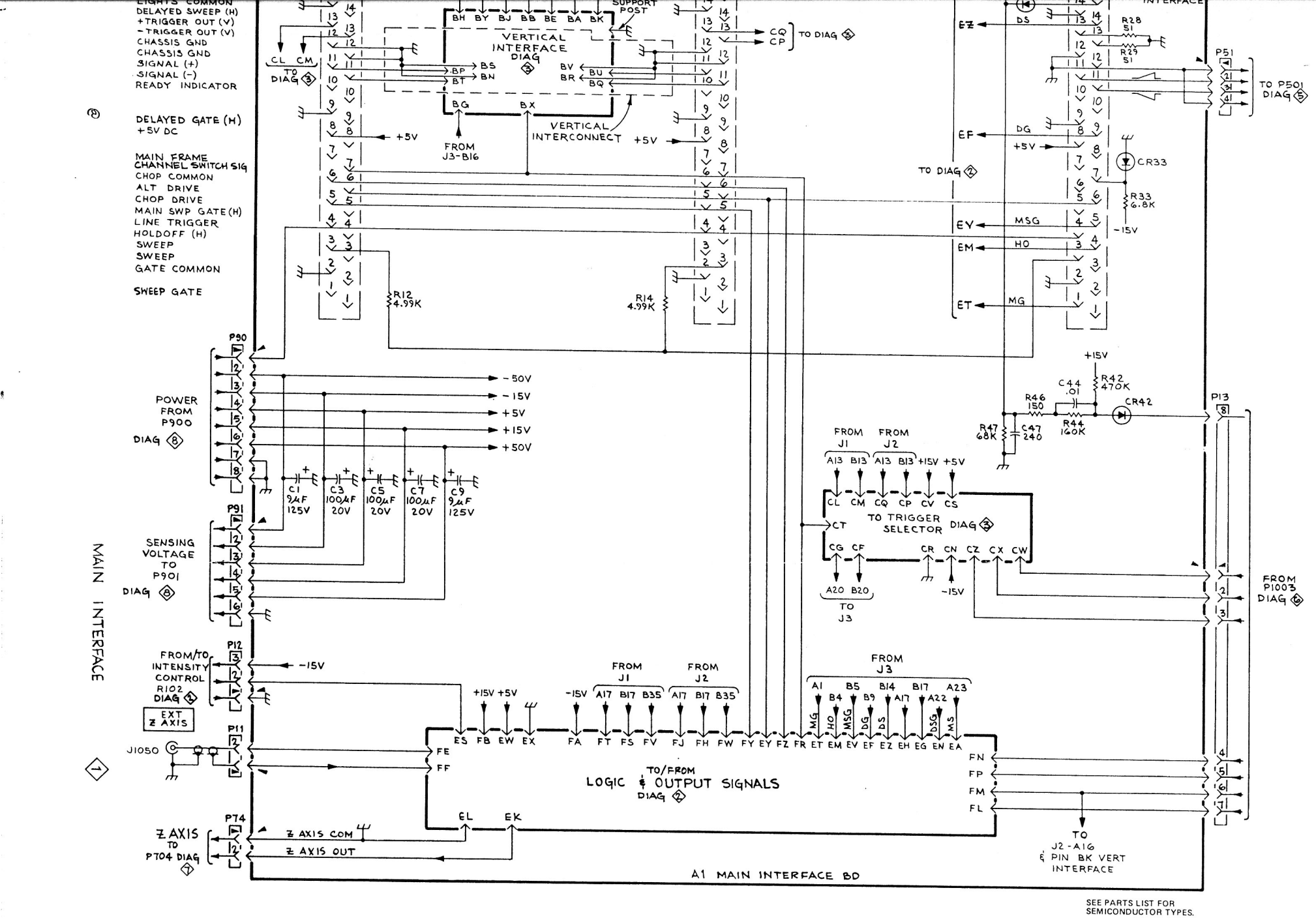


CKT NO	GRID COORD	CKT NO	GRID COORD
C1	5G	P11	1B
C3	5G	P12	1B
C5	5G	P13	1C
C7	5G	P51	5E
C9	6H	P74	1B
C44	3F	P90	1D
C47	3F	P91	1D
CR26	3F	R12	6F
CR27	2F	R14	4F
CR33	2F	R28	1F
CR42	3F	R29	1F
		R33	2F
J1	6J	R42	3F
J2	4J	R44	3F
J3	2J	R46	3F
J26	3E	R47	3F
J27	3E		

INDEX FOR FIGURE 7-3.




J1 (LEFT VERT)
J2 (RIGHT VERT)
J3 (HORIZ)
PLUG-IN MODE
MAIN SWEEP (H)
DELAYED SWEEP GATE (H)
+ TRIGGER IN (H)
- TRIGGER IN (H)
+50V DC
-50V DC
+15V DC
-15V DC
AUX Z AXIS
AUX-Z AXIS COMMON
MAIN FRAME MODE
AUX Y AXIS
SINGLE SWP RESET
LIGHTS COMMON
DELAYED SWEEP (H)
+TRIGGER OUT (V)
-TRIGGER OUT (V)
CHASSIS GND
CHASSIS GND
SIGNAL (+)
SIGNAL (-)
READY INDICATOR
DELAYED GATE (H)
+5V DC
MAIN FRAME CHANNEL SWITCH SIG
CHOP COMMON
ALT DRIVE
CHOP DRIVE
TO 50Ω DELAY LINE DIAG 3
J26
J27
VERTICAL INTERFACE DIAG 3
SUPPORT POST
FROM P13-6
FROM J3-B16
VERTICAL INTERCONNECT
TO DIAG 2
TO DIAG 3
NOTE: PINS VIEWED FROM FRONT OF INSTRUMENT
MS
DSG
TO PIN BG VERT INTERFACE
CR26
CR27
CR33
R28 51
R29 51
P51
TO P501 DIAG 5


LIGHTS COMMON
DELAYED SWEEP (H)
+TRIGGER OUT (V)
-TRIGGER OUT (V)
CHASSIS GND
CHASSIS GND
SIGNAL (+)
SIGNAL (-)
READY INDICATOR
DELAYED GATE (H)
+5V DC
MAIN FRAME CHANNEL SWITCH SIG
CHOP COMMON
ALT DRIVE
CHOP DRIVE
MAIN SWP GATE (H)
LINE TRIGGER
HOLDOFF (H)
SWEEP
SWEEP
GATE COMMON
SWEEP GATE
VERTICAL INTERFACE DIAG 3
VERTICAL INTERCONNECT
FROM J3-B16
+5V
R12 4.99K
R14 4.99K
TO DIAG 2
CR33
R33 6.8K
-15V
TO P501 DIAG 5
R28 51
R29 51
R42 470K
C44 .01
R46 150
R44 140K
CR42
R47 68K
C47 240
+15V
FROM J1
FROM J2
TO TRIGGER SELECTOR DIAG 3
TO J3
FROM P1003 DIAG 6
POWER FROM P900 DIAG 8
-50V
-15V
+5V
+15V
+50V
C1 9µF 125V
C3 100µF 20V
C5 100µF 20V
C7 100µF 20V
C9 9µF 125V
SENSING VOLTAGE TO P901 DIAG 8
FROM/TO INTENSITY CONTROL R102 DIAG 4
EXT Z AXIS
J1050
FROM J3
TO/FROM LOGIC & OUTPUT SIGNALS DIAG 2
Z AXIS TO P704 DIAG 7
Z AXIS COM
Z AXIS OUT
TO J2-A16 & PIN BK VERT INTERFACE
A1 MAIN INTERFACE BD
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
MAIN INTERFACE
1

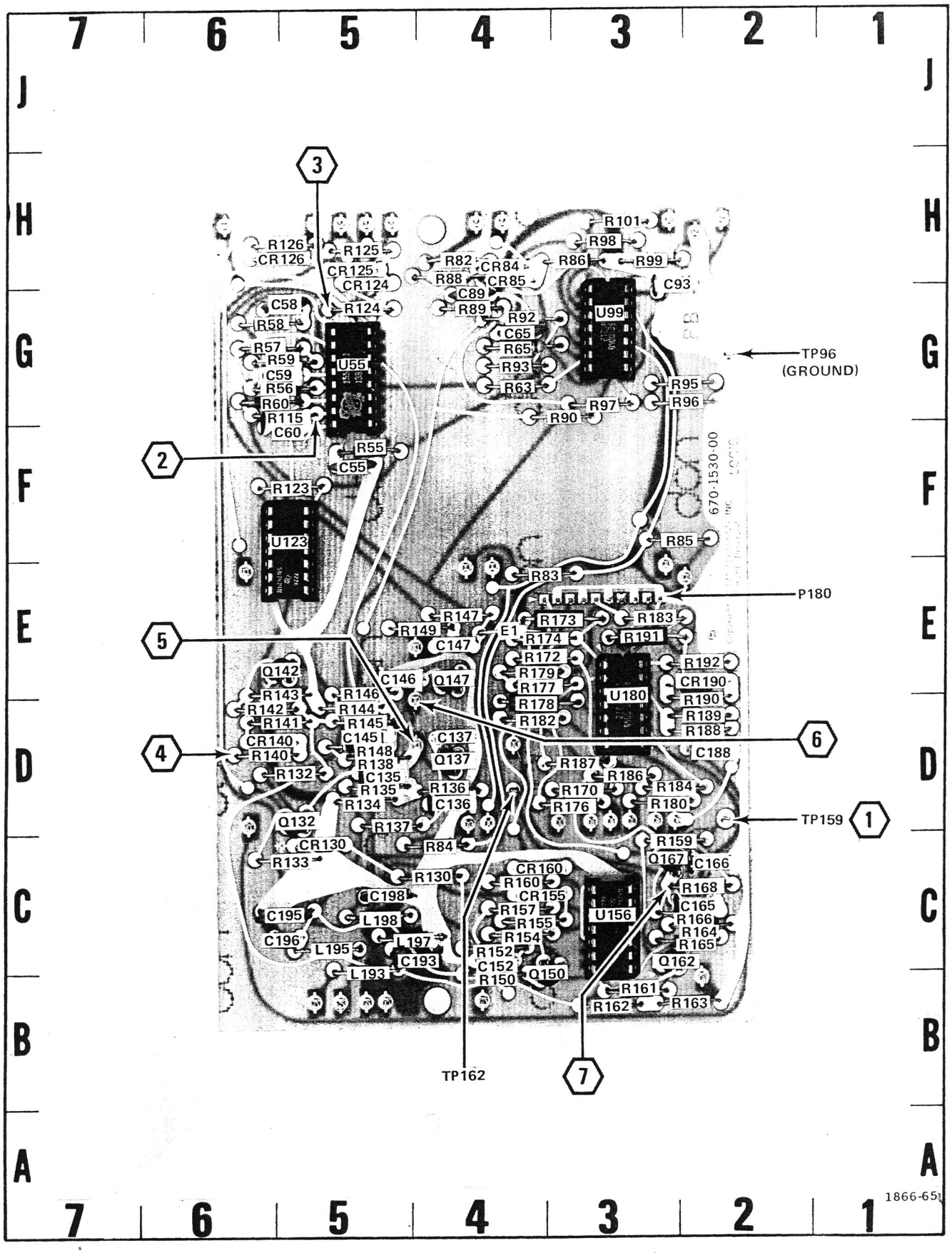
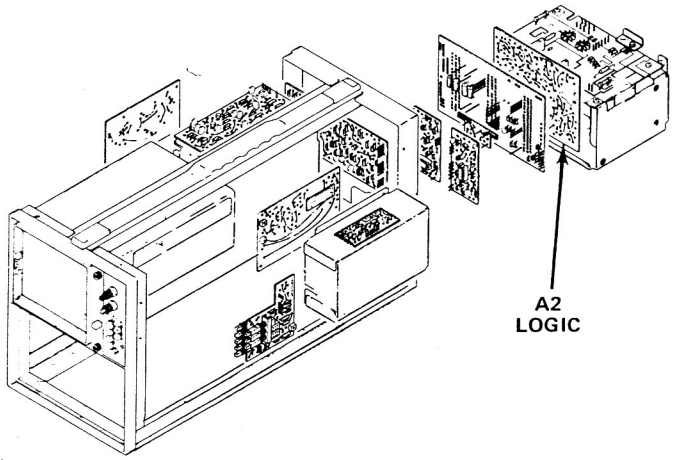


Figure 7-4. A2-Logic circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C55	5F	CR130	5C	R65	4G	R136	4D	R173	3E
C58	6G	CR140	6D	R82	4H	R137	5D	R174	4E
C59	6G	CR155	4C	R83	3E	R138	5D	R176	3D
C60	5F	CR160	4C	R84	4C	R140	6D	R177	4E
C65	4G	CR190	2E	R85	2F	R141	6D	R178	4D
C89	4G			R86	3H	R143	5E	R179	4E
C93	3G	L193	5B	R88	4H	R144	5D	R180	3D
C135	5D	L195	5C	R89	4G	R145	5D	R182	4D
C136	4D	L197	5C	R90	3G	R146	5D	R183	3E
C137	4D	L198	5C	R92	4G	R147	4E	R184	3D
C145	5D			R93	4G	R148	5D	R186	2D
C146	5E	P180	3E	R95	3G	R149	4E	R187	3D
C147	4E	Q132	5D	R96	3G	R150	5B	R188	2D
C152	4C	Q137	4D	R97	3G	R152	4C	R189	2D
C165	3C	Q142	6E	R98	3H	R154	4C	R190	2D
C166	2C	Q147	4E	R99	3H	R155	4C	R191	3E
C188	2D	Q150	4B	R101	3H	R157	4C	R192	2E
C193	5C	Q162	3C	R115	6G	R159	3C		
C195	6C	Q167	3C	R123	6F	R160	4C	TP96	2G
C196	6C			R124	5G	R161	3B	TP159	2D
C198	5C	R55	5F	R125	5H	R162	3B	TP162	4D
		R56	6G	R126	6H	R163	3B		
CR84	4H	R57	6G	R130	4C	R165	2C	U55	5G
CR85	4H	R58	6G	R132	5D	R166	2C	U99	3G
CR124	5H	R59	6G	R133	5D	R168	2C	U123	6F
CR125	5H	R60	6G	R134	5D	R170	3D	U156	3G
CR126	6H	R63	4G	R135	5D	R172	4E	U180	3D

INDEX FOR FIGURE 7-4.



WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

WAVEFORMS

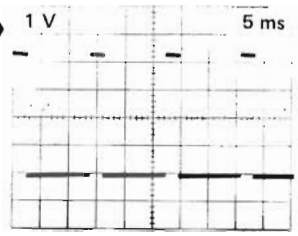
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

NOTE

Voltages and waveforms are not absolute and may vary between instruments.

1



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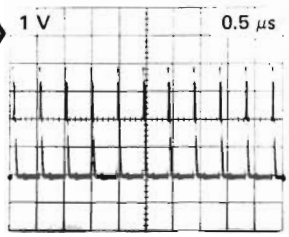

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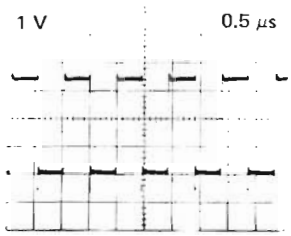

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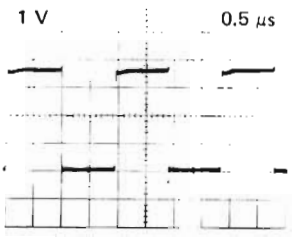

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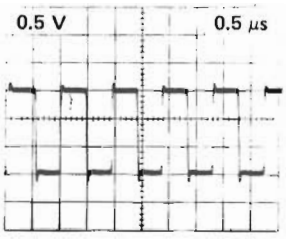
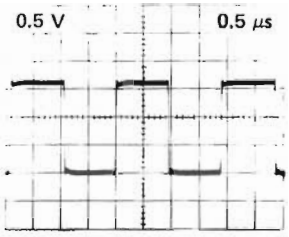


SET VERT MODE TO CHOP

6



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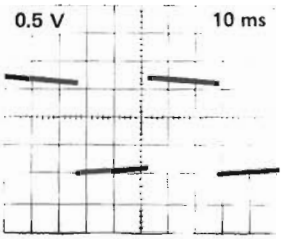
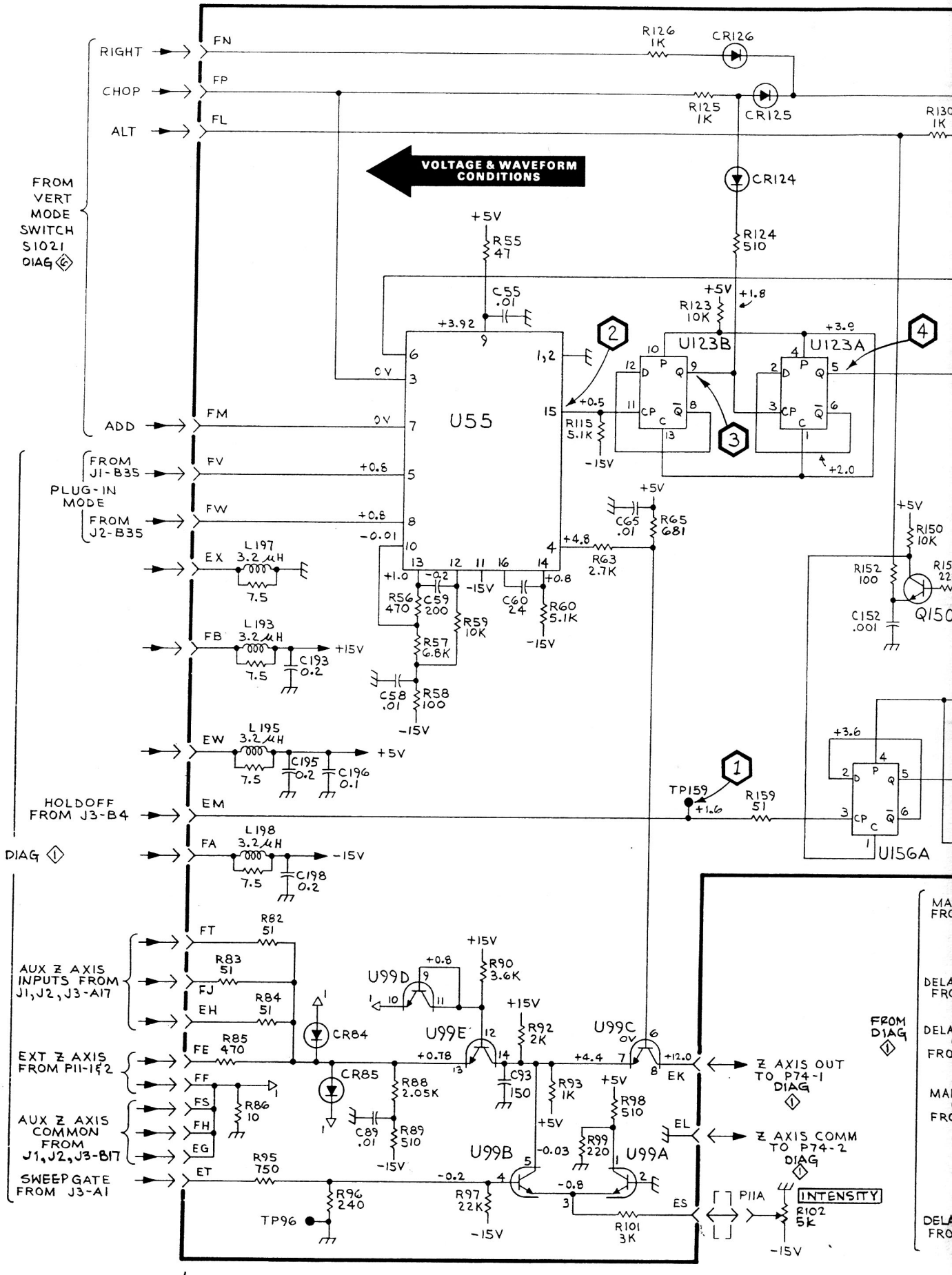
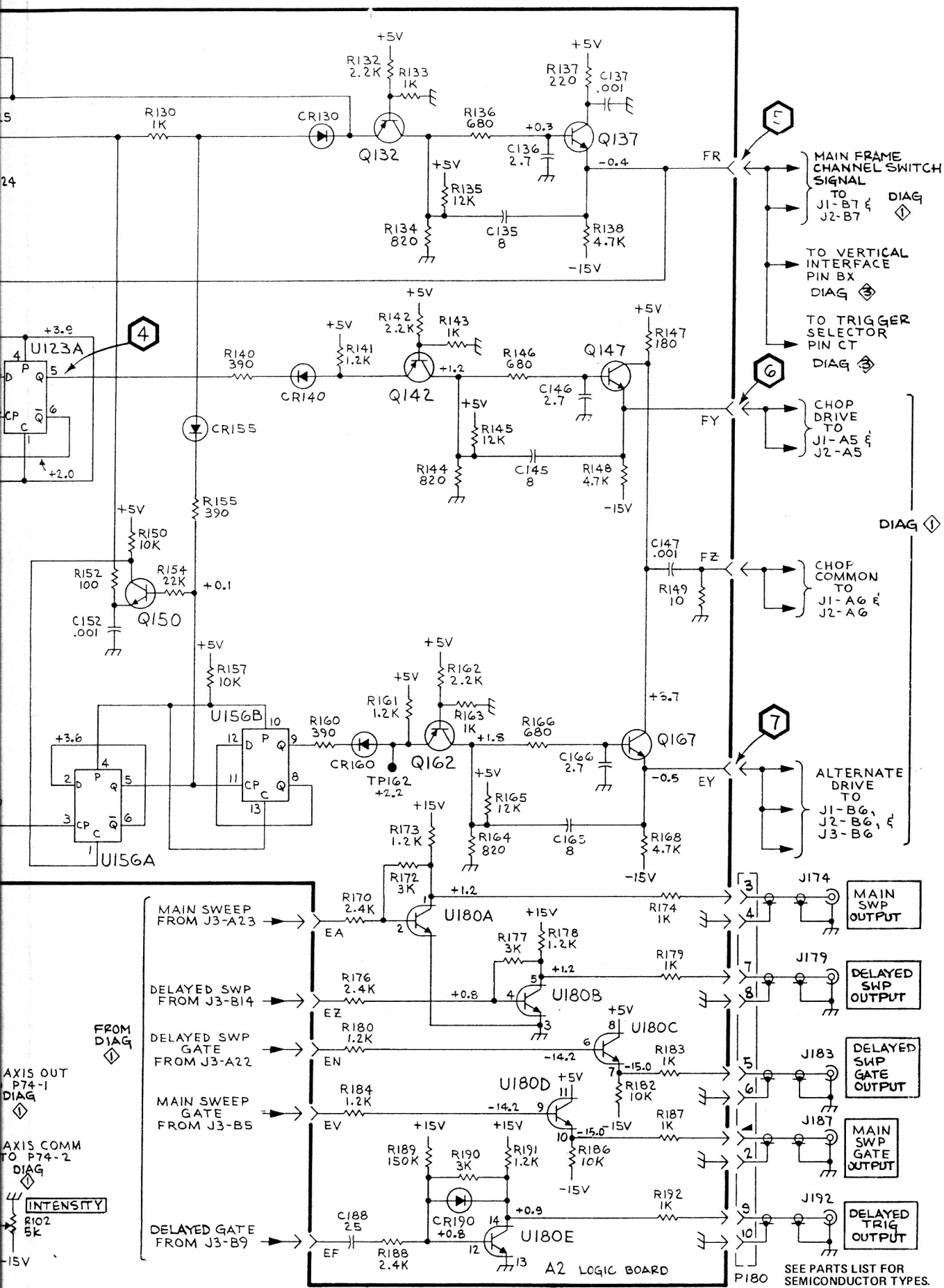


SET VERT MODE TO ALT


VOLTAGE & WAVEFORM CONDITIONS
RIGHT
CHOP
ALT
FROM VERT MODE SWITCH S1021 DIAG 16
ADD
FROM J1-B35
PLUG-IN MODE
FROM J2-B35
HOLDOFF FROM J3-B4
DIAG 1
AUX Z AXIS INPUTS FROM J1,J2,J3-A17
EXT Z AXIS FROM P11-1&2
AUX Z AXIS COMMON FROM J1,J2,J3-B17
SWEEP GATE FROM J3-A1
FN
FP
FL
FM
FV
FW
EX
FB
EW
EM
FA
FT
FJ
EH
FE
FF
FS
FH
EG
ET
R126 1K
CR126
R125 1K
CR125
CR124
R124 510
R55 47
C55 .01
R123 10K
U55
U123B
U123A
R115 5.1K
L197 3.2µH
L193 3.2µH
L195 3.2µH
L198 3.2µH
7.5
C193 0.2
C195 0.2
C196 0.1
C198 0.2
R56 470
C59 200
R59 10K
R57 6.8K
C58 .01
R58 100
C60 24
R60 5.1K
RG3 2.7K
CG5 .01
RG5 681
R150 10K
R152 100
C152 .001
Q150
U156A
TP159
R159 51
R82 51
R83 51
R84 51
R85 470
R86 10
R88 2.05K
C89 .01
R89 510
R90 3.6K
R92 2K
C93 150
R93 1K
R98 510
R99 220
R95 750
R96 240
TP96
R97 22K
R101 3K
R102 5K
INTENSITY
U99D
U99E
U99C
U99B
U99A
CR84
CR85
Z AXIS OUT TO P74-1 DIAG 1
Z AXIS COMM TO P74-2 DIAG 1
FROM DIAG 1
P11A
+5V
+15V
-15V
0V

OS-245(P)/U



LOGIC AND OUTPUT SIGNALS 2

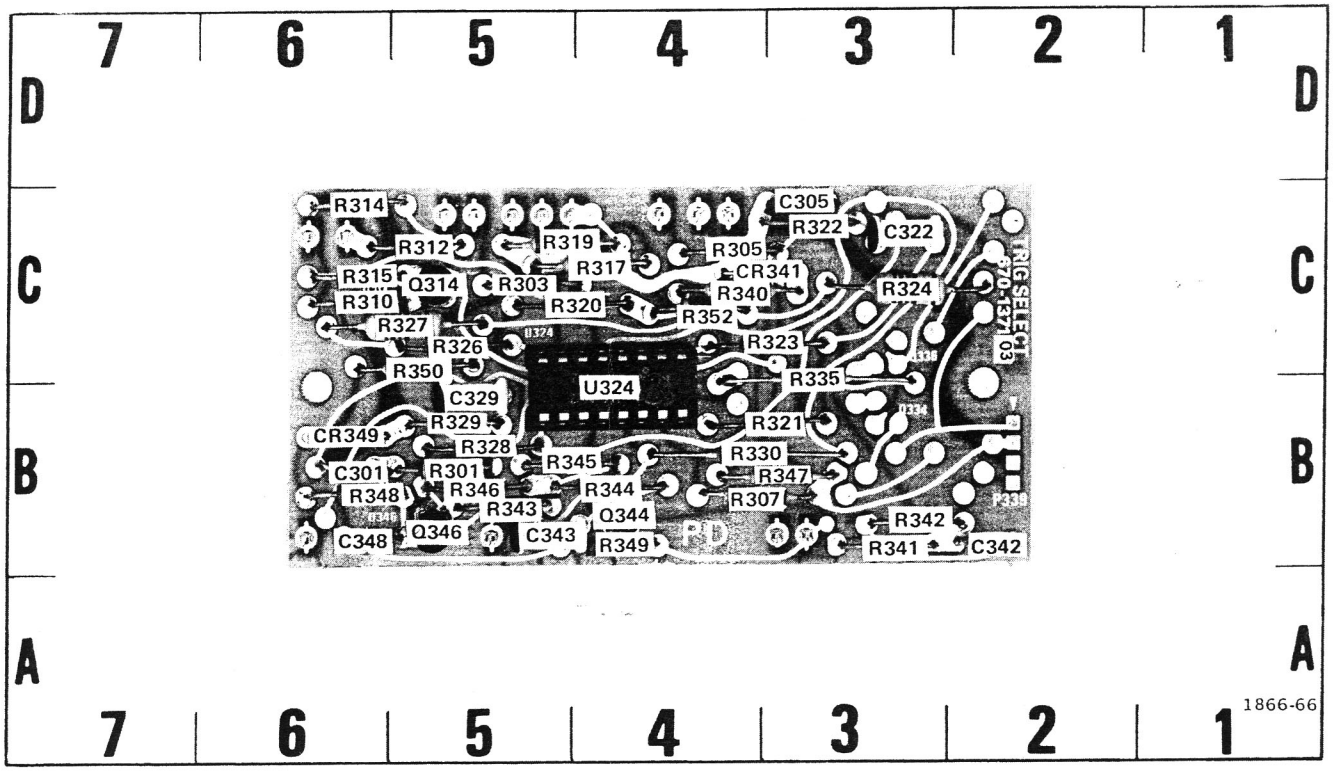


Figure 7-5. A3-Trigger Selector circuit board assembly.

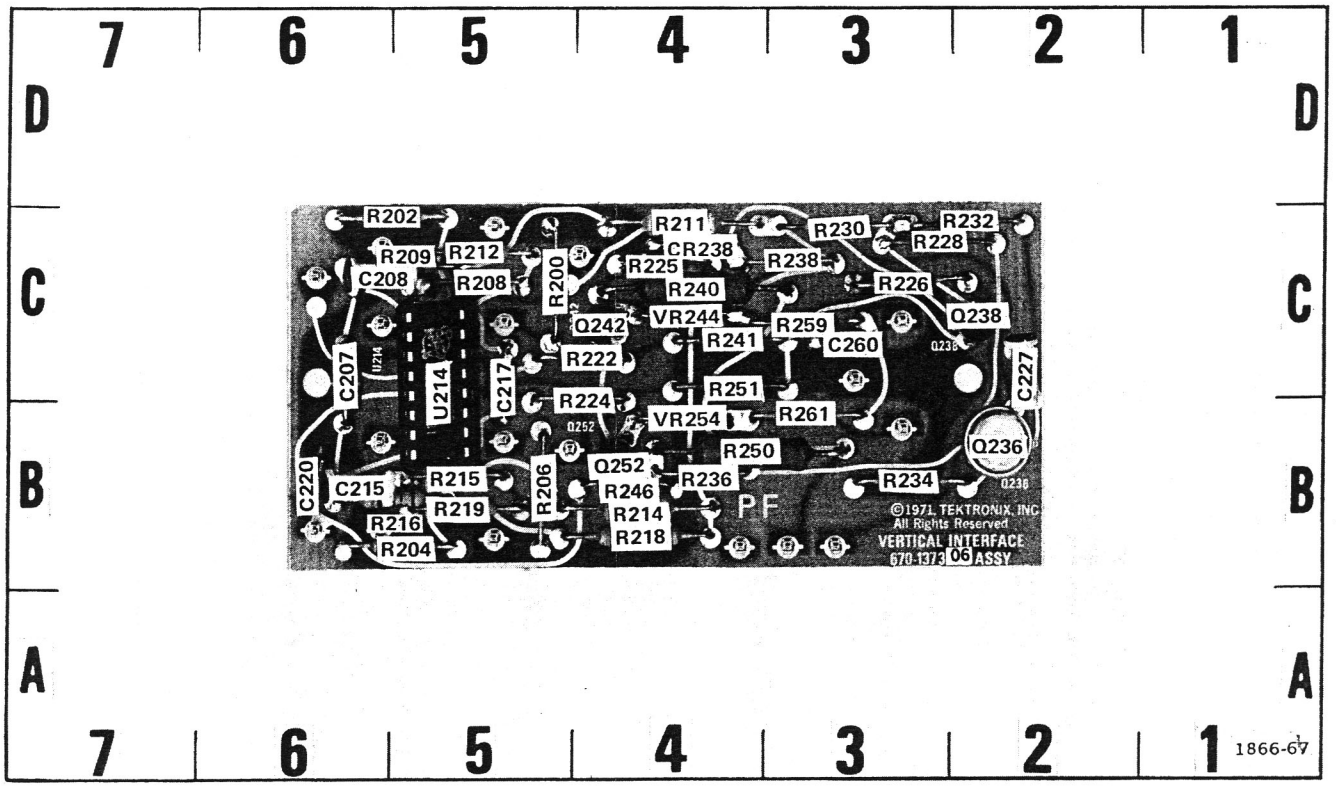


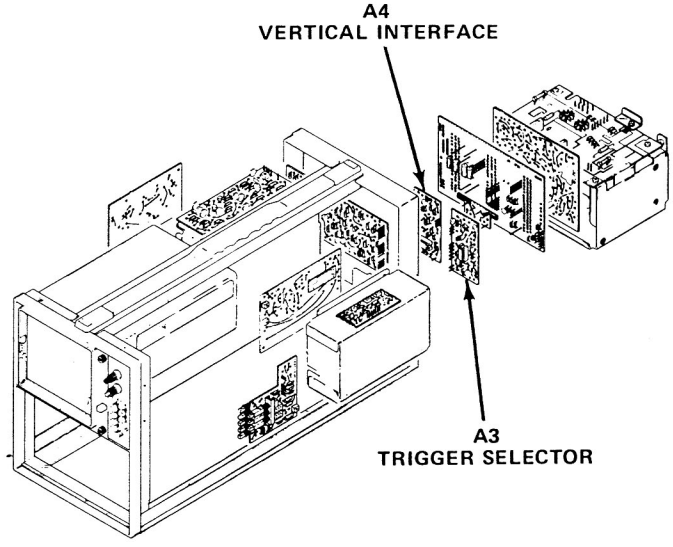
Figure 7-6. A4-Vertical Interface circuit board assembly.

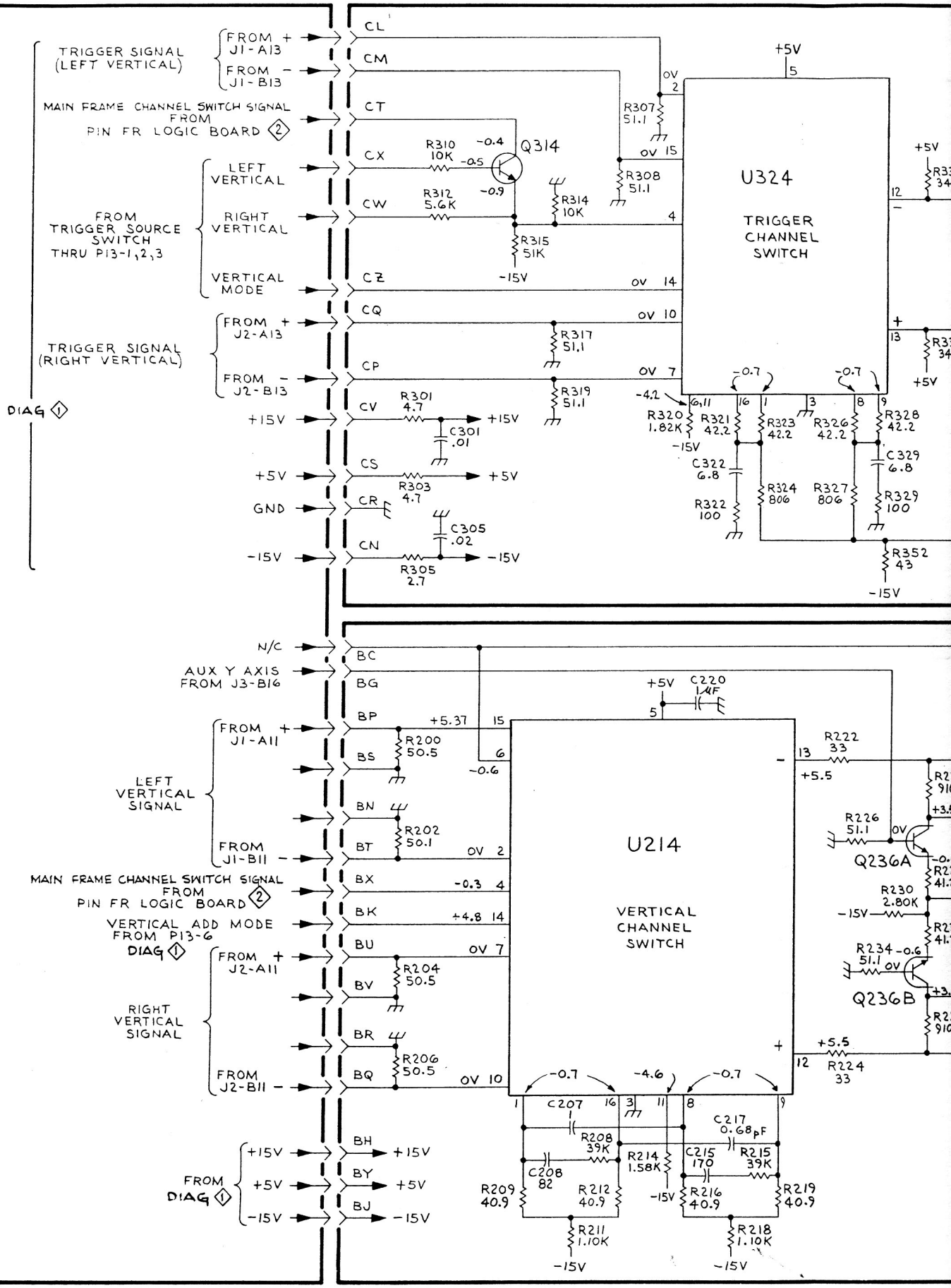
CKT NO	GRID COORD	CKT NO	GRID COORD
C301	6B	R321	3C
C305	3C	R322	3C
C322	3G	R323	3C
C329	5B	R324	3B
C342	2B	R326	5C
C343	5B	R327	5C
C348	6B	R328	5B
		R329	5B
CR341	4C	R330	4B
CR349	6B	R335	3C
		R340	4C
Q314	5C	R341	3B
Q344	4B	R342	2B
Q346	5B	R343	5B
		R344	4B
R301	5B	R345	5B
R303	5C	R346	5B
R305	4C	R348	6B
R307	3B	R349	4B
R308	3B	R350	5C
R310	6C	R352	4C
R312	5C		
R314	6C	U324	4B
R315	6C		
R317	4C		
R319	5C		
R320	5C		

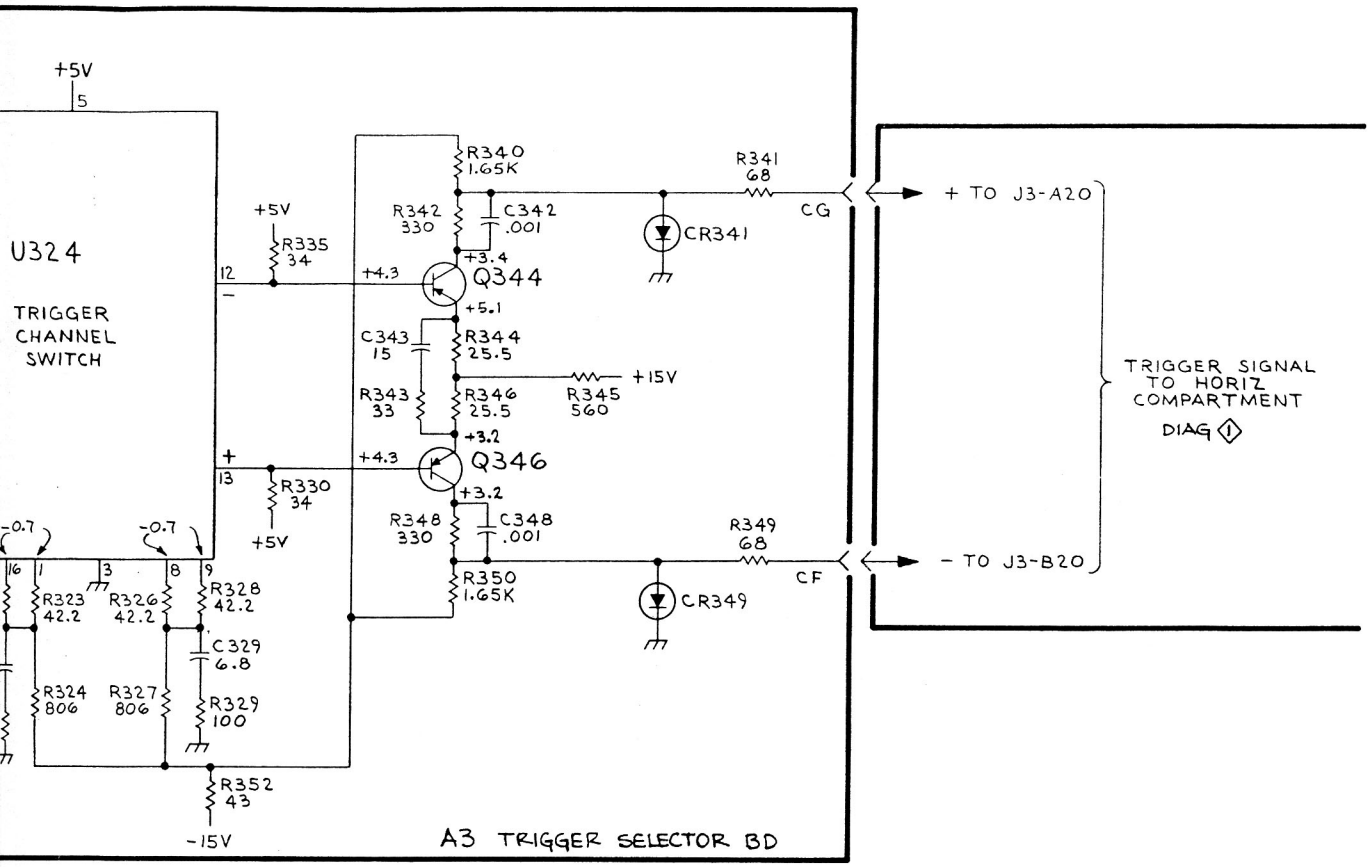
INDEX FOR FIGURE 7-5.

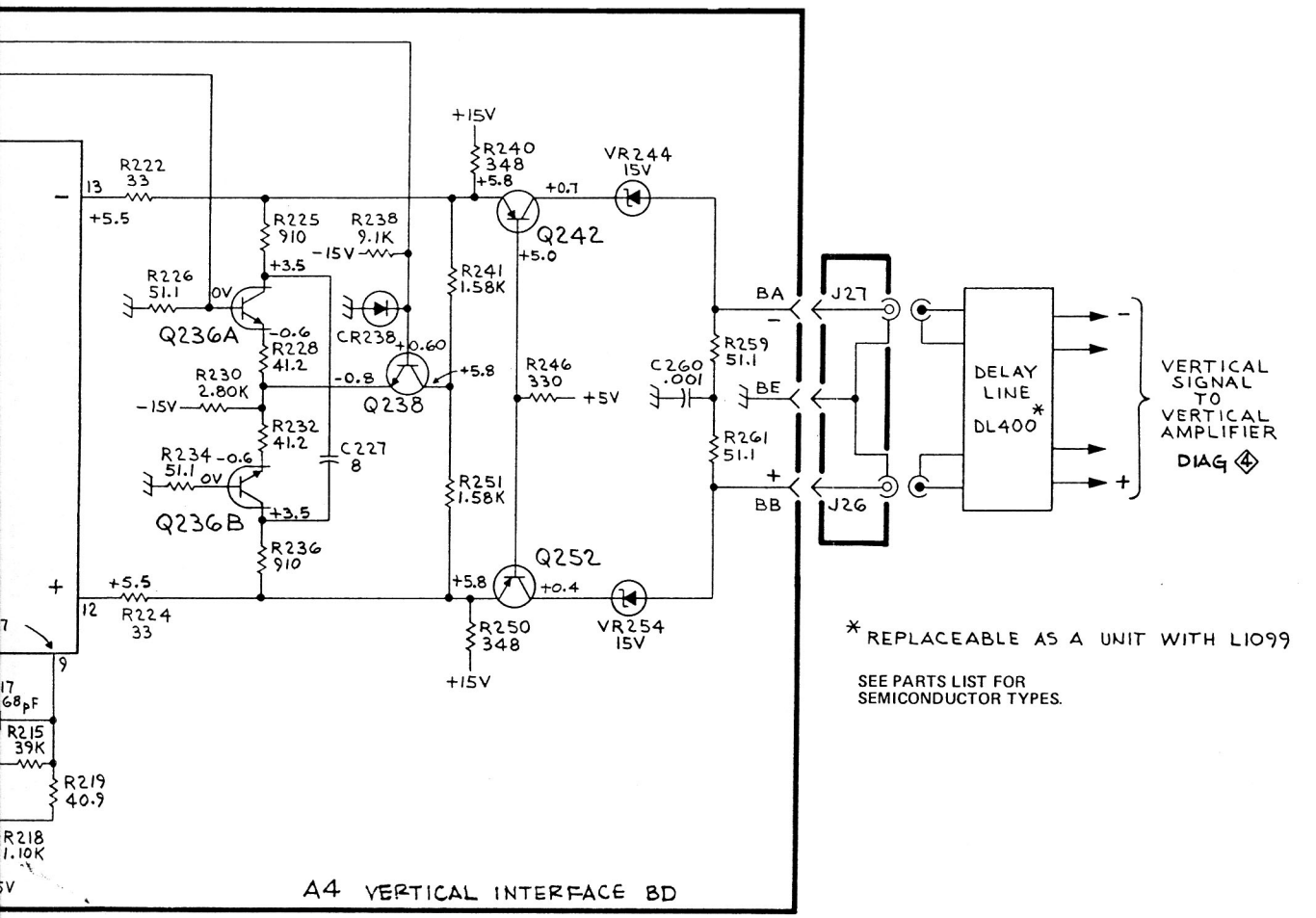
CKT NO	GRID COORD	CKT NO	GRID COORD
C207	6C	R218	4B
C208	6C	R219	5B
C215	6B	R222	4C
C217	5C	R224	4B
C220	6B	R225	4C
C227	2C	R226	3C
C260	3C	R228	3C
		R230	3C
CR238	4C	R232	2C
		R234	3B
Q236	2B	R236	4B
Q238	2C	R238	3C
Q242	4C	R240	4C
Q252	4B	R241	4C
		R246	4B
R200	5C	R250	4B
R202	5C	R251	4C
R204	5B	R259	3C
R206	5B	R261	3B
R208	5C		
R209	5C	U214	5C
R211	5C		
R212	5C	VR244	4C
R214	4B	VR254	4B
R215	5B		
R216	5B		

INDEX FOR FIGURE 7-6




TRIGGER SIGNAL (LEFT VERTICAL)
FROM + J1-A13
FROM − J1-B13
MAIN FRAME CHANNEL SWITCH SIGNAL FROM PIN FR LOGIC BOARD ②
FROM TRIGGER SOURCE SWITCH THRU P13-1,2,3
LEFT VERTICAL
RIGHT VERTICAL
VERTICAL MODE
TRIGGER SIGNAL (RIGHT VERTICAL)
FROM + J2-A13
FROM − J2-B13
DIAG ①
+15V
+5V
GND
−15V
CL
CM
CT
CX
CW
CZ
CQ
CP
CV
CS
CR
CN
R301 4.7
R303 4.7
R305 2.7
C301 .01
C305 .02
R307 51.1
R308 51.1
R310 10K
Q314
R312 5.6K
R314 10K
R315 51K
R317 51.1
R319 51.1
U324
TRIGGER CHANNEL SWITCH
R320 1.82K
R321 42.2
R322 100
R323 42.2
R324 806
R326 42.2
R327 806
R328 42.2
R329 100
C322 6.8
C329 6.8
R352 43
N/C
AUX Y AXIS FROM J3-B16
BC
BG
BP
BS
BN
BT
BX
BK
BU
BV
BR
BQ
BH
BY
BJ
LEFT VERTICAL SIGNAL
RIGHT VERTICAL SIGNAL
VERTICAL ADD MODE FROM P13-6 DIAG ①
R200 50.5
R202 50.1
R204 50.5
R206 50.5
U214
VERTICAL CHANNEL SWITCH
C220 1μF
R222 33
R224 33
R226 51.1
Q236A
Q236B
R230 2.80K
R234 51.1
C207 1
C208 82
C217 0.68pF
C215 170
R208 39K
R209 40.9
R211 1.10K
R212 40.9
R214 1.58K
R215 39K
R216 40.9
R218 1.10K
R219 40.9





* REPLACEABLE AS A UNIT WITH L1099

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

@

TRIGGER SELECTOR & VERTICAL INTERFACE 3

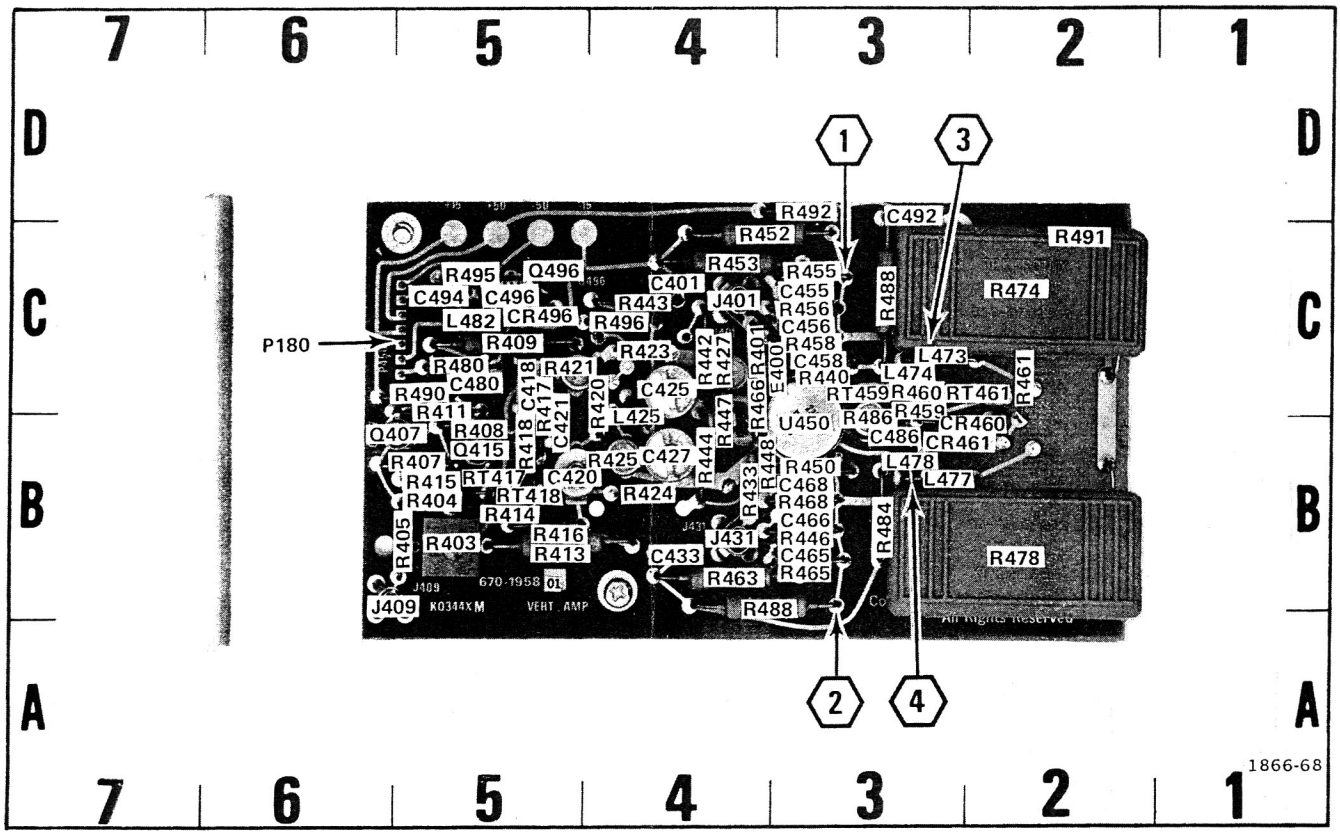
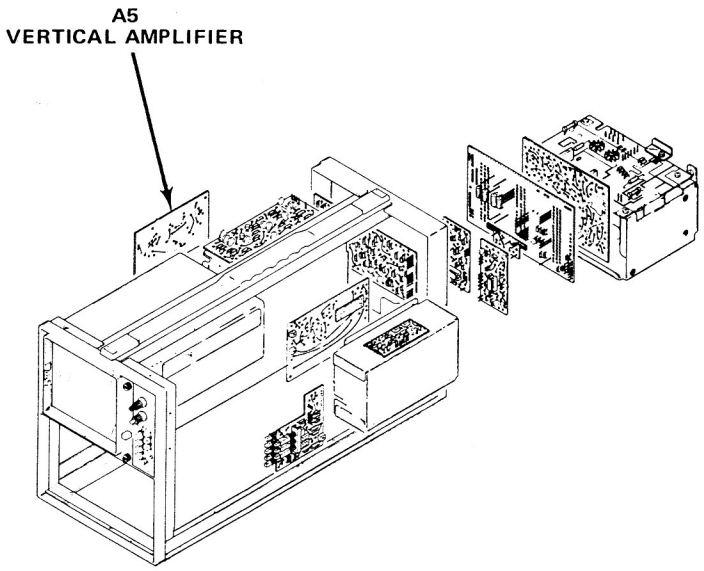


Figure 7-7. A5-Vertical Amplifier circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C401	4C	J409	6B	R416	5B	R462	4B
C418	5C	J431	4B	R417	5C	R463	4B
C420	5B			R418	5B	R465	3B
C421	5B	L425	4B	R420	4C	R466	4C
C425	4C	L473	3C	R421	5C	R468	3B
C427	4B	L474	3C	R423	4C	R474	2C
C433	4B	L477	3B	R424	4B	R478	2B
C455	3C	L478	3B	R425	4B	R480	5C
C456	3C	L482	6C	R427	4C	R484	3B
C458	3C			R429	4B*	R486	3B
C465	3B	P450	5C	R433	4B	R488	4B
C466	3B			R440	3C	R490	5C
C468	3B	Q407	5B	R442	4C	R491	2C
C480	5C	Q415	5B	R443	4C	R492	3D
C486	3B	Q496	5C	R444	4B	R465	5C
C492	3C			R446	3B	R496	4C
C494	5C	R401	4C	R447	4B		
C496	5C	R403	5B	R448	8C	RT417	5B
		R404	5B	R450	3B	RT418	5B
CR460	2B	R405	5B	R452	4C	RT459	3C
CR461	2B	R407	5B	R453	4C	RT461	2C
CR496	2B	R408	5B	R455	3C		
CR460	2B	R409	5C	R456	3C	U450	2B
CR461	2B	R411	5C	R458	3C		
CR496	5C	R413	5B	R459	3C		
		R414	5B	R460	3C		
J401	4C	R415	5B	R461	2C		

*LOCATED ON BACK OF BOARD

INDEX FOR FIGURE 7-7.


A5
VERTICAL AMPLIFIER

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

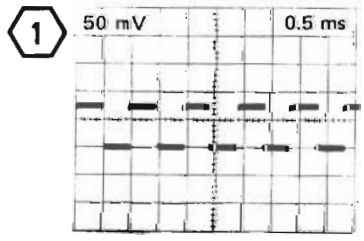
WAVEFORMS

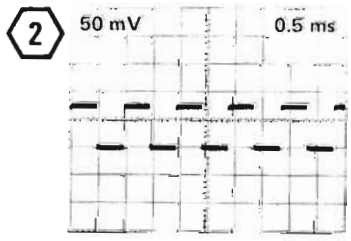
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

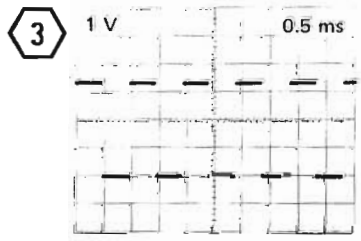
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

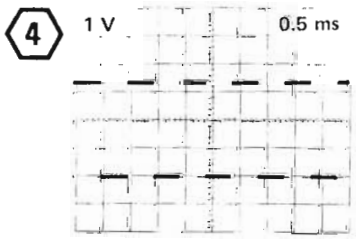
NOTE

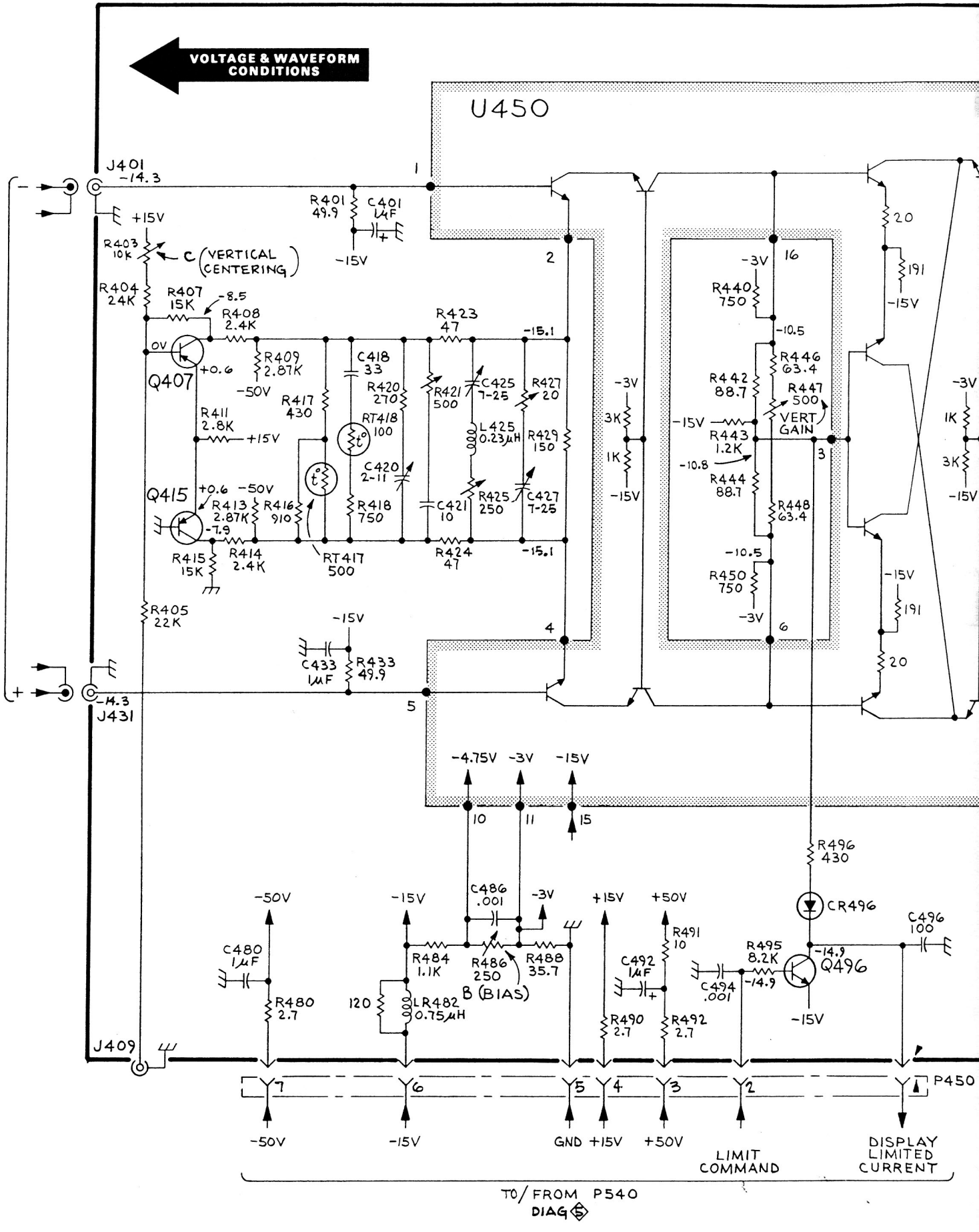
Voltages and waveforms are not absolute and may vary between instruments.



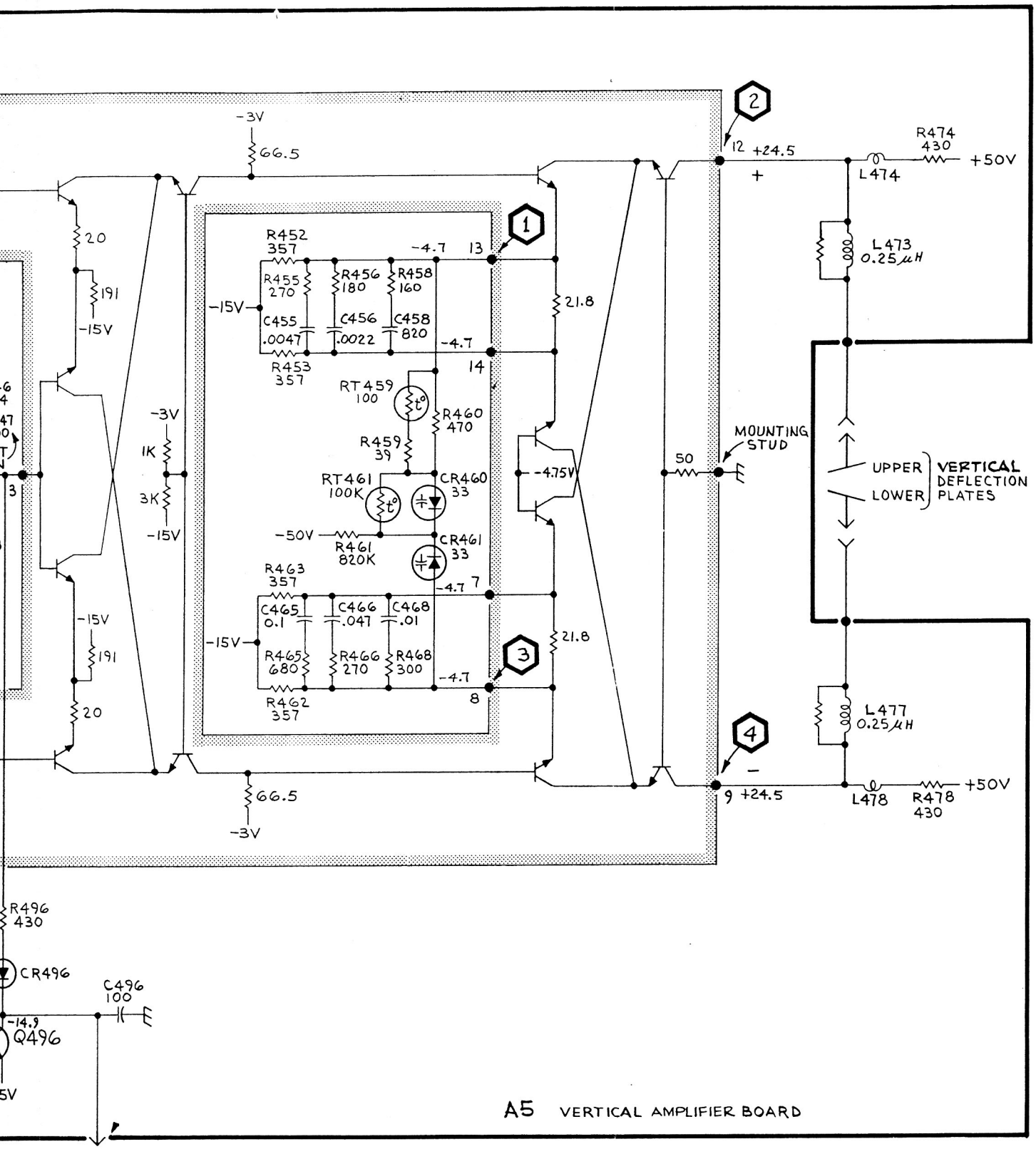







VOLTAGE & WAVEFORM CONDITIONS
U450
J401
-14.3
+15V
R403 10k
C (VERTICAL CENTERING)
R404 24K
R407 15K
-8.5
R408 2.4K
R401 49.9
C401 1μF
-15V
R423 47
-15.1
R409 2.87K
C418 33
R420 270
R421 500
C425 7-25
R427 20
R429 150
L425 0.23μH
RT418 100
C420 2-11
R417 430
R411 2.8K
+15V
Q407
0V
+0.6
-50V
Q415
+0.6
-50V
R413 2.87K
R416 910
-7.9
R414 2.4K
R415 15K
RT417 500
R418 750
C421 10
R425 250
C427 7-25
R424 47
-15.1
R405 22K
-15V
C433 1μF
R433 49.9
-14.3
J431
VERTICAL SIGNAL FROM DELAY LINE DIAG 3
-3V
3K
1K
-15V
-3V
16
R440 750
-10.5
R446 63.4
R442 88.7
R447 500 VERT GAIN
-15V
R443 1.2K
-10.8
R444 88.7
R448 63.4
-10.5
R450 750
-3V
6
3
20
191
-15V
-3V
1K
3K
-15V
-15V
191
20
-4.75V
-3V
-15V
10
11
15
R496 430
CR496
C496 100
-50V
-15V
C486 .001
-3V
+15V
+50V
C480 1μF
R484 1.1K
R486 250
B (BIAS)
R488 35.7
R491 10
C492 1μF
R495 8.2K
-14.9
Q496
C494 .001
-14.9
-15V
120
LR482 0.75μH
R480 2.7
R490 2.7
R492 2.7
J409
P450
7
6
5
4
3
2
-50V
-15V
GND
+15V
+50V
LIMIT COMMAND
DISPLAY LIMITED CURRENT
TO/FROM P540
DIAG 5

@



A5 VERTICAL AMPLIFIER BOARD

NOTE:
VERTICAL AMPLIFIER BD & U450
ARE MOUNTED TO HEATSINK

SEE PARTS LIST FOR
SEMICONDUCTOR TYPES.

VERTICAL AMPLIFIER ④

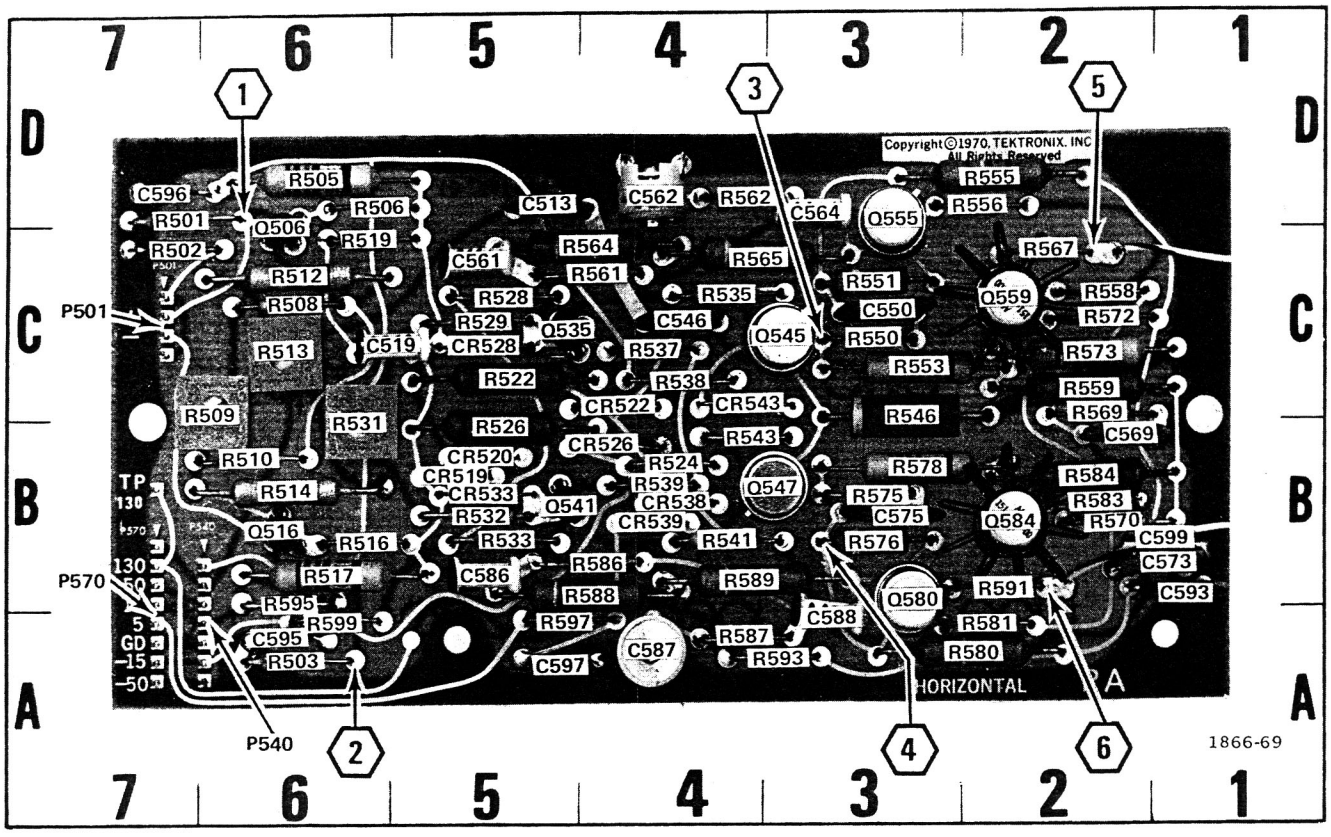
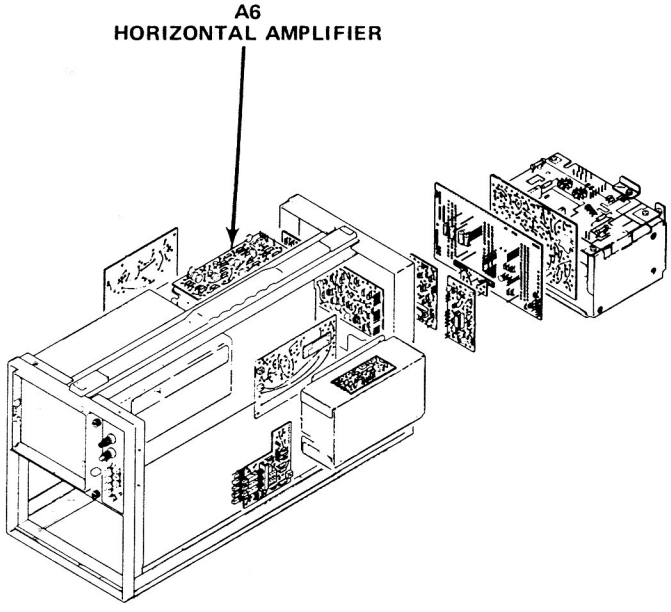


Figure 7-8. A6-Horizontal Amplifier circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C513	5D	CR543	4C	R514	6B	R562	4D
C519	5C			R516	6B	R564	4C
C546	4C	P501	7C	R517	6B	R565	4C
C550	3C	P540	A7	R519	6C	R567	2C
C561	5C	P570	A7	R522	5C	R569	2C
C562	4D			R524	4B	R570	2B
C564	3D	Q506	6C	R526	5B	R572	2C
C569	2B	Q516	6B	R528	5C	R573	2C
C573	1B	Q535	5C	R529	5C	R575	3B
C575	3B	Q541	5B	R531	6B	R576	3B
C586	5B	Q545	3C	R532	5B	R578	3B
C587	4A	Q547	3B	R533	5B	R580	2A
C588	3A	Q555	3D	R535	4C	R581	2A
C593	1B	Q559	2C	R537	4C	R583	2B
C595	6A	Q580	3B	R538	4C	R584	2B
C596	7D	Q584	2B	R539	4B	R586	4B
C597	5A			R541	4B	R587	4A
C599	1B	R501	7D	R543	4B	R588	4B
		R502	7C	R546	4C	R589	4B
CR519	5B	R503	6A	R550	3C	R591	2B
CR520	5B	R505	6D	R551	3C	R593	3A
CR522	4C	R506	6D	R553	3C	R595	6B
CR526	4B	R508	6C	R555	2D	R597	5A
CR528	5C	R509	6C	R556	2D	R599	6A
CR533	5B	R510	6B	R558	2C		
CR538	4B	R512	6C	R559	2C		
CR539	4B	R513	6C	R561	4C		

INDEX FOR FIGURE 7-8.


A6
HORIZONTAL AMPLIFIER

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

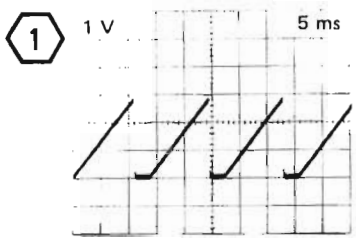
WAVEFORMS

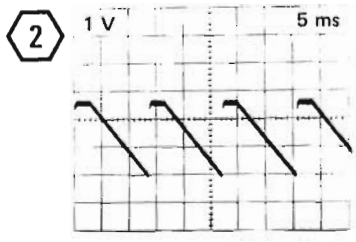
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

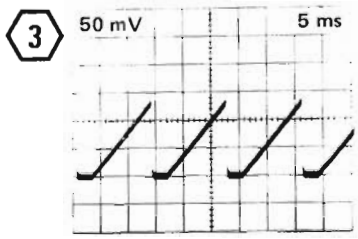
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

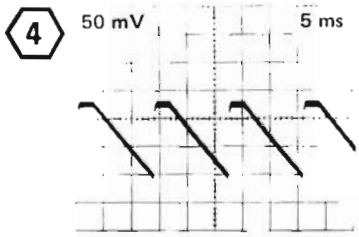
NOTE

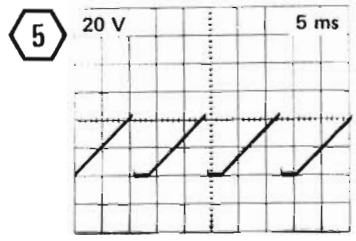
Voltages and waveforms are not absolute and may vary between instruments.

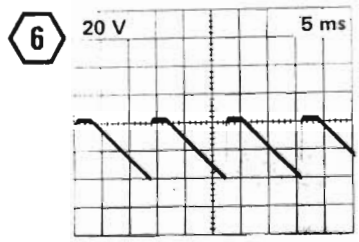


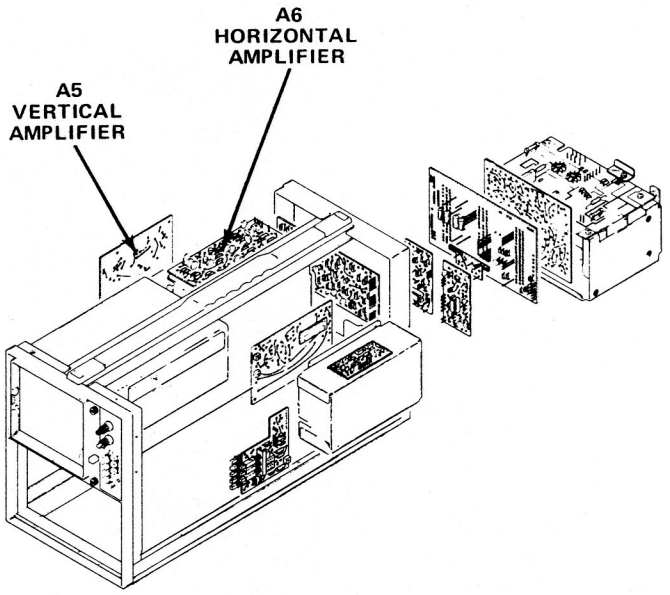


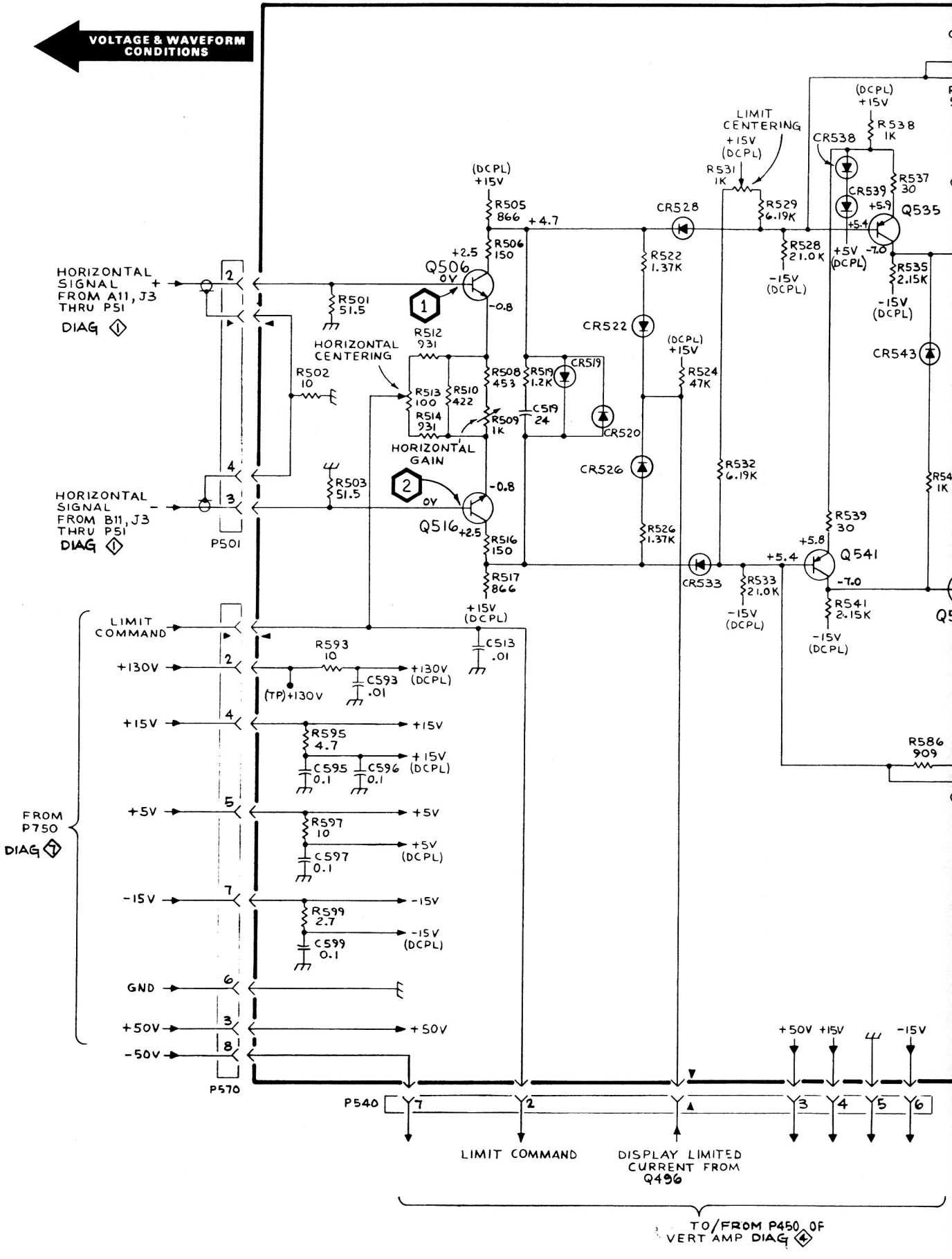






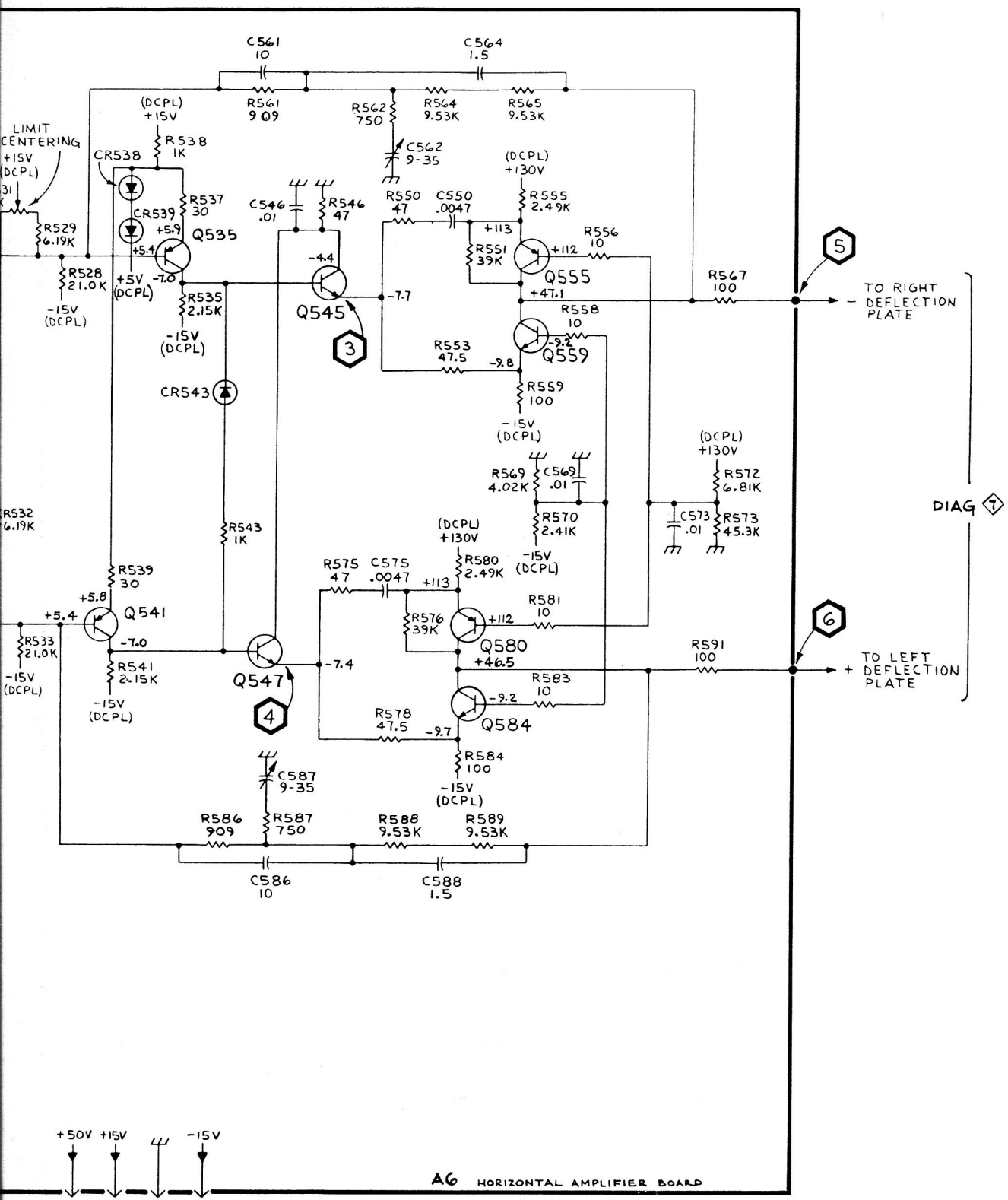



A6
HORIZONTAL
AMPLIFIER
A5
VERTICAL
AMPLIFIER


VOLTAGE & WAVEFORM CONDITIONS
HORIZONTAL SIGNAL + FROM A11, J3 THRU P51
DIAG 1
HORIZONTAL SIGNAL - FROM B11, J3 THRU P51
DIAG 1
P501
LIMIT COMMAND
+130V
+15V
+5V
-15V
GND
+50V
-50V
FROM P750
DIAG 7
P570
HORIZONTAL CENTERING
HORIZONTAL GAIN
LIMIT CENTERING
(DCPL) +15V
+5V (DCPL)
-15V (DCPL)
(TP)+130V
Q506
Q516
Q535
Q541
CR519
CR520
CR522
CR526
CR528
CR533
CR538
CR539
CR543
P540
LIMIT COMMAND
DISPLAY LIMITED CURRENT FROM Q496
TO/FROM P450 OF VERT AMP DIAG 4

OS-245(P)/U

@



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

@

HORIZONTAL AMPLIFIER 5

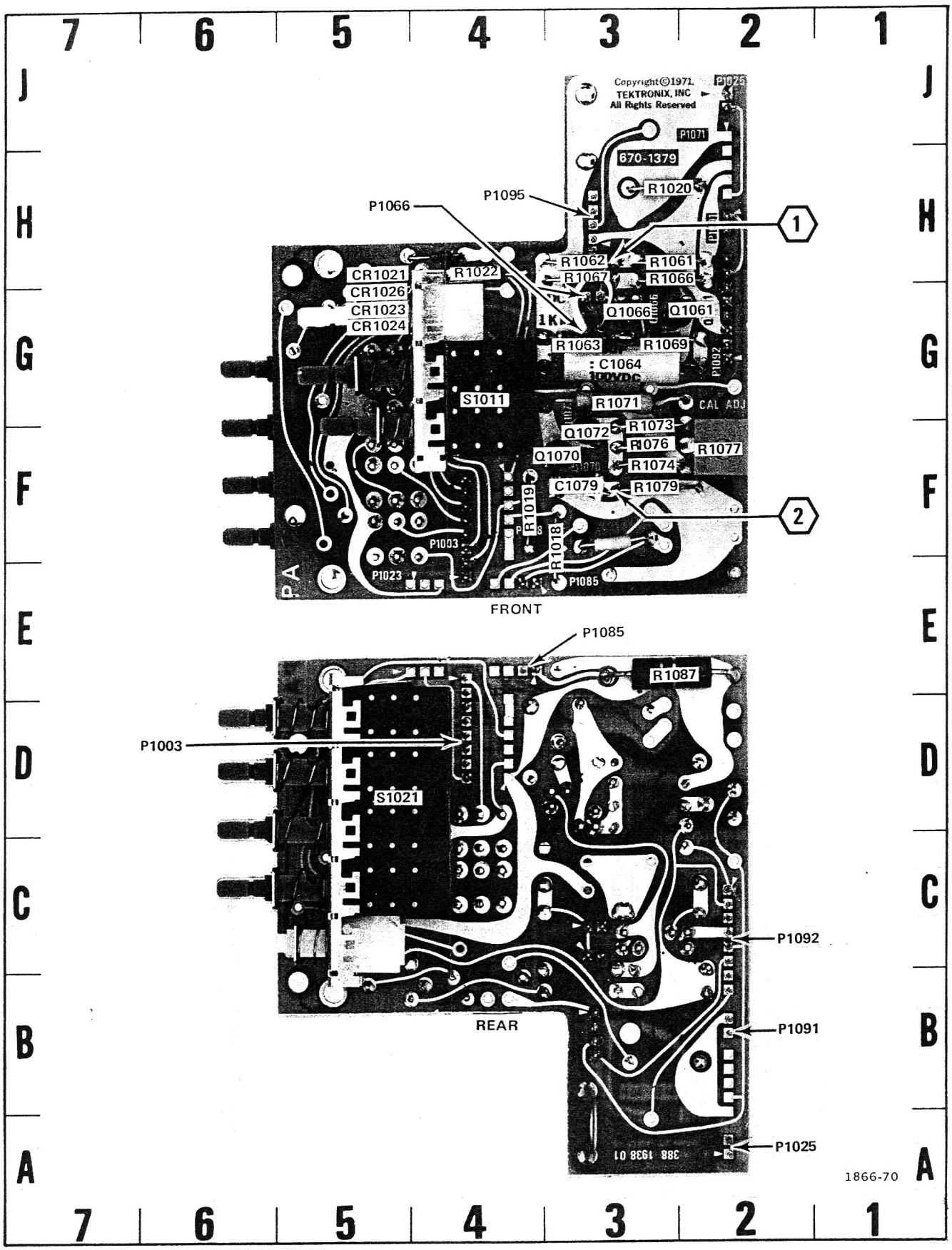
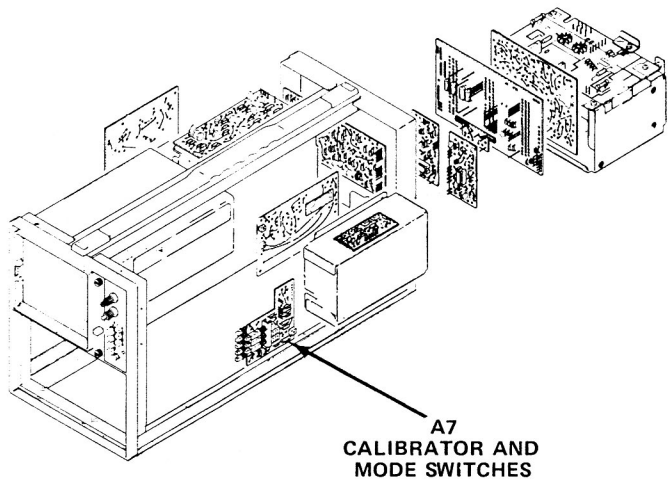


Figure 7-9. A7-Calibrator and Mode Switches circuit board assembly.



CKT NO	GRID COORD	CKT NO	GRID COORD
C1064	3G	R1020	3H
C1079	3F	R1022	4H
		R1061	3H
CR1021	5H	R1062	3H
CR1023	5G	R1063	3G
CR1024	5G	R1066	3H
CR1026	5G	R1067	3H
		R1069	3G
P1003	4D	R1071	3G
P1025	2A	R1073	3F
P1066	3G	R1074	3F
P1091	2B	R1076	3F
P1092	2C	R1077	2F
P1095	3H	R1079	3F
		R1087	2E
Q1061	2G		
Q1066	7G	S1011	4G
Q1070	4F	S1021	5D
Q1072	4F		
R1018	3F		
R1019	4F		

INDEX FOR FIGURE 7-9.

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

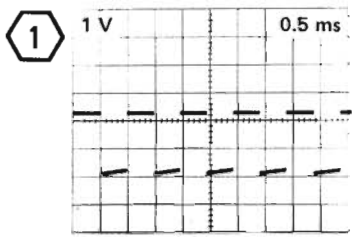
WAVEFORMS

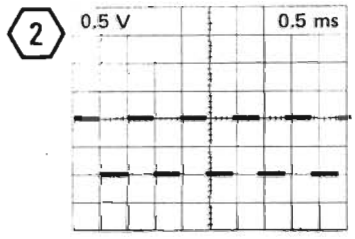
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

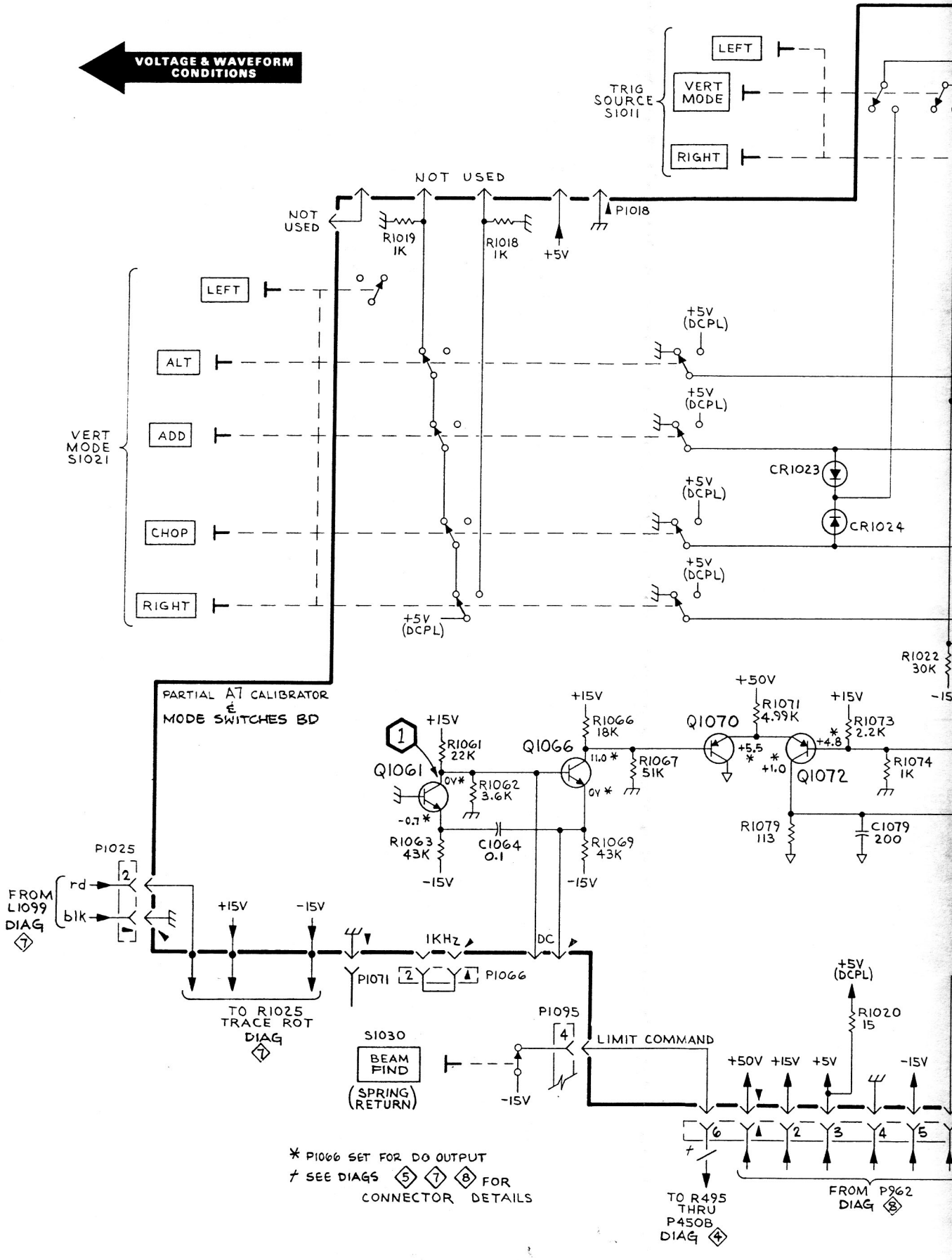
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

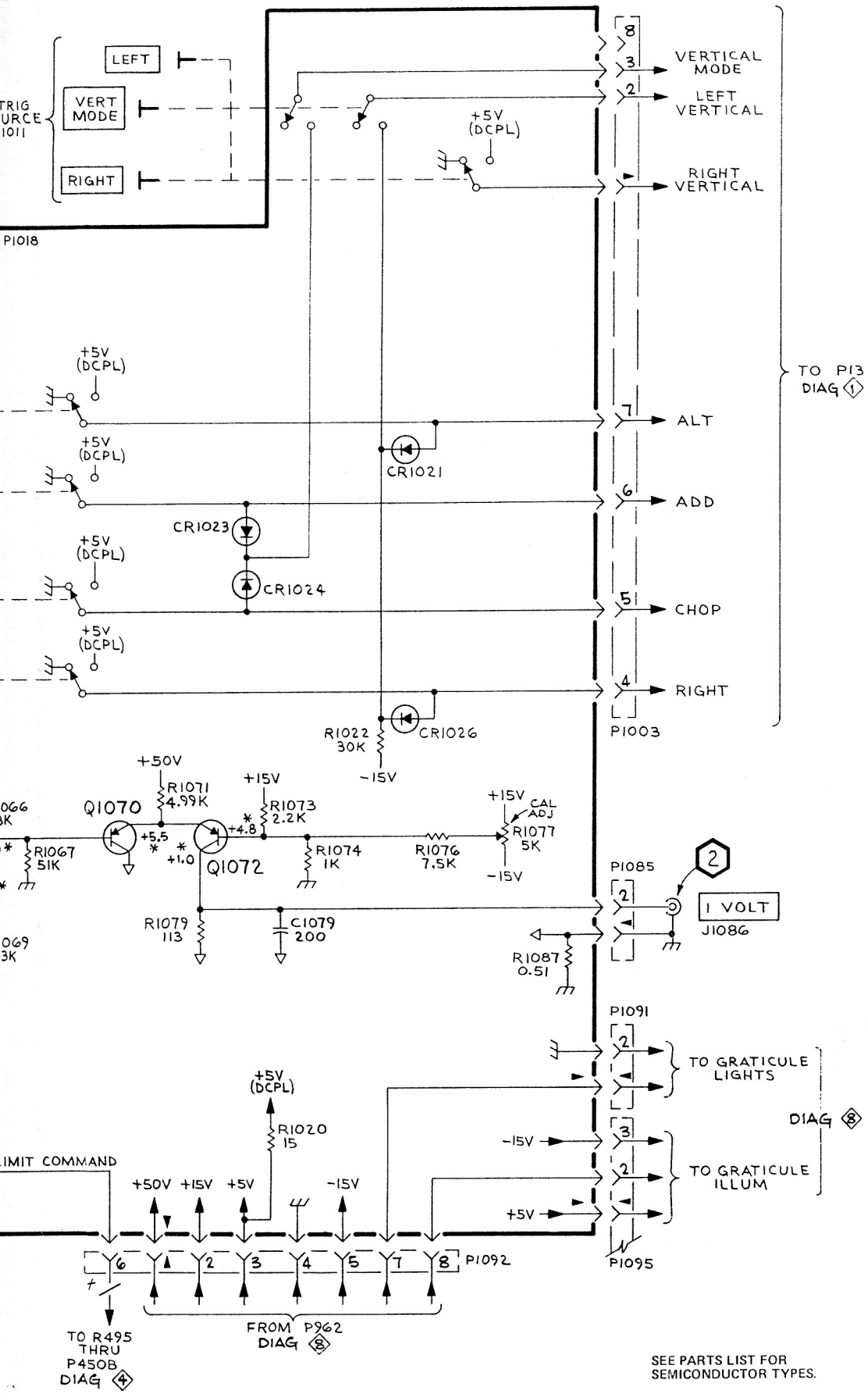
NOTE

Voltages and waveforms are not absolute and may vary between instruments.






VOLTAGE & WAVEFORM CONDITIONS
TRIG SOURCE S1011
LEFT
VERT MODE
RIGHT
NOT USED
NOT USED
R1019 1K
R1018 1K
+5V
P1018
VERT MODE S1021
LEFT
ALT
ADD
CHOP
RIGHT
+5V (DCPL)
CR1023
CR1024
PARTIAL A7 CALIBRATOR & MODE SWITCHES BD
R1022 30K
+50V
+15V
R1071 4.99K
R1073 2.2K
Q1070
Q1072
R1074 1K
R1066 18K
Q1066
R1067 51K
R1061 22K
Q1061
R1062 3.6K
R1063 43K
C1064 0.1
R1069 43K
R1079 113
C1079 200
-15V
P1025
FROM L1099 DIAG 7
rd
blk
1KHz
DC
P1071
P1066
TO R1025 TRACE ROT DIAG 7
P1095
S1030
BEAM FIND
(SPRING RETURN)
LIMIT COMMAND
R1020 15
FROM P962 DIAG 8
TO R495 THRU P450B DIAG 4
* P1066 SET FOR DO OUTPUT
† SEE DIAGS 5 7 8 FOR CONNECTOR DETAILS



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

CALIBRATOR & FRONT PANEL SWITCHING 6

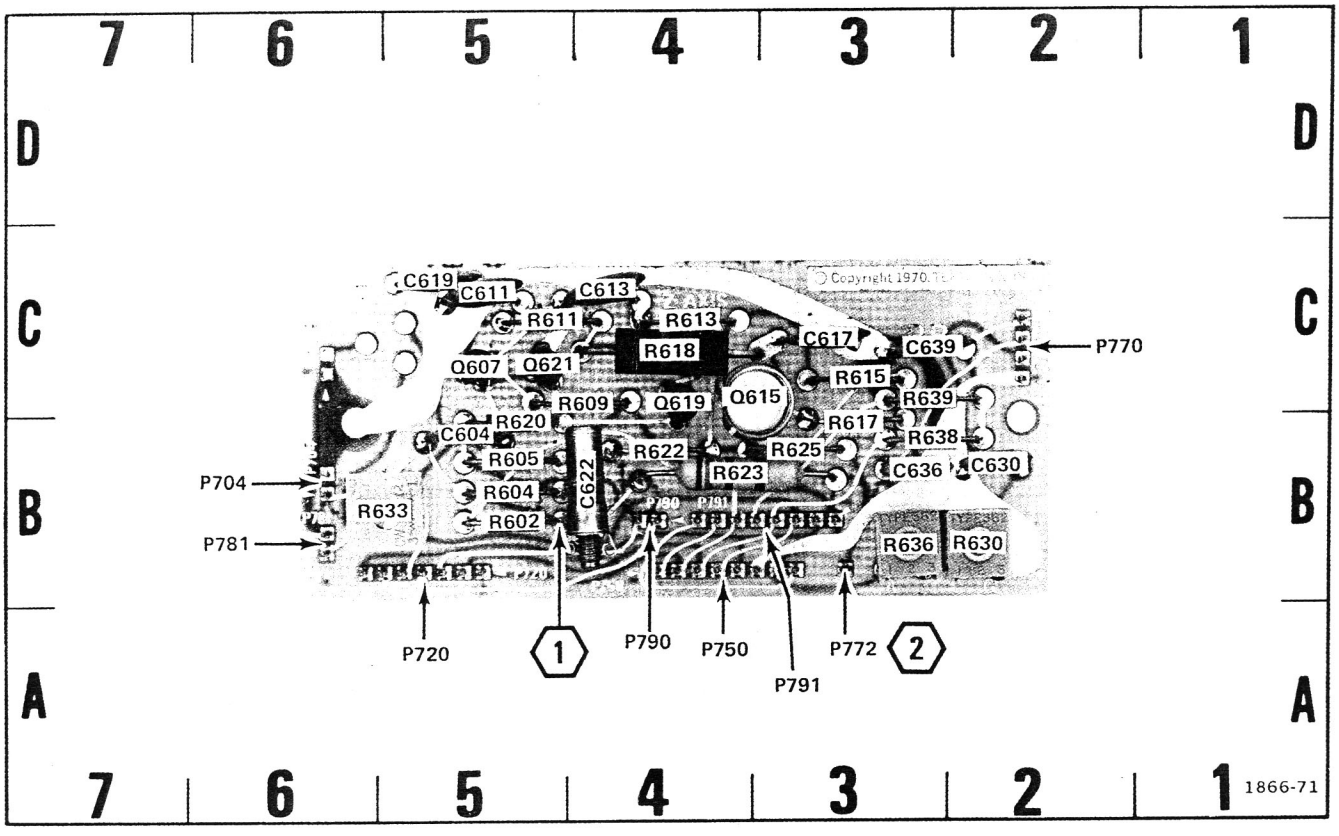


Figure 7-10. A8-Z-Axis Amplifier circuit board assembly.

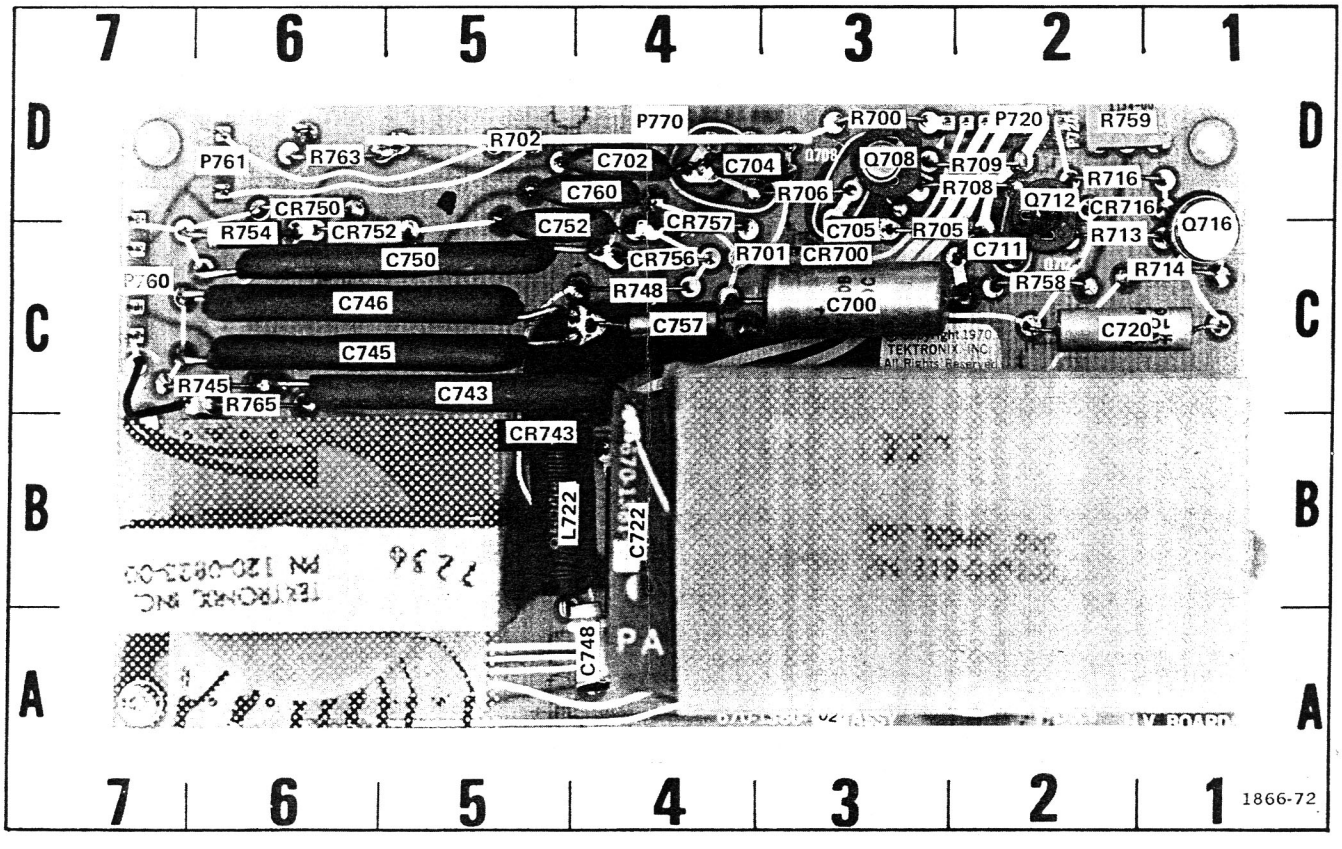


Figure 7-11. A9-High Voltage circuit board assembly.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

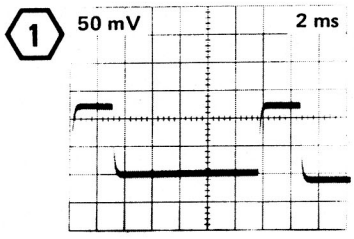
WAVEFORMS

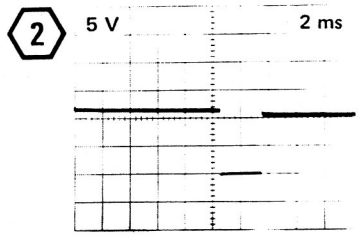
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

NOTE

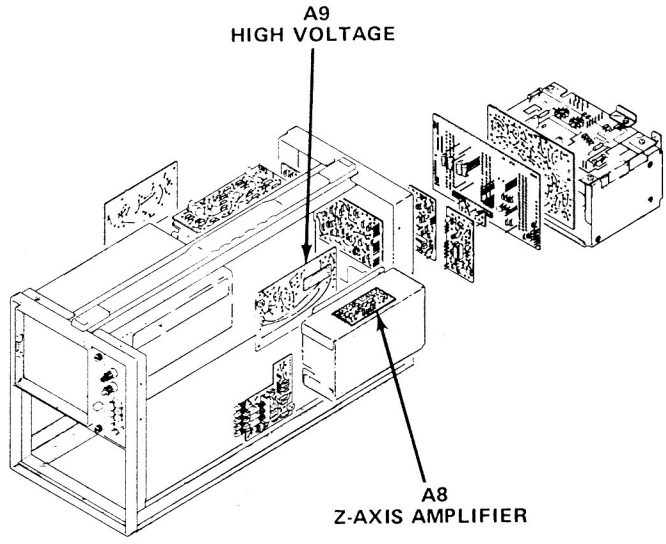
Voltages and waveforms are not absolute and may vary between instruments.





CKT NO	GRID COORD	CKT NO	GRID COORD
C604	5B	Q619	4C
C611	5C	Q621	5C
C613	4C		
C617	3C	R602	5B
C619	5C	R604	5B
C622	4B	R605	5B
C630	2B	R609	4C
C636	3B	R611	5C
C639	3C	R613	4C
		R615	3C
P704	6B	R617	3B
P720	5B	R618	4C
P750	4B	R620	5B
P770	2C	R622	4B
P772	3B	R623	4B
P781	6B	R625	3B
P790	4B	R630	2B
P791	3B	R633	5B
		R636	3B
Q607	5C	R638	3B
Q615	3C	R639	3C

INDEX FOR FIGURE 7-10.



CKT NO	GRID COORD	CKT NO	GRID COORD
C700	3C	P761	7D
C702	4D	P770	4D
C704	4D		
C705	3C	Q708	3D
C711	2C	C712	2D
C720	2C	Q716	1C
C722	4B	Q764	4A*
C743	5C	Q766	3A*
C745	6C		
C746	6C	R700	3D
C748	4A	R701	3C
C750	5C	R702	5D
C752	5C	R705	3C
C757	4C	R706	3D
C760	4D	R708	2D
		R709	2D
CR700	3C	R713	2C
CR716	2D	R714	1C
CR743	5B	R716	2D
CR750	6D	R745	6C
CR752	6C	R748	4C
CR756	4C	R754	6C
CR757	4C	R758	2C
		R759	2D
L722	5B	R763	6D
		R765	6C
P720	2D		
P760	7C		
P761	7D		

*LOCATED ON BACK OF BOARD

INDEX FOR FIGURE 7-11.

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

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 . Name & Description	Mfr Code	Mfr Part Number
2-1	----- -----			1	CKT BOARD ASSY:Z-AXIS AMPLIFIER(SEE A8 EPL)		
					(ATTACHING PARTS)		
-2	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CIRCUIT BOARD ASSEMBLY INCLUDES:		
-3	136-0183-00			1	. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-4	136-0252-04			12	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-5	131-0608-00			30	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-6	134-0067-00			1	BUTTON,PLUG:GRAY PLASTIC	80009	134-0067-00
-7	131-0008-00			1	CONN,PLUG,ELEC:	02660	91MC4M
-8	348-0085-00			2	GROMMET,PLASTIC:U-SHAPED	80009	348-0085-00
-9	343-0008-00			1	CLAMP,LOOP:0.375 INCH DIA,PLASTIC	95987	3-46R
					(ATTACHING PARTS)		
-10	211-0510-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-11	210-0863-00			1	WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
					- - - * - - -		
-12	----- -----			2	TRANSISTOR:(SEE Q764,Q766 EPL)		
					(ATTACHING PARTS FOR EACH)		
-13	211-0510-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-14	386-0978-00			2	INSULATOR,PLATE:0.002 INCH MICA,FOR TO-3	80009	386-0978-00
-15	337-1668-00			1	SHIELD,ELEC:HIGH VOLTAGE	80009	337-1668-00
					(ATTACHING PARTS)		
-16	211-0504-00			3	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-17	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-18	----- -----			1	MULTIPLIER,HV:(SEE U741 EPL)		
					(ATTACHING PARTS)		
-19	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-20	----- -----			1	CKT BOARD ASSY:HIGH VOLTAGE(SEE A9 EPL)		
					(ATTACHING PARTS)		
-21	211-0040-00			2	SCREW,MACHINE:4-40 X 0.25",BDCH PLSTC	26365	OBD
-22	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CIRCUIT BOARD ASSEMBLY INCLUDES:		
-23	131-0608-00			8	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
	131-0589-00			8	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-24	136-0183-00			3	. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-25	214-0579-00			1	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-26	136-0361-00			2	. SOCKET,PLUG-IN:	80009	136-0361-00
-27	136-0384-00			4	. CONTACT,ELEC:FOR 0.04 DIAMETER PIN	00779	52120
-28	131-0847-00			4	. TERMINAL STUD:6-32 X 0.435 INCH LONG	80009	131-0847-00
-29	129-0143-00			2	INSULATOR,STDF:0.312 OD X 0.406" L,NYLON	80009	129-0143-00
					(ATTACHING PARTS FOR EACH)		
-30	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-31	129-0098-00			1	POST,ELEC-MECH:0.250 HEX.X0.406 INCH L,BRS	80009	129-0098-00
					(ATTACHING PARTS)		
-32	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-33	386-2274-00			1	MOUNT,RESILIENT:CRT	80009	386-2274-00
					(ATTACHING PARTS)		
-34	211-0516-00			2	SCREW,MACHINE:6-32 X 0.875 INCH,PNH STL	83385	OBD
					- - - * - - -		
-35	214-1304-00			2	SPRING,HLCPS:0.30 OD X 1.25 INCH LONG	80009	214-1304-00
-36	136-0505-00			1	SKT,PL-IN ELEK:CRT	80009	136-0505-00
-37	136-0304-02			1	. SOCKET,PLUG-IN:CRT,14 PIN SOCKET,W/PINS	80009	136-0304-02
-38	200-0917-01			1	. COV,ELECTRON TU:2.052 OD X 0.291" THK,PLSTC	80009	200-0917-01
-39	367-0117-00			1	. PULL,SOC,PL-IN:	80009	367-0117-00
-40	343-0235-00			1	. CLAMP,SOCKET:	80009	343-0235-00
-41	384-1081-00			1	EXTENSION SHAFT:W/KNOB	80009	384-1081-00
-42	376-0053-00			1	CPLG,SHAFT,RGD:0.128 ID X 0.312 OD	80009	376-0053-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	213-0048-00			2	. SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-43	384-1152-00			1	EXTENSION SHAFT:	80009	384-1152-00
-44	376-0127-00			1	COUPLER,SHAFT:PLASTIC	80009	376-0127-00
-45	260-1222-00			1	SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
-46	361-0109-00			2	NUT,SLEEVE:0.641 INCH LONG,0.375 HEX	80009	361-0109-00
-47	348-0056-00			2	GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-48	407-1077-00			1	BRKT,CRT SHIELD:	80009	407-1077-00
					(ATTACHING PARTS)		
-49	210-0457-00			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-50	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-51	252-0562-00			FT	PLASTIC CHANNEL:0.100 X 0.120,POLYETHYLENE	06229	OBD
-52	343-0013-00			1	CLAMP,LOOP:0.375 INCH DIA	95987	3-8-6B
					(ATTACHING PARTS)		
-53	211-0012-00			1	SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-54	210-0863-00			1	WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
					- - - * - - -		
-55	348-0070-01			1	PAD,CUSHIONING:0.69 INCH,RUBBER	80009	348-0070-01
-56	131-1093-00			1	LEAD,ELECTRICAL:ANODE	80009	131-1093-00
-57	131-0026-00			1	BUTTON,PLUG:	83058	118738
-58	200-0541-00			1	FR,FLTR ELEM,AI:4.562 H X 5.625 INCH WIDE	80009	200-0541-00
-59	348-0324-00			1	PAD,CUSHIONING:	80009	348-0324-00
-60	386-1952-01			4	SUPPORT,CRT:	80009	386-1952-01
					(ATTACHING PARTS FOR EACH)		
-61	211-0603-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,HEX HD STL	83385	OBD
-62	210-0803-00			1	WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
					- - - * - - -		
-63	----- -----			1	COIL,TUBE DEFL:(SEE L1098 EPL)		
					(ATTACHING PARTS)		
-64	213-0138-00			2	SCR,TPG,THD FOR:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-65	----- -----			1	DELAY LINE,ELEC:(SEE L1099 EPL)		
					(ATTACHING PARTS)		
-66	211-0008-00			3	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-67	----- -----			1	CKT BOARD ASSY:VERTICAL AMPL(SEE A5 EPL)		
					(ATTACHING PARTS)		
-68	211-0014-00			2	SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-69	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-70	136-0252-01			19	. CONTACT,ELEC:0.178 INCH LONG	00779	1-332095-2
-71	131-1303-00			1	. CONTACT,ELEC:IC GROUND	80009	131-1303-00
-72	136-0252-04			9	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-73	131-0589-00			7	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-74	352-0100-00			1	. HOLDER,RESISTOR:0.128 DIA,PLASTIC	80009	352-0100-00
-75	361-0008-00			1	. SPACER,SLEEVE:0.11 ID X 0.25 OD X 0.28"H	80009	361-0008-00
-76	131-1003-00			3	. CONNECTOR BODY,:CKT BD MT,3 PRONG	80009	131-1003-00
-77	214-1652-00			1	. HEAT SINK,ELEC:	80009	214-1652-00
-78	214-1757-00			1	. HEAT SINK,ELEC:1.0 DIA X 0.27 THICK	80009	214-1757-00
-79	361-0477-00			2	SPACER,SLEEVE:0.238 ID X 0.25 INCH LONG	80009	361-0477-00
-80	351-0087-00			1	GUIDE,CKT CARD:4.75 INCH LONG,PLASTIC	80009	351-0087-00
-81	195-0085-00			1	LEAD SET,ELEC:	80009	195-0085-00
-82	131-0865-00			4	. TERMINAL,PIN:	80009	131-0865-00
-83	----- -----			1	. CKT BOARD ASSY:HORIZONTAL AMPL(SEE A6 EPL)		
					(ATTACHING PARTS)		
-84	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-85	136-0252-04			30	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-86	131-0608-00			20	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-87	214-1292-00			2	. HEAT SINK,ELEC:TRANSISTOR	05820	205-AB
-88	136-0183-00			6	. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00

Fig. & Index No.	Tektronix Part No.	Serial/M Eff
2-89	361-0008-00	
-90	351-0087-00	
-91	407-1120-00	
-92	210-0458-00	
-93	210-0457-00	
-94	211-0538-00	
-95	201-0011-00	
-96	348-0338-00	
-97	337-1676-00	
-98	211-0541-00	
-99	211-0502-00	
-100	210-1150-00	
-101	220-0552-00	
-102	210-0458-00	
-103	212-0004-00	
-104	354-0347-00	
-105	211-0170-00	
-106	214-1333-00	
-107	343-0205-01	
-108	211-0507-00	
-109	441-1082-00	
-110	348-0001-00	
-111	211-0529-00	
-112	361-0484-00	
-113	210-0847-00	
-114	337-1682-00	
-115	211-0542-00	
-116	210-1011-00	
-117	----- -----	
-118	211-0511-00	
-119	386-0978-00	
-120	----- -----	
-121	211-0511-00	
-122	386-0978-00	
-123	441-1079-01	
-124	211-0538-00	
-125	----- -----	
-126	136-0361-00	
-127	131-0847-00	
-128	136-0269-00	
-129	136-0183-00	
-130	136-0235-00	
-131	136-0252-04	
-132	131-0608-00	
-133	346-0077-00	

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-180	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	23499	TEK-175-0825-00
-181	175-0826-00			FT	WIRE,ELECTRICAL:3 WIRE RIBBON	08261	TEK-175-0826-00
-182	175-0827-00			FT	WIRE,ELECTRICAL:4 WIRE RIBBON	08261	TEK-175-0827-00
-183	175-0829-00			FT	WIRE,ELECTRICAL:6 WIRE RIBBON	83501	TEK-175-0829-00
-184	175-0830-00			FT	WIRE,ELECTRICAL:7 WIRE RIBBON	08261	TEK-175-0830-00
-185	175-0831-00			FT	WIRE,ELECTRICAL:8 WIRE RIBBON	08261	TEK-175-0831-00
	175-0857-00			FT	WIRE,ELECTRICAL:8 WIRE RIBBON	23499	TEK-175-0857-00
-186	175-0855-00			FT	WIRE,ELECTRICAL:10 WIRE RIBBON	23499	TEK-175-0855-00
-187	179-1817-00			1	WIRING HARNESS:50 OHM COAX	80009	179-1817-00
-188	131-0707-00			5	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-0708-00			5	CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
-189	352-0168-00			1	. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
	179-1637-00			1	WIRING HARNESS,:POWER	80009	179-1637-00
-190	131-0861-00			4	. CONTACT,ELEC:QUICK DISCONNECT	00779	42617-2
-191	200-1075-00			4	. COVER,ELEC CONN:PLASTIC	00779	1-480435-0
-192	352-0169-01			1	. CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01
-193	175-1263-00			1	CABLE,SP,ELEC:17 INCH LONG,W/SHIELD	80009	175-1263-00
-194	131-0621-00			3	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-195	352-0199-00			1	. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	131-0707-00			179	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-0708-00			6	CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
	131-0621-00			2	CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-196	352-0171-00			2	CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00
	352-0169-00			2	CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	352-0169-01			2	CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01
	352-0169-04			2	CONN BODY,PL,EL:2 WIRE YELLOW	80009	352-0169-04
-197	352-0161-00			1	CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0161-00
	352-0161-02			1	CONN BODY,PL,EL:3 WIRE RED	80009	352-0161-02
-198	352-0162-00			2	CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
	352-0162-01			1	CONN BODY,PL,EL:4 WIRE BROWN	80009	352-0162-01
	352-0162-05			1	CONN BODY,PL,EL:4 WIRE GREEN	80009	352-0162-05
-199	352-0164-01			2	CONN BODY,PL,EL:6 WIRE BROWN	80009	352-0164-01
-200	352-0165-00			4	CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0165-00
-201	352-0166-00			4	CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00
	352-0166-01			3	CONN BODY,PL,EL:8 WIRE BROWN	80009	352-0166-01
	352-0166-02			3	CONN BODY,PL,EL:8 WIRE RED	80009	352-0166-02
	352-0166-03			2	CONN BODY,PL,EL:8 WIRE ORANGE	80009	352-0166-03
	352-0168-00			2	CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-202	210-0775-00			8	EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-203	210-0774-00			8	EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00

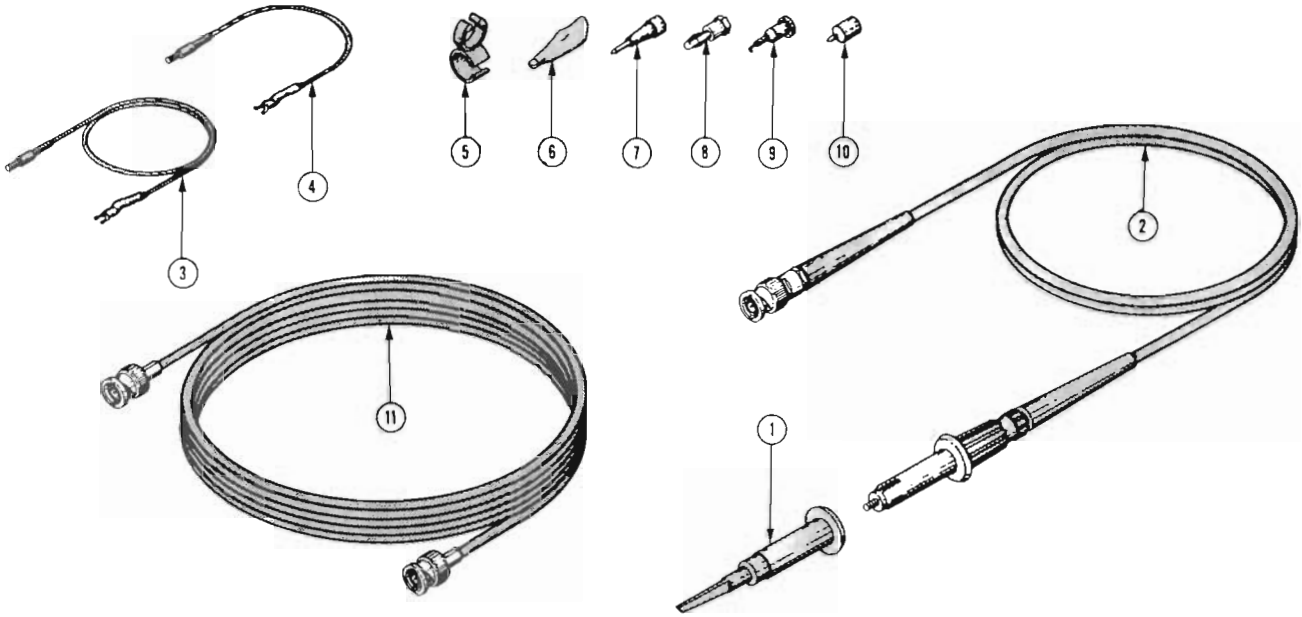


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	016-0553-00			1	COV ASSY,SCOPE:W/PROBE AND ACCESSORIES	80009	016-0553-00
	010-0127-00			2	. LEAD,TEST:	80009	010-0127-00
	----- -----			-	. . EACH PROBE INCLUDES:		
-1	013-0071-00			1	. . TIP,PROBE:RETRACTABLE HOOK	80009	013-0071-00
-2	010-0128-00			1	. . PROBE,VOLTAGE:42.0 INCH LONG,10X	80009	010-0128-00
-3	175-0125-01			1	. . LEAD,ELECTRICAL:PROBE GND,12 INCHES LONG	80009	175-0125-01
-4	175-0124-01			1	. . LEAD,ELECTRICAL:PROBE GND,5 INCHES LONG	80009	175-0124-01
-5	352-0090-00			1	. . HOLDER,TEST PRO:0.45 ID X 0.600 OD	80009	352-0090-00
-6	344-0046-00			2	. . CLIP,ELECTRICAL:ALLIGATOR TYPE,W/COVER	80009	344-0046-00
-7	206-0060-00			1	. . TIP,PROBE:STRAIGHT TIP,ASSY	80009	206-0060-00
-8	134-0013-00			1	. . PLUG,TIP:	74970	108-753-17
-9	206-0105-00			1	. . TIP,PROBE:HOOK ASSEMBLY	80009	206-0105-00
-10	206-0015-00			1	. . TIP,PROBE:	80009	206-0015-00
-11	012-0366-00			2	. CABLE,INTCON:8 FEET LONG,W/BNC EACH END	80009	012-0366-00

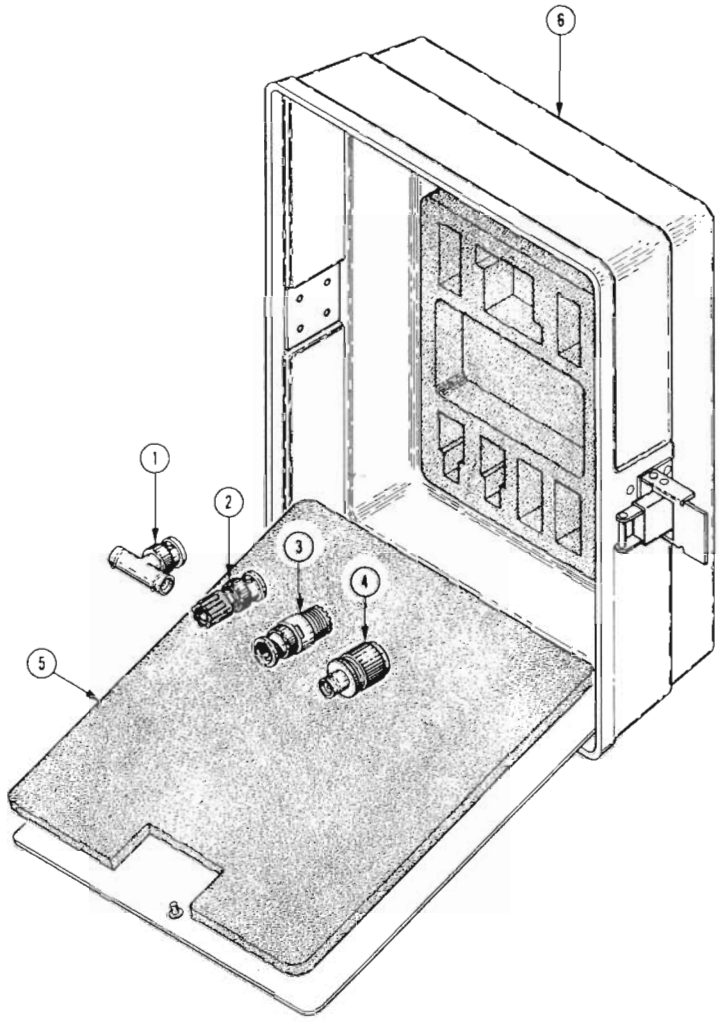


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
-1	103-0030-00			2	. ADAPTER,CONN:BNC TO BNC	91737	UG274BUDURAPLATE
-2	103-0033-00			2	. ADAPTER,CONN:BNC TO BINDING POST	24931	28PB100-2
-3	103-0032-00			2	. ADAPTER,CONN:BNC MALE TO UHF FEMALE	24931	29-JP116-1
-4	103-0015-00			2	. ADAPTER,CONN:BNC TO UHF	24931	29JP100-3
-5	348-0320-00			1	. PAD,CUSHIONING:TOP	80009	348-0320-00
-6	200-1360-01			1	. COVER,SCOPE FR:W/TRAY	80009	200-1360-01
	070-1866-00			1	MANUAL,TECH:INSTRUCTION	80009	070-1866-00

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.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

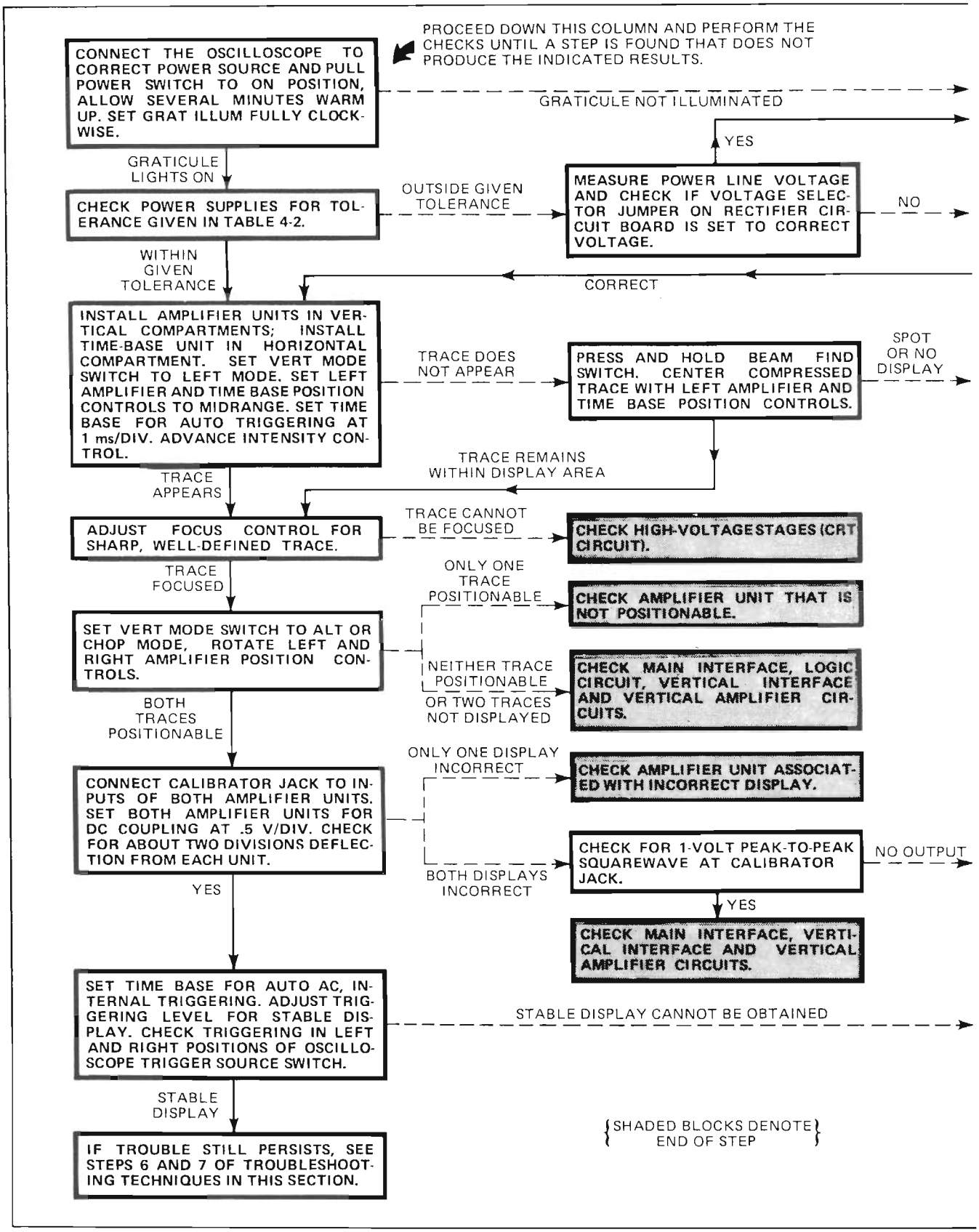


Figure 4-2. Oscilloscope troubleshooting chart.

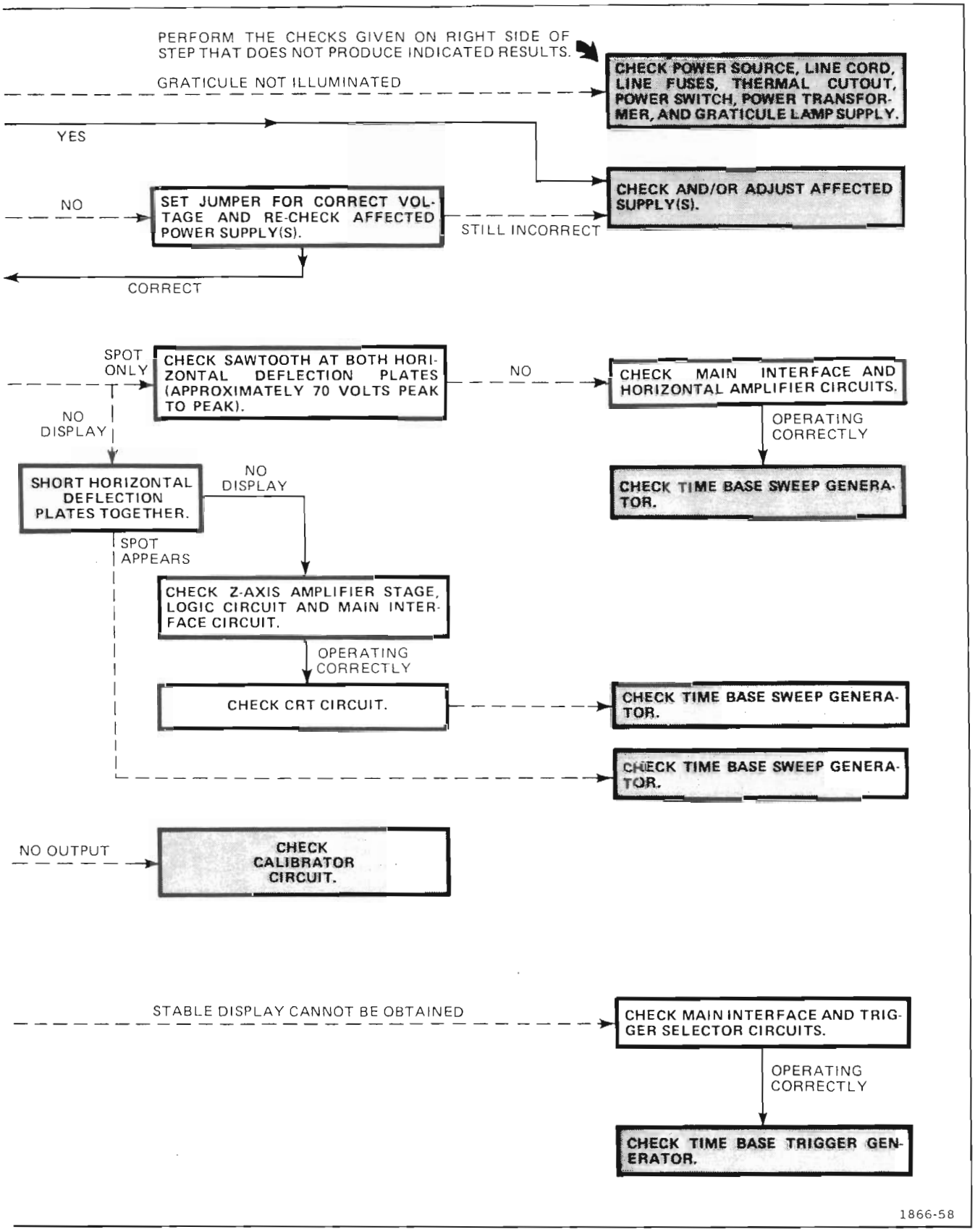


Figure 4-2 (Continued). Oscilloscope troubleshooting chart.

Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals after disconnecting one end from the circuit. With an ohmmeter set to the R x 1k scale, the resistance should be very high in one direction and very low when the leads are reversed.

Voltmeter checks on diodes can be performed in much the same manner as on transistor emitter-to-base junctions. Silicon diodes should have 0.6 to 0.8 volt across the junction when conducting. Higher reading indicate that they are either back biased or defective, depending on polarity.

Resistors. Check the resistors with an ohmmeter after disconnecting one end from the circuit. Check the Replaceable Electrical Parts list in Section 6 for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

Capacitors. A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter, on the highest scale, after dsiconnecting one end from the circuit. Do not exceed the voltage rating of the capacitor (some ohmmeters use 30 volts as source voltage). The resistance reading should be high after initial charge of the capacitor. An open capacitor can also be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

CAUTION

Observe ohmmeter polarity when checking electrolytic capacitors. Wrong polarity may damage the capacitor under test.

8. REPAIR AND ADJUST THE CIRCUIT. If any defective parts are located, use the appropriate replacement procedures given in this section under Corrective Maintenance. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced. Calibration of the affected circuit may be necessary.

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 the Oscilloscope can be obtained through your local Tektronix Field Office or representative. However, many of the 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 Replaceable Electrical Parts list in Section 6 for value, tolerance, rating and description. To determine the manufacturer of a part, note the number listed under Mfr. Code in the Parts List and refer to a Cross Index Mfr. Code Number to Manufacturer listing at the beginning of the Parts List.

NOTE

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

Special Parts

In addition to the standard electronic components, some special parts are used in this instrument. These parts are manufactured or selected by 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,, it is imperative that all of the following information be included in the order to ensure receiving the proper parts.

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include the circuit number).
4. Tektronix Part number.

SOLDERING TECHNIQUES

WARNING

High voltage and current levels are present in this instrument. To avoid electrical shock, 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 15- 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 circuit boards in this instrument are multi-layer boards with a conductive path(s) laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to the center conductor(s); only experienced maintenance personnel should attempt repair on these boards.

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

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board, as it may damage the board.

2. When the solder begins to melt, pull the lead out gently. If unable to pull the lead without using force, try removing the other end of the component as it may be more easily removed.

NOTE

The reason that some component leads seem troublesome to remove is due to a bend placed on each lead during machine insertion of the component in the manufacturing process. The purpose of the bent leads is to hold the component in place during a flow-soldering manufacturing process that solders all components at once.

If a component lead is extremely difficult to remove, it may be helpful to straighten the leads on the back side of the board with a small screwdriver or pliers while heating the soldered connection.

Unsolder the component from the circuit board, using heat on the component lead so that the solder will stay behind on the board. If it is desired to remove solder from a circuit-board hole for easier installation of a new component, use a vacuum-type desoldering tool or a solder-removing wick.

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

6. Clean the area around the solder connection with a flux-remover solvent. Be careful not to remove information printed on the board.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

To avoid electrical shock, disconnect the instrument from the power source before replacing components.

Semiconductors

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

CAUTION

Power must be disconnected before removing or replacing semiconductors to avoid component damage.

Replacement semiconductors should be of the original type or a direct replacement. The lead configuration of most semiconductors used in this instrument are shown in Figure 7-1 on the first page of the Diagrams section. 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 used for metal-case 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 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 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 the pins may be damaged.

Interconnecting Pins

Two methods of interconnection are used in this instrument to connect the circuit boards with other boards and components. Some interconnections are made with a pin soldered onto the board. Two types of mating connections are used for these interconnecting pins. If the mating connector is mounted on a plug-on circuit board, a special socket is soldered into the board. If the mating connector is on the end of a lead, an end-lead pin connector is used which mates with the interconnecting pin. The following information provides the replacement procedure for the various interconnecting methods.

CIRCUIT-BOARD PINS. A circuit-board pin replacement kit including necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order Tektronix Part 040-0542-00. Replacement of circuit-board pins on multilayer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.

To replace a pin which is mounted on a circuit board, first disconnect any pin connectors. Unsolder the damaged pin and pull it out of the circuit board with a pair of pliers (see Soldering Techniques, in this section, for recommended soldering and unsoldering procedures). Be careful not to damage the wiring on the board with too much heat. The ferrule on the pin may or may not disconnect from the hole with the damaged pin. If the ferrule remains in the circuit board, remove the ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the original ferrule is removed with the damaged pin, clean out the hole using soldering-iron heat, a solder-removing wick, and a scribe. Press the replacement pin with attached ferrule into the circuit-board hole. Position the replacement pin in the same manner as the removed pin. Solder the pin to the circuit board on each side of the board. If the removed pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

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

CAUTION

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

END-LEAD PIN CONNECTORS. The pin connectors used to connect wires to the inter-connecting 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 appears on the circuit board 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.

MAIN INTERFACE CONNECTOR PINS. The individual contacts of the interface connectors can be replaced. However, it is recommended that the entire Main Interface board be replaced if a large number of contacts are damaged. An alternative solution is to refer the maintenance of the Main Interface board to your local Tektronix Field Office or representative. Use the following procedure to replace an individual contact of the interface connector.

1. Remove the Main Interface circuit board from the instrument as described under Circuit Board Replacement—Main Interface Circuit Board.

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

3. Unsolder and remove the damaged contact.

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

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

6. Replace the Main Interface board.

Circuit Boards

If a circuit board is damaged beyond repair, the entire assembly including all soldered-on components should be replaced. Part numbers are given in Section 6 (Replaceable Electrical Parts) for the completely wired board.

To aid in identifying and locating circuit boards in the instrument, see Figure 7-2 on the first page of the Diagrams section for board locations, names, and assembly numbers. Determine the circuit board to be removed or replaced, find the name of the board listed within this procedure, and follow the removal and replacement instructions. To aid in identifying small components described in this procedure, use the diagrams in Section 8--Replaceable Mechanical Parts.

Most of the circuit boards in this instrument are mounted on the chassis; pin connectors are used for interconnection with other circuits. Use the following procedure to remove the chassis-mounted circuit boards (removal instructions for the exceptions will be given later).

CHASSIS-MOUNTED BOARDS. To replace a circuit board:

1. Disconnect any pin connectors on the board or connected to other portions of the instrument. Note the order of these connectors so they can be correctly replaced.

2. Remove the securing screws.

3. Remove the board.

4. To replace the board, reverse the order of removal. Match the arrows on the multi-pin connectors to the arrows on the board. Correct location of the pin connectors is shown in the circuit board illustrations in the Diagrams section.

TRIGGER SELECTOR AND VERTICAL INTERFACE CIRCUIT BOARDS. The Trigger Selector and Vertical Interface circuit boards plug onto the front of the Main Interface circuit board. Use the following procedure to replace either board:

1. Remove the securing screws.

2. Pull out on the edges of the board until the board clears the interconnecting terminals. Hold the board parallel to the Main Interface board until the board is free, so as not to bend the interconnecting terminals.

3. To replace the circuit board, position it so the interconnecting pins and sockets mate properly.

4. Gently press the circuit board against the mounting surface. Be sure that all the interconnecting pins and sockets mate properly.

5. Replace the securing screws.

LOGIC CIRCUIT BOARD. To remove the circuit board:

1. Slide out the power unit as described under Power-Unit Removal at the beginning of this section.

2. Disengage the plastic retainers which secure the sides of the board.

3. Pull out on the edges of the board until the board clears the interconnecting terminals. Hold the board parallel to the Main Interface board until the board is free, so as not to bend the interconnecting terminals.

4. To replace the Logic board, position it so the guide holes in the board mate with the guide posts. Check that all the interconnecting pins and sockets mate properly.

5. Gently press the board against the Main Interface board until the plastic retainers secure the board.

MAIN INTERFACE CIRCUIT BOARD. To remove the circuit board:

1. Slide out the power unit as described under Power-Unit Removal at the beginning of this section.

2. Remove all of the plug-on circuit boards from the Main Interface board.

3. Disconnect the multi-pin connectors from the rear of the Main Interface board. Note the order of these connectors so they can be correctly replaced.

4. Remove the three screws from inside each plug-in compartment which hold the plug-in interface connectors to the chassis (total of nine screws). Also, remove the hexagonal posts which secure the ground straps to the Main Interface board.

5. Remove the Main Interface board assembly through the rear of the instrument.

6. To replace the Main Interface board, reverse the order of removal. Match the arrows on the multi-pin connectors to the arrows on the board. Correct location of the pin connectors is shown in the circuit board illustration in the Disgrams section.

REGULATOR CIRCUIT BOARD. To remove the circuit board:

1. Remove the four screws which secure the protective cover to the rear frame of the instrument.

2. Remove the four screws that secure the heat radiator to the sides of the rear frame.

3. Disconnect and tag the connectors on the front of the circuit board.

4. Remove and tag (as to location) each power transistor from the heat radiator. (Upon removal of the power transistors, the Regulator board is released from the heat sink.)

5. To replace the Regulator board, reverse the order of removal.

NOTE

After replacing the power transistors, check that the transistor cases are not shorted to the heat radiator before applying power.

RECTIFIER BOARD. To replace the Rectifier board, proceed as follows:

1. Slide out the power unit as described under Power-Unit Removal at the beginning of this section.

2. Disconnect and tag the pin connectors from the board.

3. Disconnect and tag the wires soldered to the top of the board that connect the board to the power transformer and other circuits.

4. Remove the screws holding each corner of the board to the power unit, then remove the board. Remove the solder from all holes in the circuit board where wires were removed, to ease installation.

5. To replace the Rectifier board, reverse the order of removal. Be sure that all of the transformer wires are properly placed before soldering. Match the arrows on the multi-pin connectors to the arrows on the board.

CALIBRATOR AND MODE SWITCHES BOARD. To remove the circuit board:

1. Remove the FOCUS, INTENSITY, BEAM FIND, and GRAT ILLUM control knobs.

2. Remove the securing nuts that hold the INTENSITY and GRAT ILLUM control to the front panel.

3. Disengage the power switch actuating rod at the coupler adjacent to the high-voltage assembly and remove the rod and plastic bushing through the front of the instrument.

4. Remove the front panel.

5. Remove the two screws holding the VERT MODE switch to the front sub-panel.

6. Remove the nylon screw holding the board to the support on the crt shield.

7. Pull the board out only far enough to allow the multi-pin connectors and wire leads to be disconnected (note the placement of the connectors or tag them).

8. Remove the board.

9. To replace the circuit board, reverse the removal procedure. Match the arrows on the multi-pin connectors to the arrows on the circuit board.

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.

REMOVAL. To remove the crt, proceed as follows:

1. Remove the heat radiator/Regulator circuit board assembly as described previously under Circuit Board Replacement-Regulator Board.

2. Remove the two screws with springs, and a plate that hold the crt base socket in place.

3. Remove the crt base socket from rear of crt.

4. Disconnect the deflection plate connectors (two at top and two at side near midpoint of crt length.

5. Disconnect crt anode lead at the connector fastened to the front of the high-voltage assembly; immediately ground this lead to dissipate any stored charge.

6. Remove the two screws securing the crt bezel to the front panel; remove the bezel and light filters.

7. Hold one hand on the crt faceplate and push forward on the crt base with the other. As the crt starts out of the shield, grasp it firmly. Guide the anode lead through the cutout in the crt shield as the crt is removed.

INSTALLATION. To replace the crt, proceed as follows:

1. Insert the crt into the shield. Guide the anode lead through the hole in the crt shield.

2. Clean the crt faceplate and the light filter with denatured alcohol.

3. Install the crt bezel, mesh filter, and light filter. Firmly tighten the two screws.

4. Push forward on the crt base to be certain that the crt is as far forward as possible. Then install the crt base socket, retaining plate, springs, and screws of the crt clamp assembly.

5. Position and tighten down the crt clamp until the springs are compressed and the faceplate of the crt is tight against the implosion shield.

6. Reconnect the crt anode plug.

7. Install the heat radiator/Regulator circuit board assembly.

8. Carefully connect the deflection-plate connectors. After each connector is installed, lightly pull on its lead to be sure that it will remain in its socket.

9. Check the calibration of the complete instrument. The Calibration procedure is given in Section 5.

Graticule-Bulbs

To remove a graticule bulb, first remove the two screws securing the crt bezel to the front panel. Remove the plastic light shield and retaining spring. Now, firmly grasp the defective bulb and pull straight out. Push the replacement bulb straight into the socket as far as it will go. Replace the retaining spring, light shield, and crt bezel.

Power Transformer

Replace the power transformer only with a direct replacement transformer. When removing the transformer, tag the leads with the corresponding terminal numbers to aid in connecting the new transformer. After the transformer has been replaced, check the performance of the complete instrument using the procedure given in the Calibration section.

High-Voltage Assembly Components

The components located within the High-Voltage Assembly can be reached for maintenance or replacement by using the following procedure.

NOTE

All solder joints in the High-Voltage Assembly should have smooth surfaces. Any protusions may cause high-voltage arcing at high altitudes.

1. Remove the heat radiator/Regulator circuit board assembly as described previously under Circuit Board Replacement--Regulator Board.

2. Disconnect the crt clamp and crt base socket.

3. Disconnect the crt anode plug and discharge it to the chassis. Using an insulated probe or wire, discharge the jack portion of the crt anode connector to chassis ground.

4. Disconnect the multi-pin connectors on the Z-Axis Amplifier board and tag the connectors.

5. Remove the screws securing the High-Voltage Assembly Shield to the Oscilloscope frame (two screws at top, one on bottom, and two at front).

6. Guide the High-Voltage Assembly Shield away from the instrument chassis. Be careful not to damage any of the components or the pin connectors on the High-Voltage or Z-Axis Amplifier circuit boards. Disconnect the multi-pin connectors from the High-Voltage board.

7. Using an insulated shorting strap, discharge the exposed connections to chassis ground.

8. Remove the two power transistors and the four screws which secure the High-Voltage board to the High-Voltage Assembly. Now, all of the high-voltage circuitry can be reached for maintenance or replacement except the components in the encapsulated high-voltage multiplier.

9. To replace the encapsulated high-voltage multiplier, remove four screws located on the bottom of the High-Voltage circuit board (remove board to reach screws).

10. To replace the High-Voltage Assembly, reverse the above procedure. Be careful not to pinch any of the interconnecting wires when attaching the high-voltage compartment to the chassis.

Fuse Replacement

Table 4-3 gives the rating, location, and function of the fuses used in this instrument.

TABLE 4-3

Fuse Rating, Location, and Function

Circuit Number	Rating	Location	Function
F1000	2 A Slow	Rear Panel	115-volt line
F1001	2 A Slow	Rear Panel	115-volt line
F855	0.15 A Fast	Carrying-handle frame (rear)	+130 volts

CALIBRATION AFTER REPAIR

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits. Since the low-voltage power supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the low-voltage supplies or if the power transformer has been replaced. See Section 5, Calibration, for a complete calibration procedure.

PACKAGING FOR SHIPMENT

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

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

If the original packing is unfit for use or not available, package 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 Table 4-4 for carton test strength requirements.

TABLE 4-4

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

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 the carton and the instrument, allowing three inches on all sides.

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

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

CALIBRATION

This section contains a performance check procedure and a calibration procedure. Completion of either procedure ensures that the instrument is correctly adjusted and operating within its published specifications. Refer to the following discussion for instructions on performing complete or partial performance check and calibration procedures.

Any reference to Oscilloscope throughout this section refers to the OS-245(P)/U Oscilloscope mainframe. Also, any reference to amplifier unit or time-base unit refers to the plug-in units used as test equipment with the Oscilloscope mainframe.

PRELIMINARY INFORMATION

Incoming Inspection

To perform an initial check of electrical operation, see Operating Checkout in the Operating Instructions section of this manual. The Operating Checkout is intended to determine the acceptability of newly purchased instruments. This procedure does not check every facet of instrument calibration; rather it is concerned primarily with those portions of the instrument that are essential to correct operation.

Calibration Interval

To ensure instrument accuracy, check the calibration of the Oscilloscope every 1000 hours of operation, or every 6 months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section of this manual.

Tektronix Field Service

Tektronix, Inc. provides complete instrument repair and calibration at local Field Service Centers and the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Using This Procedure

This procedure provides several features to facilitate calibration and checking the Oscilloscope. These are:

INDEX. An index is given preceding the calibration procedure to aid in locating performance check and calibration procedure steps. A check mark symbol (√) preceding a step title indicates that a check of instrument performance is made during the procedure of that step.

PERFORMANCE CHECK PROCEDURE. The performance of the Oscilloscope can be checked, without removing the cabinet sides or making internal adjustments, by performing the calibration procedure and omitting the ADJUST— parts of the steps. A check mark symbol (√) preceding a step title indicates a check of performance will be made later in the procedure of the step. The (√) symbol preceding a CHECK— part of the step indicates a check of performance against a tolerance listed as a performance requirement in the Specification section of this manual. Limits and tolerances given in other Check— steps (Check— steps without the √ symbol) are calibration guides and should not be interpreted as instrument specifications. Operator front-panel adjustments are adjusted as part of the performance check procedure. If the tolerance given for a √ CHECK— part cannot be met, and an ADJUST— part immediately follows, a partial adjustment can be quickly performed when internal adjustments are accessible.

CALIBRATION PROCEDURE. Completion of each step in the calibration procedure ensures that the instrument is correctly adjusted and meets the electrical specifications listed in the Specification section of this manual. Where possible, instrument performance is checked before an adjustment is made. The recommended calibration philosophy is to adjust a specific internal control only when test indications show that part of a step is not within the specified limits. Do not attempt to bring the adjustment to the desired level if the indications are within the limits. Adherence to this philosophy will extend the life of the Oscilloscope. In areas of the calibration procedure where the best electrical measurement accuracy is desired, the ADJUST— part of the step may be made to the exact setting, even if the preceding Check— part is within the allowable tolerance. It will be necessary to remove the cabinet sides in order to have full access to the internal adjustments and test points.

PARTIAL PROCEDURES. A partial performance check or calibration may be desirable after replacing components, or to improve the adjustment of a portion of the instrument between major calibrations. To check or adjust only part of the instrument, refer to the Equipment Required list, the plug-in installation instructions and the Control Settings which precedes that portion to be performed. To prevent unnecessary calibration of other parts of the instrument, adjust only if the tolerance given in the Check— part of the step is not met. If adjustment is necessary, also check the calibration of any steps listed in the INTERACTION— part of the step.

If the applications for which you will use the Oscilloscope do not require the full available performance from the Oscilloscope and plug-in units, the procedures and the Equipment Required list can be shortened accordingly. For example, the basic low-frequency measurement capabilities of the Oscilloscope system can be verified by just checking vertical deflection accuracy and basic horizontal timing. Also, if the Oscilloscope-plug-in combination is to be used as a fixed system without the need to interchange plug-in units, the important measurement capabilities can be verified with the fixed system and applicable test signals instead of using the Calibration Fixture Signal Standardizer (see Table 5-1, Test Equipment Required).

COMPLETE PROCEDURES. The ideal way to calibrate or performance check this instrument is to perform a complete procedure from beginning to end, using the exact sequence provided. The procedures are carefully arranged so that interaction of control settings and adjustments have the least affect on overall instrument accuracy. No concern to interaction (other than the interactions mentioned in the calibration procedure) is necessary when all instructions are performed in the procedures.

If all the recommended test equipment is used and all front-panel control settings are strictly followed when performing a complete procedure, the Control Settings list of the following subsection may not need to be completely checked. Notice the controls that are high-lighted in a bold-face type (new setting) and set those controls as recommended.

Also, at the beginning of each major portion of the calibration procedure (i.e., A. POWER SUPPLY), you will notice a reference to an Adjustment Locations pullout page located in the Diagrams section of this manual. This page is normally used when performing the calibration procedure. Fold out the designated page so that the Adjustment Locations illustrations on the page are always in view for rapid location of test points and adjustments.

TEST EQUIPMENT REQUIRED

All of the following test equipment and accessories, or their equivalents, are required for a complete performance check or calibration of the Oscilloscope. Specifications given in Table 5-1 for the test equipment are the minimum required to meet those specifications listed in the Specification section of this manual. Therefore, some of the specifications listed here may differ from the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed minimum specifications. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the test equipment instruction manuals if more information is needed. The fast sweep-speed characteristics of the Oscilloscope and time-base unit must be checked and adjusted as a system. The calibration of the plug-in units should first be checked according to the procedure given in their respective instruction manuals before performing the Oscilloscope procedures.

Special Calibration Fixtures

Special Tektronix calibration fixtures are used only where they facilitate instrument calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number from Tektronix Field Offices or representatives.

Calibration Equipment Alternatives

Test equipment listed in the Examples of Applicable Test Equipment column, Table 5-1, is required to check and calibrate this instrument. The performance check/calibration procedures are based on the first item of equipment given as an example. If other equipment is substituted, control settings or calibration setups may need to be altered slightly to meet the requirements of the substitute equipment. If the exact item of test equipment given as an example is not available, first check the Minimum Specifications column carefully to see if any other equipment is available which might suffice. Then, check the Purpose column to see what this item is used for. If used for a check or adjustment that is of little or no importance to your measurement requirements, the item and corresponding step(s) can be deleted.

National Stock Numbers

The Examples of Applicable Test Equipment column in Table 5-1, lists the National Stock Number for each item having an assigned number. The numbers are provided for convenience and ease in purchasing test equipment.

Signal Connections

Detailed signal-connection information is not always provided except when critical for a particular test. Signals should be interconnected to other equipment using RG-58/U, 50-ohm BNC cables. When simultaneously connecting a signal to two inputs, use a BNC T-connector. For test equipment signal-connection and termination information, refer to the test equipment instruction manuals.

TABLE 5-1
Test Equipment Required

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Amplifier plug-in unit (2 identical units required)	Tektronix 7A-series; combined bandwidth of amplifier unit and Oscilloscope, 65 MHz; input resistance, 1 MΩ.	Provides vertical input for the Oscilloscope.	a. Tektronix AM-6565/U Amplifier. National Stock Number 6625-00-106-9625. b. Tektronix 7A15A Amplifier. c. Tektronix 7A16A Amplifier. National Stock Number 6625-00-217-0418. d. Tektronix 7A18 Dual Trace Amplifier. National Stock Number 6625-00-185-7817. e. Tektronix 7A26 Dual Trace Amplifier. National Stock Number 6625-00-361-5318.
2. Time-base plug-in unit	Tektronix 7B-series; sweep rate, to at least 5 ns/div. Horizontal amplifier mode.	Provides a sweep for the Oscilloscope.	a. Tektronix TD-1085/U Dual Time Base. National Stock Number 6625-00-106-9624.
3. Calibration Fixture Signal Standardizer	Produces gain-check and pulse-response waveforms.	Standardizes the instrument so plug-in units can be interchanged without complete recalibration.	a. Tektronix 067-0587-01 Calibration Fixture Signal Standardizer. National Stock Number 6625-00-115-6711. b. Calibrated plug-in units with suitable signal sources may be substituted if lower performance is acceptable.
4. Test oscilloscope system with 10X probes (2 identical probes required)	Dual-channel with chopped vertical mode; bandwidth, 25 MHz; sweep rate, to at least 0.05 μs/div.	Z-axis compensation adjustment. Horizontal limit centering adjustment. Output signals check.	a. Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope system with standard accessories (AN/USM-281C). National Stock Number 6625-00-106-9622. b. Any oscilloscope system that meets minimum specifications. Two identical 10X probes with 25 MHz bandwidth are required. c. Refer to the Tektronix catalog for compatible oscilloscope systems.
5. Digital voltmeter	Range, 0 to 150 V; accuracy, within 0.2%.	Power supply voltages check and adjustment. Z-axis dc levels checks. Calibrator output accuracy check and adjustment.	a. Tektronix DM 501 Digital Multimeter.[1] National Stock Number 6625-00-500-6640. b. Any digital voltmeter that meets minimum specifications.

[1] Requires a TM 500-series power module.

TABLE 5-1 (CONT.)
Test Equipment Required

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
6. Dc voltmeter	Range, 0 to 3000 V or higher; accuracy, calibrated to within 1% at −2960 V.	High-voltage power supply check.	a. Triplett Model 630-NA. b. Simpson Model 262.
7. Sine-wave generator	Frequency, variable from 250 kHz to 120 MHz; reference frequency, 50 kHz; output amplitude, from 15 mV to 4 V into 50 Ω; amplitude accuracy, constant within 3% of reference as output frequency changes.	Vertical bandwidth and isolation checks. Horizontal bandwidth check.	a. Tektronix SG 503 Leveled Sine-Wave Generator.[1] National Stock Number 6625-00-520-5143. b. Any sine-wave generator that meets minimum specifications.
8. Time-mark generator	Marker outputs, 10 ns to 0.1 s; accuracy, within 0.1%.	Horizontal timing checks and adjustment.	a. Tektronix TG 501 Time-Mark Generator.[1] National Stock Number 6625-00-520-5199. b. Tektronix TG 501 Opt. 1 Time-Mark Generator.[1] National Stock Number 6625-00-534-2638. c. Tektronix 2901 Time-Mark Generator. National Stock Number 6625-00-483-2619. d. Tektronix Type 184 Time-Mark Generator. National Stock Number 6625-00-982-1543.
9. Low-frequency generator	Frequency, 35 kHz and 50 kHz; output amplitude, variable from 250 mV to 5 V into 50 Ω.	X-Y phase shift check.	a. Tektronix FG 501 Function Generator.[1] National Stock Number 6625-00-140-7817. b. Tektronix FG 503 Function Generator.[1]
10. Cable (2 required)	Impedance, 50 Ω; type RG-58/U; length, 42 in.; connectors, BNC.	Signal interconnection.	a. Tektronix Part 012-0057-01. National Stock Number 6625-00-498-4834. b. Any cable that meets minimum specifications.
11. Cable (2 required)	Impedance, 50 Ω; type RG-58/U; length, 18 in.; connectors, BNC.	Signal interconnection.	a. Tektronix Part 012-0076-00. National Stock Number 6125-00-916-8025. b. Any cable that meets minimum specifications.

[1] Requires a TM 500-series power module.

TABLE 5-1 (CONT.)
Test Equipment Required

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
12. Termination	Impedance, 50 Ω; accuracy, within 2%; connectors, BNC.	Signal termination.	a. Tektronix Part 011-0049-01. National Stock Number 5985-00-087-4954.
13. T-connector	Connectors, BNC.	Signal interconnection.	a. Tektronix Part 103-0030-00. National Stock Number 5935-00-284-1962 (2 supplied as standard accessories).
14. Screwdriver	Length, 3-in. shaft; bit size, 3/32 in.	Adjust variable resistors.	a. Xcelite R3323.
15. Low-capacitance screwdriver	Length, approximately 4 in.; bit size, 3/32 in.	Adjust all variable capacitors.	a. J.F.D. Electronics Adjustment Tool Part 5284.

PERFORMANCE CHECK/CALIBRATION PROCEDURES

The following performance check procedure (calibration procedure with ADJUST— parts omitted) can be used for periodic checks of the instrument to confirm that the Oscilloscope is operating within acceptable limits. This procedure is concerned with those portions of the Oscilloscope which are essential to measurement accuracy, and checks the instrument against the tolerances given as Performance Requirements in the Specification section of this manual. It is not necessary to remove the cabinet sides to perform the procedure, since all checks are made from the front panel. Read the information given previously under Performance Check Procedure to be sure all considerations are well understood.

The following calibration procedure, when performed in its entirety, returns the Oscilloscope to correct calibration. All limits and tolerances given in this procedure are calibration guides, and should not be interpreted as instrument specifications except when listed as Performance Requirements in the Specification section of this manual.

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@

PRELIMINARY PROCEDURE FOR PERFORMANCE CHECK

NOTE

The performance of this instrument should be checked within an ambient temperature range of +15° to +35° C to allow application of the most exact specifications listed in the performance check procedure. This instrument can be checked within an ambient temperature range of 0° to +50° C.

1. Connect the Oscilloscope to a power source which meets the voltage and frequency requirements of the instrument (refer to Operating Voltage in the Operating Instructions section of this manual).

NOTE

If the correct line voltage is not available, use a variable autotransformer to provide the correct input voltage.

2. Assemble the plug-in units and Oscilloscope together as directed under Install Plug-In Units preceding the subsection to be performed.

3. Set the controls as given under Control Settings preceding the same subsection.

4. Turn on the Oscilloscope, and allow at least 20 minutes warmup before proceeding with the performance check.

NOTE

Titles for external controls of the Oscilloscope are capitalized in this procedure (e.g., INTENSITY, VERT MODE).

PRELIMINARY PROCEDURE FOR CALIBRATION

NOTE

The Oscilloscope must be adjusted within an ambient temperature range of +20° to +30° C for best overall accuracy and to meet the electrical characteristic tolerances given as Performance Requirements in the Specification section of this manual.

1. Remove the cabinet sides from the Oscilloscope (refer to Cabinet Removal in the Maintenance section of this manual).

2. Connect the Oscilloscope to a power source which meets the voltage and frequency requirements of the instrument (refer to Operating Voltage in the Operating Instructions section of this manual).

NOTE

If the correct line voltage is not available, use a variable autotransformer to provide the correct input voltage.

3. Assemble the plug-in units and Oscilloscope together as directed under Install Plug-In Units preceding the subsection to be performed.

4. Set the controls as given under Control Settings preceding the same subsection.

5. Turn on the Oscilloscope and allow at least 20 minutes warmup before proceeding.

NOTE

Titles for external controls of the Oscilloscope are capitalized in this procedure (e.g., GRAT ILLUM, POWER). Internal adjustments are initial capitalized only (e.g., Crt Grid Bias, Vertical Centering).

A. POWER SUPPLY

NOTE

No performance checks in this Portion (A) of the calibration procedure.

Equipment Required

1. Digital voltmeter
2. Dc voltmeter (vom)
3. Screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 1** in the pullout pages.

Do Not Install Plug-In Units

Plug-in units should not be electrically connected to the Oscilloscope throughout this portion (A) of the calibration procedure.

Control Settings

Oscilloscope

INTENSITY . . . . . Counterclockwise (off)
FOCUS . . . . . Midrange
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

A1. CHECK –50-VOLT POWER SUPPLY

a. Connect the digital voltmeter between pin 1 of P901 on the Regulator circuit board, and chassis ground. See Figure 7-14 for voltage test point location.

b. Check—For a meter reading of –49.9 to –50.1 volts.

NOTE

If the –50-volt supply is within the specified tolerance, proceed with step A2. If the –50-volt adjustment is to be made, all circuits will be affected and the entire calibration procedure should be performed to verify the accuracy of all adjustments in the instrument.

c. ADJUST— –50 Adj R881 for a meter reading of exactly –50 volts. See Figure 7-14 for adjustment location.

A2. CHECK REMAINING POWER SUPPLY VOLTAGES

a. Check—Each supply with the digital voltmeter to ensure that all output voltages are within the limits given in Table 5-2. See Figure 7-14 for voltage test point locations.

TABLE 5-2
Power Supply Voltage Limits

Power Supply	Test Point Location	Output Voltage Limits
–50 V (Previously Checked)	P901-Pin 1 (on Regulator Board)	–49.9 to –50.1 V
–15 V	P901-Pin 2	–14.7 to –15.3 V
+5 V	P901-Pin 3	+4.85 to +5.15 V
+15 V	P901-Pin 4	+14.7 to +15.15 V
+50 V	P901-Pin 5	+49.4 to +50.6 V
+130 V	F855 (under carrying-handle frame, rear)	+124.8 to +135.2 V

NOTE

Ripple and regulation of the individual supplies can be checked using the procedure given under Troubleshooting Techniques in the Maintenance section of this manual.

b. Disconnect the digital voltmeter.

A3. CHECK HIGH-VOLTAGE POWER SUPPLY

a. Press the POWER switch to turn off the Oscilloscope.

b. Remove the plastic plug button from the high-voltage test-point access hole on the high-voltage assembly (pry gently on the plug if necessary). See Figure 7-15 for plug button location.

c. Set the dc voltmeter (vom) to measure at least −3000 volts and connect it between H.V. Test Point and chassis ground. See Figure 7-15 for test point location.

d. Pull the POWER switch to turn the Oscilloscope on.

e. Check—For a meter reading of −2871 to −3049 volts.

f. Press the POWER switch to turn off the Oscilloscope before disconnecting the voltmeter.

g. Disconnect the dc voltmeter and insert the plastic plug button in the high-voltage assembly.

h. Pull the POWER switch to turn the Oscilloscope on.

B. Z-AXIS AND CRT DISPLAY

Equipment Required

1. Amplifier plug-in unit
2. Time-base plug-in unit
3. Digital voltmeter
4. Test oscilloscope system with one 10X probe
5. Calibration Fixture Signal Standardizer
6. Sine-wave generator or low-frequency generator
7. 42-inch, 50-ohm BNC cable (2 required)
8. 50-ohm BNC termination
9. BNC T-connector
10. Screwdriver
11. Low-capacitance screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 1** in the pullout pages.

Install Plug-In Units

Install an amplifier unit in the left vertical compartment. Install the time-base unit in the horizontal compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . Counterclockwise (off)
FOCUS . . . . . Midrange
GRAT ILLUM . . Counterclockwise (off, new setting)
VERT MODE . . . . . .LEFT
TRIG SOURCE. . . . . VERT MODE
POWER . . . . . .On

Amplifier Unit

Position . . . . . Midrange
Input coupling . . . . . .Dc
Polarity . . . . . + Up
Mag X1
Volts/division . . . . . 1 V
Variable volts/division . . . . . .Cal detent

Time-Base Unit

Main triggering
Slope . . . . . .+
Level 0
Mode . . . . . Auto
Coupling . . . . . .Ac
Source . . . . . .Int

Dlyd trig
Level . . . . . .Runs after dly time
Slope . . . . . .+
Coupling . . . . . .Ac
Source . . . . . .Int
Position . . . . . .As desired
Mag X1
Time/div or dly time . . . . . .Ampl
Dly'd time/division . . . . . Ampl (knobs locked)
Variable. . . . . .Cal detent
Delay time mult 1.00

B1. CHECK Z-AXIS DC LEVELS

a. Connect the digital voltmeter between P772 on the Z-Axis Amplifier board, and chassis ground. See Figure 7-15 for test point location.

b. Note the voltmeter reading. The Oscilloscope INTENSITY control should be fully counterclockwise (off) for this reference voltage measurement.

c. Turn the INTENSITY control slowly clockwise until the voltmeter reading is 4 volts more positive than the reference voltage noted previously in part b. Note this new voltmeter reading.

d. Check—For a spot display that is just extinguished. It may be helpful to increase the level of INTENSITY momentarily, to locate the spot. Then as INTENSITY is decreased, the spot display should just extinguish as the voltmeter reading returns to the reference level plus 4-volt level.

e. ADJUST—Crt Grid Bias R759 (through the hole in the high-voltage shield) until the spot display is just extinguished with the INTENSITY control set at the reference level plug 4-volt level on the voltmeter. See Figure 7-15 for adjustment location.

f. Set the amplifier unit position control fully counterclockwise to move the spot display vertically off the crt screen.

g. Set the FOCUS control fully counterclockwise, then set INTENSITY fully clockwise (maximum intensity).

h. Check—For a voltmeter reading of +80 to +100 volts.

i. Set INTENSITY fully counterclockwise (off).

j. Disconnect the digital voltmeter.

B2. CHECK Z-AXIS COMPENSATION

a. Set the time-base unit for a sweep rate of 0.5 microsecond/division.

b. Set the test oscilloscope: Time/division to 0.5 microsecond, volts/division to 0.5 volt, input coupling to ac and vertical position for a free-running trace near graticule center.

c. Connect a 10X probe (properly compensated) from the test oscilloscope to P772 on the Z-Axis Amplifier board (same signal point used previously for Z-axis dc levels). See Figure 7-15 for test point location. Connect the probe ground lead to a convenient chassis ground.

d. Set INTENSITY for a positive step amplitude of 6 divisions (30 volts) on the test oscilloscope and center the display on the graticule. See Figure 5-1.

e. Check—For a flat-top waveform with approximately 1 volt or less (0.2 division) of aberration at leading corner. See Figure 5-1.

f. ADJUST—Z-Axis Compensation C622, using a low-capacitance screwdriver, for optimum square leading corner with approximately 1 volt or less (0.2 division) of aberration. See Figure 7-15 for adjustment location.

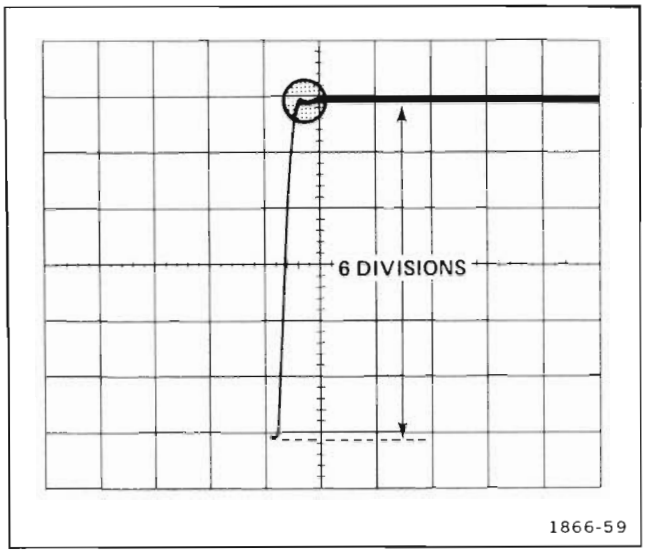

Figure 5-1. Typical display when Z-Axis Compensation is properly adjusted. Circle surrounds compensated portion of waveform.

g. Disconnect the 10X probe.

h. Set the amplifier unit position control to midrange. Adjust FOCUS and INTENSITY controls for a focused trace of normal intensity.

√ B3. CHECK GRATICULE ILLUMINATION OPERATION

a. Turn the GRAT ILLUM control through its range.

√ b. CHECK—For control of graticule illumination from minimum to maximum settings.

c. Set GRAT ILLUM control to the desired setting.

B4. ADJUST ASTIGMATISM

a. Set the time-base unit for a sweep rate of 10 microseconds/division.

b. Remove the amplifier unit from the left vertical compartment and install the Calibration Fixture Signal Standardizer in this compartment.

c. Set the Calibration Fixture to Vert or Horiz + Step Resp, set Rep Rate switch to 100 kHz and adjust Amplitude and Position controls for approximately 2 divisions of display centered on the graticule.

d. Set FOCUS control for the best display focus.

√ **Performance Requirement check; see introductory information.**

√ e. CHECK—For well-defined front corners on the displayed waveform.

f. ADJUST—A (Astigmatism) R636 and FOCUS control together, to obtain the best defined front corners on the displayed waveform. See Figure 7-15 for adjustment location.

√ B5. ADJUST TRACE ALIGNMENT

a. Set the Calibration Fixture Test switch to Aux In and position the trace to the center horizontal graticule line.

√ b. CHECK—That the trace is aligned with the center horizontal graticule line.

√ c. ADJUST—TRACE ROT (front-panel screwdriver adjustment) to align the trace exactly with the center horizontal graticule line.

B6. ADJUST Y-AXIS ALIGNMENT

a. Interchange the time-base unit and the Calibration Fixture.

b. Set the vertical trace on the center vertical graticule line using the Calibration Fixture Position control.

c. Check—That the trace aligns with the center vertical graticule line within 0.1 division.

d. ADJUST—Y (Y Axis) R633 to align the trace exactly with the center vertical graticule line. See Figure 7-15 for adjustment location.

B7. ADJUST GEOMETRY

a. Set the Calibration Fixture Test switch to Vert or Horiz Gain and Rep Rate to 100 kHz.

b. Check—The display for no more than 0.1 division of bowing or tilt of the vertical traces at left and right edges of the graticule.

c. ADJUST—G (Geometry) R630 for minimum bowing or tilt of the vertical traces at left and right edges of the graticule. Adjustment may have to be compromised to obtain less than 0.1 division bowing and tilt everywhere within the graticule area. See Figure 7-15 for adjustment location.

√ B8. CHECK BEAM FINDER OPERATION

a. Press the BEAM FIND push button.

√ b. CHECK—For a reduced-size display, compressed in the vertical and horizontal directions.

c. Release the BEAM FIND push button.

d. Remove the plug-in units.

√ B9. CHECK EXTERNAL Z-AXIS OPERATION

a. Install an amplifier unit in the left vertical compartment. Set the deflection factor for 1 volt/division.

b. Install the time-base unit in the horizontal compartment. Set the sweep rate for 20 microseconds/division.

c. Connect the sine-wave generator or the low-frequency generator output to a 42-inch 50-ohm BNC cable, 50-ohm BNC termination, and BNC T-connector to the amplifier unit.

d. Set the generator for a 2-division display of 50 kilohertz signal.

e. Connect a 42-inch 50-ohm BNC cable from the BNC T-connector to the EXT Z AXIS connector on the rear panel of the Oscilloscope.

√ f. CHECK—That the top portion of the displayed waveform is blanked out.

g. Disconnect all signal cables.

√ Performance Requirement check; see introductory information.

C. VERTICAL SYSTEM

Equipment Required

1. Time-base plug-in unit
2. Calibration Fixture Signal Standardizer
3. Sine-wave generator
4. Amplifier plug-in units (2 identical units required)
5. 42-inch, 50-ohm BNC cable
6. 18-inch, 50-ohm BNC cable (2 required)
7. 50-ohm BNC termination
8. BNC T-connector
9. Screwdriver
10. Low-capacitance screwdriver

BEFORE YOU BEGIN CALIBRATION, see ADJUSTMENT LOCATIONS 2 in the pullout pages.

Install Plug-In Units

Install the time-base unit in the horizontal compartment. Install the Calibration Fixture Signal Standardizer in the left vertical compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

Calibration Fixture Signal Standardizer

Position . . . . . Midrange
Amplitude . . . . . Midrange
Test switch . . . . . Vert or Horiz Gain
Rep Rate . . . . . 100 kHz

Time-Base Unit

Main triggering
- Slope . . . . . +
- Level 0
- Mode . . . . . Auto
- Coupling . . . . . Ac
- Source . . . . . Int

Dlyd trig
- Level . . . . . Runs after dly time
- Slope . . . . . +
- Coupling . . . . . Ac
- Source . . . . . Int

Position . . . . . As desired
Mag X1
Time/div or dly time . . . . . 20 μs
Dly'd time/division . . . . . 20 μs (knobs locked)
Variable . . . . . Cal detent
Delay time mult 1.00

C1. ADJUST VERTICAL AMPLIFIER BIAS

a. With the Calibration Fixture Position control, align the bright center trace of the display with the center horizontal graticule line.

b. ADJUST—B (Bias) R486 for maximum deflection between the traces (maximum overall gain of the display). See Figure 7-16 for adjustment location.

C2. CHECK VERTICAL AMPLIFIER CENTERING

a. Set the Calibration Fixture Test switch to Vert or Horiz Com Mode.

b. Check—That the displayed trace is within 0.3 division of the center horizontal graticule line.

c. ADJUST—Vertical Centering R403 to position the trace to the center horizontal graticule line. See Figure 7-16 for adjustment location.

√ C3. CHECK VERTICAL AMPLIFIER GAIN

a. Set the Calibration Fixture Test switch to Vert or Horiz Gain.

b. Position the display with the Calibration Fixture position control to align the bright center trace of the display with the center horizontal graticule line.

√ c. CHECK—That the deflection over the center 7 traces is 6 divisions within 0.06 division. Note the exact deflection for part g of this step if adjustment of vertical gain is not necessary and the following part d of this step will not be performed.

d. ADJUST—Vertical Gain R447 for exactly 6 divisions of deflection over the center 7 traces. See Figure 7-16 for adjustment location.

e. Remove the Calibration Fixture from the left vertical compartment and install it in the right vertical compartment.

f. Set the VERT MODE switch to RIGHT.

√ g. CHECK—That the deflection over the center 7 traces is the same deflection noted in previous part c within 0.06 division (6 divisions within 0.06 division if vertical gain was adjusted in previous part d).

h. INTERACTION—Of gain adjustments between vertical compartments. If necessary, readjust Vertical Gain R447 for the optimum gain setting compromise for both vertical compartments. If readjustment is performed, recheck parts c through g.

√ C4. CHECK VERTICAL LINEARITY

a. Note the exact amplitude of the center 2 divisions of display.

√ b. CHECK—The display over any 2 division vertical interval within the graticule area for less than 0.1 division of compression or expansion from the exact amplitude noted in part a.

c. Remove the Calibration Fixture from the right vertical compartment and install it in the left vertical compartment.

d. Set the VERT MODE switch to LEFT.

e. Note the exact amplitude of the center 2 divisions of display.

√ f. CHECK—The display over any 2 division vertical interval within the graticule area for less than 0.1 division of compression or expansion from the exact amplitude noted in part e.

C5. CHECK VERTICAL HIGH-FREQUENCY COMPENSATION

a. Set the Calibration Fixture Test switch to Vert or Horiz + Step Resp and Rep Rate switch to 1 MHz. Adjust Amplitude and Position controls for a 6-division display centered vertically on the graticule.

b. Set the time-base unit for a calibrated sweep rate of 0.05 microsecond/division and triggering for auto mode, ac coupled from the internal source. Adjust trigger level and position controls for a stable display triggered on the rising portion of the pulse and center the pulse horizontally on the graticule.

c. Check—For optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed +0.1 or −0.1 division with total peak-to-peak aberrations not to exceed 0.1 division.

d. ADJUST—Vertical compensations C420, R421, R425, C425, C427 and R427, in the order given, for optimum square leading corner and flat top with aberrations within the limits given in part c. See Figure 7-16 for adjustment locations. Use a low-capacitance screwdriver to adjust the variable capacitors. Repeat the complete adjustment procedure as necessary to obtain optimum response.

e. Remove the Calibration Fixture from the left vertical compartment and install it in the right vertical compartment.

f. Set the VERT MODE switch to RIGHT.

g. Check—For optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed +0.1 or −0.1 division with total peak-to-peak aberrations not to exceed 0.1 division.

√ Performance Requirement check; see introductory information.

h. INTERACTION—Of waveform front-corner aberrations between vertical compartments. If necessary, compromise the adjustment of C420, R421, R425, C425, C427 and R427 to obtain the best corner appearance with aberrations within the limits specified for both left and right vertical compartments.

i. To verify correct high-frequency compensation, perform the bandwidth check as given in the next step.

√ C6. CHECK VERTICAL AMPLIFIER BANDWIDTH

a. Set the Calibration Fixture Test switch to Vert or Horiz Freq Resp and turn the Amplitude control fully clockwise.

b. Set the time-base unit for a sweep rate of 1 millisecond/division.

c. Connect the sine-wave generator output through a 42-inch 50-ohm BNC cable to the Cw In connector of the Calibration Fixture.

d. Set the sine-wave generator for an 8-division display at a frequency of 3 megahertz.

e. Set the Calibration Fixture Position and Amplitude controls to obtain a centered, 6-division display.

NOTE

The Calibration Fixture Cw Leveled light must be on and the sine-wave generator must be properly connected for a valid check. It may be helpful to refer to the Calibration Fixture and sine-wave generator manuals.

f. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to 4.2 divisions.

√ g. CHECK—The generator for a reading that equals or exceeds the frequency listed below for the appropriate ambient temperature range:

+15° to +35° C, 120 megahertz

0° to +50° C, 100 megahertz

−28° to +65° C, 90 megahertz

NOTE

The frequencies specified in the preceding (part g) are typical of the vertical system bandwidth for the 067-0587-01 Calibration Fixture Signal Standardizer and OS-245(P)/U Oscilloscope. If an amplifier plug-in unit is used with the Oscilloscope to verify vertical bandwidth, select the appropriate frequency from Table 2-4 in the Specification section of this manual and substitute for the frequency given in part g. (Insert a 50-ohm BNC termination to signal cable at amplifier input if the amplifier has a one-megohm input impedance.)

h. Remove the Calibration Fixture from the right vertical compartment and install it in the left vertical compartment (leave the signal cable connected).

i. Set the VERT MODE switch to LEFT.

j. Set the sine-wave generator frequency to 3 megahertz.

√ k. Repeat parts e through g for the left vertical compartment.

l. Disconnect the signal cable.

√ C7. CHECK VERTICAL AMPLIFIER ISOLATION

a. Remove the Calibration Fixture from the left vertical compartment and install an amplifier unit in this compartment.

b. Connect the sine-wave generator output through a 42-inch 50-ohm BNC cable and 50-ohm BNC termination to the amplifier unit.

c. Set the sine-wave generator for an 8-division display at a frequency of 100 megahertz.

d. Set the VERT MODE switch to RIGHT.

√ e. CHECK—The display for 0.08 division or less of 100 megahertz signal. Do not include the trace width (line thickness) in this measurement.

√ Performance Requirement check; see introductory information.

f. Remove the amplifier unit from the left vertical compartment and install it in the right vertical compartment (leave the signal cable setup connected).

g. Set the sine-wave generator for an 8-division display of the 100 megahertz input signal.

h. Set the VERT MODE switch to LEFT.

√ i. CHECK—The display for 0.08 divisions or less of 100 megahertz signal. Do not include the trace width (line thickness) in this measurement.

j. Disconnect the signal cable setup.

√ C8. CHECK VERTICAL MODES

a. Install identical amplifier units in the left and right vertical compartments.

b. Set both amplifier units for a deflection factor of 0.5 volt/division.

c. Connect the 1 V CALIBRATOR signal to the inputs of the amplifier units with a BNC-T connector and two 18-inch 50-ohm BNC cables.

d. Set the time-base unit for a sweep rate of 0.5 millisecond/division.

e. Center the display with the left amplifier unit position control and note the vertical deflection.

f. Set the VERT MODE switch to RIGHT.

g. Center the display with the right amplifier unit position control and note the vertical deflection.

h. Set the VERT MODE switch to ADD.

√ i. CHECK—The resultant display for a vertical deflection approximately equalling the algebraic sum of the deflections noted in parts e and g of this step. For example, if the deflections were 2 divisions each, the resultant deflection will be approximately 4 divisions.

j. Disconnect the signal cable setup.

k. Set the VERT MODE switch to ALT.

√ l. CHECK—That traces from both vertical compartments are displayed.

m. Position the traces about 2 divisions apart.

n. Set the time-base unit for a sweep rate of 50 milliseconds/division.

√ o. CHECK—That the traces alternate between the left and right amplifier units.

p. Set the VERT MODE switch to CHOP.

√ q. CHECK—That the traces are displayed simultaneously.

√ **Performance Requirement check; see introductory information.**

D. TRIGGERING SYSTEM

NOTE

No adjustments in this Portion (D) of the calibration procedure.

Equipment Required

1. Time-base plug-in unit
2. Amplifier plug-in unit
3. Calibration Fixture Signal Standardizer
4. 18-inch, 50-ohm BNC cable

Install Plug-In Units

Install the time-base unit in the horizontal compartment. Install an amplifier unit in the left vertical compartment. Install the Calibration Fixture Signal Standardizer in the right vertical compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT (new setting)
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

Amplifier Unit

Position . . . . . Midrange
Input coupling . . . . . Dc
Polarity . . . . . + Up
Mag X1
Volts/division . . . . . 0.5 V
Variable volts/division . . . . . Cal detent

Calibration Fixture Signal Standardizer

Position . . . . . Midrange
Amplitude . . . . . Midrange
Test switch . . . . . Vert or Horiz + Step Resp (new setting)
Rep Rate . . . . . 1 kHz (new setting)

Time-Base Unit

Main triggering
Slope . . . . . +
Level 0
Mode . . . . . Auto
Coupling . . . . . Ac
Source . . . . . Int
Dlyd trig
Level . . . . . Runs after dly time
Slope . . . . . +
Coupling . . . . . Ac
Source . . . . . Int
Position . . . . . As desired
Mag X1
Time/div or dly time . . . . . 0.5 ms (new setting)
Dly'd time/division . . . . . 0.5 ms (knobs locked, new setting)
Variable . . . . . Cal detent
Dly time mult 1.00

√ D1. CHECK TRIGGER SOURCE MODES

a. Connect the 1 V CALIBRATOR signal to the amplifier unit with an 18-inch 50-ohm BNC cable.

b. Move the calibrator-waveform display to the upper half of the graticule area.

c. Set the VERT MODE switch to RIGHT.

d. Set the Calibration Fixture Amplitude and Position controls for a 2-division display in the lower half of the graticule area.

e. Set the VERT MODE switch to ALT and the TRIG SOURCE switch to LEFT.

√ **Performance Requirement check, see introductory information.**

√ f. CHECK–That only the calibrator waveform is stable (triggered).

g. Set the TRIG SOURCE to RIGHT.

√ h. CHECK–That only the Calibration Fixture waveform is stable (triggered).

i. Disconnect the signal cable.

√ Performance Requirement check, see introductory information.

E. HORIZONTAL SYSTEM

Equipment Required

1. Time-base plug-in unit
2. Calibration Fixture Signal Standardizer
3. Test-oscilloscope system with 10X probes (2 identical probes required)
4. Amplifier plug-in units (2 identical units required)
5. Time-mark generator
6. Low-frequency generator
7. Sine-wave generator
8. 42-inch, 50-ohm BNC cable
9. 18-inch, 50-ohm BNC cable
10. 50-ohm BNC termination
11. BNC T-connector
12. Screwdriver
13. Low-capacitance screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 2 in the pullout pages.**

Install Plug-In Units

Install the time-base unit in the left vertical compartment. Install the Calibration Fixture Signal Standardizer in the horizontal compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT (new setting)
TRIG SOURCE. . . . . VERT MODE (new setting)
POWER . . . . . On

Time-Base Unit

Main triggering
- Slope . . . . . +
- Level 0
- Mode . . . . . Auto
- Coupling . . . . . Ac
- Source . . . . . Int

Dlyd trig
- Level . . . . . Runs after dly time
- Slope . . . . . +
- Coupling . . . . . Ac
- Source . . . . . Int

Position . . . . . Display centered vertically
Mag X1
Time/div or dly time . . . . . 0.1 μs (new setting)
Dly'd time/division . . . . . 0.1 μs (knobs locked, new setting)
Variable . . . . . Cal detent
Delay time mult 1.00

Calibration Fixture Signal Standardizer

Position . . . . . Midrange
Amplitude . . . . . Midrange
Test switch. . . . . Vert or Horiz Gain (new setting)
Rep Rate . . . . . 100 kHz (new setting)

E1. CHECK HORIZONTAL AMPLIFIER GAIN

a. With the Calibration Fixture Position control, align the bright center trace of the display with the center vertical graticule line.

b. Check—That the deflection over the center 9 traces is 8 divisions within 0.08 division.

c. ADJUST—Horizontal Gain R509 for exactly 8 divisions of deflection over the center 9 traces. See Figure 7-17 for adjustment location.

d. INTERACTION—If Horizontal Gain R509 was adjusted, check the following steps E2, E3, and E4.

√ E2. CHECK LOW-FREQUENCY LINEARITY

a. Note the exact horizontal amplitude of the center 2 divisions of display.

√ b. CHECK–The display over any 2 division horizontal interval within the graticule area for less than 0.1 division of compression or expansion from the exact amplitude noted in part a.

E3. CHECK HORIZONTAL AMPLIFIER CENTERING

a. Set the Calibration Fixture Test switch to Vert or Horiz Com Mode.

b. Check–That the displayed trace is within 0.3 division of the center vertical graticule line.

c. ADJUST–Horizontal Centering R513 to position the trace to the center vertical graticule line. See Figure 7-17 for adjustment location.

d. INTERACTION–If Horizontal Centering R513 was adjusted, recheck the previous steps E2 and E3.

E4. CHECK HORIZONTAL AMPLIFIER LIMIT CENTERING

a. Interchange the time-base unit and the Calibration Fixture.

b. Set time-base unit: sweep rate for 0.2 millisecond/division, position the trace start to the left vertical graticule line, then set the magnifier switch to X10.

c. Set both vertical amplifiers of the test oscilloscope for dc input coupling. Connect a 10X probe from each vertical amplifier input to a convenient square-wave signal and check the compensation of the probes. Disconnect the probe tips from the square-wave signal.

d. Set both vertical amplifiers of the test oscilloscope for a vertical deflection factor of 0.5 volt/division (5 volts/division at probe tips) in the vertical dual-trace chopped mode. Set the test oscilloscope for a sweep rate of 0.5 millisecond/division, internally triggered from the amplifier in the right compartment.

e. Connect the probe tips to a convenient ground, and position both traces to the center horizontal line of the graticule. Do not change the test oscilloscope position controls after establishing this ground reference.

f. Connect the test oscilloscope probes to the horizontal deflection output signals of the Horizontal Amplifier board in the following manner: Connect left amplifier probe to the left deflection output signal; connect right amplifier probe to the right deflection output signal. See Figure 7-17 for deflection output signal locations.

g. Check–The base lines of the displayed triangular waveforms for dc level match within 0.2 division. See Figure 5-2.

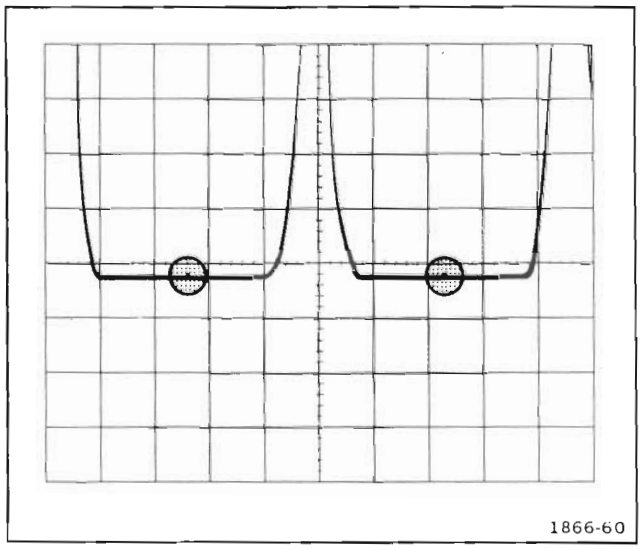

Figure 5-2. Typical display when horizontal limit centering is properly adjusted. Circles indicate the baseline areas for dc level match.

h. ADJUST–Limit Centering R531 to match the dc levels of both waveform base lines. See Figure 7-17 for adjustment location.

i. INTERACTION–If Limit Centering R531 was adjusted, recheck the previous steps E1 and E3.

j. Disconnect the probes from the Horizontal Amplifier board.

E5. CHECK HIGH-FREQUENCY TIMING

a. Remove the Calibration Fixture from the left vertical compartment and install an amplifier unit in this compartment.

b. Set the time-base unit magnifier switch to X1 and set time/division for a sweep rate of 1 millisecond/division.

√ **Performance Requirement check, see introductory information.**

c. Set the time-mark generator for 1-millisecond time marks and connect through a 42-inch 50-ohm BNC cable and 50-ohm BNC termination to the amplifier unit. Set the deflection factor of the amplifier unit so the markers are at least 2 divisions in amplitude.

d. Position the first marker to the extreme left vertical graticule line.

e. Set the time-base unit front-panel adjustment, Swp Cal, for 1 time-mark/division and coincidence of the second and tenth time marks exactly with their respective graticule lines (position the display as necessary).

NOTE

Unless otherwise stated, always adjust and check timing accuracy using the center eight divisions of timing waveform and graticule (always exclude the first and last divisions of unmagnified sweep).

f. Set the time-base unit for a sweep rate of 0.05 microsecond/division, then set magnifier switch to X10.

g. Set the time-mark generator for 10-nanosecond time marks. Maintain a display of at least 2 divisions in amplitude with stable triggering.

h. Check—The displayed waveform over the center 8 graticule divisions for 1 marker every 2 divisions within 0.28 division.

i. ADJUST—C562 and C587 for 1 marker every 2 divisions and best linearity over the center 8 divisions of display using a low-capacitance screwdriver. See Figure 7-17 for adjustment locations.

j. Disconnect the signal cable setup.

√ E6. CHECK X-Y PHASE SHIFT

a. Remove the time-base unit from the horizontal compartment and install identical amplifier units in the left vertical and horizontal compartments.

b. Set both amplifier units for a deflection factor of 50 millivolts/division and dc input coupling.

c. Connect the low-frequency generator output through a 42-inch 50-ohm BNC cable, 50-ohm termination, and a BNC T-connector, to an amplifier unit. Connect an 18-inch 50-ohm BNC cable from the BNC T-connector to the other amplifier unit.

d. Set the low-frequency generator for 8 divisions of vertical and horizontal deflection at a frequency of 35 kilohertz.

e. Center the resultant Lissajous display on the graticule as shown in Figure 5-3.

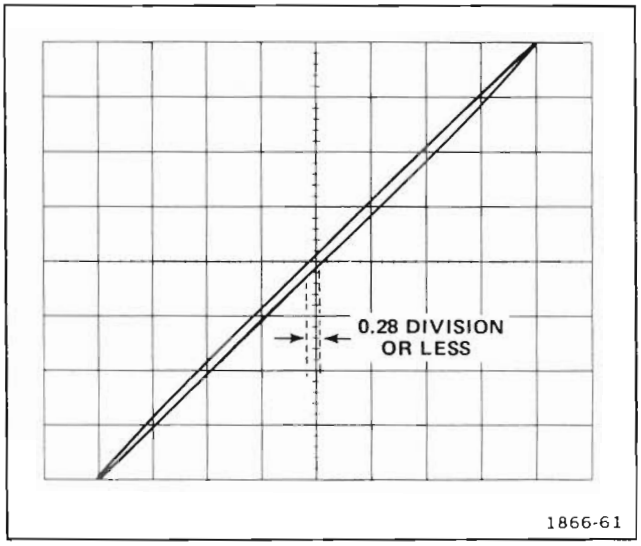

Figure 5-3. Typical display when checking X-Y phase shift.

√ f. CHECK—For 0.28 division or less of opening at center of the Lissajous display (measured horizontally). See Figure 5-3.

g. Disconnect the signal cable setup.

√ E7. CHECK HORIZONTAL BANDWIDTH

a. Install the time-base unit in the right vertical compartment.

b. Set the VERT MODE switch to RIGHT.

c. Set the time-base unit magnifier switch to X1, then set time/division control for a sweep rate of 0.5 millisecond/division.

√ **Performance Requirement check, see introductory information.**

d. Connect the sine-wave generator output through a 42-inch 50-ohm BNC cable and 50-ohm BNC termination to the amplifier unit in the horizontal compartment.

e. Set the sine-wave generator for an 8-division horizontal display at a 50-kilohertz reference frequency.

f. Without changing the output amplitude, increase the generator frequency to 2 megahertz.

√ g. CHECK—The display for at least 5.6 divisions of signal amplitude.

h. Disconnect the signal cable setup.

√ Performance Requirement check, see introductory information.

F. CALIBRATOR AND REAR PANEL OUTPUT SIGNALS

Equipment Required

1. Amplifier plug-in unit
2. Time-base plug-in unit
3. Digital voltmeter
4. Test oscilloscope
5. 42-inch, 50-ohm BNC cable
6. 18-inch, 50-ohm BNC cable
7. Screwdriver

BEFORE YOU BEGIN CALIBRATION, see **ADJUSTMENT LOCATIONS 3** in the pullout pages.

Install Plug-In Units

Install an amplifier unit in the left vertical compartment. Install the time-base unit in the horizontal compartment.

Control Settings

Oscilloscope

INTENSITY . . . . . As desired
FOCUS . . . . . Well-defined display
GRAT ILLUM . . . . . As desired
VERT MODE . . . . . LEFT (new setting)
TRIG SOURCE . . . . . VERT MODE
POWER . . . . . On

Amplifier Unit

Position . . . . . Midrange
Input coupling . . . . . Dc
Polarity . . . . . + Up
Mag X1
Volts/division . . . . . 0.5 V (new setting)
Variable volts/division . . . . . Cal detent

Time-Base Unit

Main triggering
- Slope . . . . . +
- Level 0
- Mode . . . . . Auto
- Coupling . . . . . Ac
- Source . . . . . Int

Dlyd trig
- Level . . . . . Runs after dly time
- Slope . . . . . +
- Coupling . . . . . Ac
- Source . . . . . Int

Position . . . . . As desired
Mag X1
Time/div or dly time . . . . . 1 ms (new setting)
Dly'd time/division . . . . . 1 ms (knobs locked, new setting)
Variable . . . . . Cal detent
Delay time mult . . . . . 0.00 (new setting)

√ F1. CHECK CALIBRATOR OUTPUT VOLTAGE

a. Move the jumper on the Calibrator and Mode Switches board to the dc output position. See Figure 7-18 for jumper location and placement.

b. Connect the digital voltmeter between the center conductor and shell of the front-panel CALIBRATOR connector.

√ c. CHECK—The voltmeter for a reading within the tolernace listed below for the appropriate ambient temperature range:

+15° to +35° C, 0.988 to 1.012 volts.
0° to +50° C, 0.978 to 1.022 volts.
−28° to +65° C, 0.958 to 1.042 volts.

d. ADJUST—Cal Adj R1077 for a reading of exactly 1 volt. See Figure 7-18 for adjustment location.

e. Disconnect the digital voltmeter.

√ Performance Requirement check, see introductory information.

f. Return the jumper on the Calibrator and Mode Switches board to the 1 kHz output position. See Figure 7-18 for jumper location and placement.

F2. CHECK CALIBRATOR 1 kHz REPETITION RATE

a. Connect an 18-inch 50-ohm BNC cable from the CALIBRATOR output connector to the amplifier unit.

b. Position the start of the square-wave display to the extreme left graticule line.

c. Check—The display for approximately 1 cycle/division.

d. Disconnect the signal cable.

√ F3. CHECK REAR PANEL OUTPUT SIGNALS

NOTE

Sweep, gate, and trigger waveforms are available at the rear panel only when the Oscilloscope is used with a TD-1085/U Dual Time Base unit. When the Oscilloscope is used with some other 7000-series time-base units, a sawtooth signal may be available at the MAIN SWP OUTPUT connector.

a. Set the time-base unit for a sweep rate of 0.2 millisecond/division.

b. Connect MAIN SWP OUTPUT (output connector on rear panel of the Oscilloscope) to the vertical input of the test oscilloscope through a 42-inch 50-ohm BNC cable.

c. Set the test oscilloscope: Vertical deflection factor for 2 volts/division in the single-trace mode, sweep rate for 1 millisecond/division, position and triggering for a stable triggered waveform near graticule center.

√ d. CHECK—The test oscilloscope display for a sawtooth waveform amplitude of at least 2.5 divisions (5 volts).

e. Move the Oscilloscope cable to the DELAYED SWP OUTPUT connector.

f. Pull the time-base unit delayed time/division switch outward to activate the intensified-sweep mode function.

√ g. CHECK—The test oscilloscope display for a sawtooth waveform amplitude of at least 2.5 divisions (5 volts).

h. Move the Oscilloscope cable to MAIN SWP GATE OUTPUT connector.

√ i. CHECK—The test oscilloscope display for a gate-waveform amplitude of at least 1 division (2 volts).

j. Move the Oscilloscope cable to the DELAYED SWP GATE OUTPUT connector.

√ k. CHECK—The test oscilloscope display for a gate-waveform amplitude of at least 1 division (2 volts).

l. Move the Oscilloscope cable to the DELAYED TRIG OUTPUT connector.

m. Press in the time-base unit delayed time/division switch (to lock the time/division knobs together), then set for a sweep rate of 1 microsecond/division. Pull the delayed time/division switch outward for the intensified-sweep mode.

n. Set the test oscilloscope for a vertical deflection factor of 0.5 volt/division and a sweep rate of 0.5 microsecond/division.

√ o. CHECK—The test oscilloscope display for a pulse-waveform amplitude of at least 2 divisions (1 volt) with a duration of at least 0.1 division.

p. Disconnect all test equipment.

This completes the performance check/calibration procedures of the Oscilloscope. If complete calibration was performed to this point, install the cabinet sides on the Oscilloscope.

√ Performance Requirement check, see introductory information.

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 CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P. O. BOX 5012	DALLAS, TX 75222
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04222	AVX CERAMIC CORP.	P.O. BOX 867	MURTLE BEACH, SC 29577
04239	GENERAL ELECTRIC CO., CHEMICAL AND METALLURGICAL VENTURES, OPN MAGNETIC MATERIALS PRODUCT	P. O. BOX 72	EDMORE, MI 48829
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPT.	NELA PK.	CLEVELAND, OH 44112
12040	NATIONAL SEMICONDUCTOR CORP.	COMMERCE DRIVE	DANBURY, CT 06810
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON ST.	DOVER, NH 03820
12954	DICKSON ELECTRONICS CORP.	8700 E. THOMAS RD.	SCOTTSDALE, AZ 85252
12969	UNITRODE CORP.	580 PLEASANT ST.	WATERTOWN, MA 02172
13715	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	4300 REDWOOD HWY.	SAN RAFAEL, CA 94903
14433	ITT SEMICONDUCTORS, A DIV. OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORP.	3301 ELECTRONICS WAY	WEST PALM BEACH, FL 33401
15818	TELEDYNE SEMICONDUCTOR	1300 TERRA BELLA AVE.	MOUNTAIN VIEW, CA 94040
21845	SOLITRON DEVICES, INC., TRANSISTOR DIV.	1177 BLUE HERON BLVD.	RIVIERA BEACH, FL 33404
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SAN YSIDRO WAY	SANTA CLARA, CA 95051
28480	HEWLETT-PACKARD CO., CORPORATE HQ.	1501 PAGE MILL RD.	PALO ALTO, CA 94304
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787	MUSKEGON, MI 49443
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.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
80294	BOURNS, INC., INSTRUMENT DIV.	6135 MAGNOLIA AVE.	RIVERSIDE, CA 92506
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
83003	VARO, INC.	800 W. GARLAND AVE.	GARLAND, TX 75040
86684	RCA CORP., ELECTRONIC COMPONENTS	415 S. 5TH ST.	HARRISON, NJ 07029
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NB 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. MANSFIELD PLANT	P. O. BOX 1007	MANSFIELD, OH 44903

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1529-00			CKT BOARD ASSY:MAIN INTERFACE	80009	670-1529-00
A2	670-1530-00			CKT BOARD ASSY:LOGIC	80009	670-1530-00
A3	670-1371-03			CKT BOARD ASSY:TRIGGER SELECTOR	80009	670-1371-03
A4	670-1373-06			CKT BOARD ASSY:VERTICAL INTERFACE	80009	670-1373-06
A5	670-1958-01			CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-1958-01
A6	670-1378-02			CKT BOARD ASSY:HORIZONTAL AMPLIFIER	80009	670-1378-02
A7	670-1379-02			CKT BOARD ASSY:CALIBRATOR AND MODE SW	80009	670-1379-02
A8	670-1383-02			CKT BOARD ASSY:Z-AXIS AMPLIFIER	80009	670-1383-02
A9	670-1380-02			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-1380-02
A10	670-1996-00			CKT BOARD ASSY:RECTIFIER	80009	670-1996-00
A11	670-1376-08			CKT BOARD ASSY:REGULATOR	80009	670-1376-08
C1	290-0271-00			CAP.,FXD,ELCTLT:9UF,+20-15%,125V	56289	109D905C2125F2
C3	290-0302-00			CAP.,FXD,ELCTLT:100UF,10%,20V	12954	D100D20KI
C5	290-0302-00			CAP.,FXD,ELCTLT:100UF,10%,20V	12954	D100D20KI
C7	290-0302-00			CAP.,FXD,ELCTLT:100UF,10%,20V	12954	D100D20KI
C9	290-0271-00			CAP.,FXD,ELCTLT:9UF,+20-15%,125V	56289	109D905C2125F2
C44	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C47	281-0638-00			CAP.,FXD,CER DI:240PF,5%,500V	72982	301000Z5D241J
C55	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C58	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C59	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C60	281-0564-00			CAP.,FXD,CER DI:24PF,5%,500V	72982	301-000C0G0240J
C65	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C89	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C93	281-0524-00			CAP.,FXD,CER DI:150PF,+/-30PF,500V	04222	7001-1381
C135	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C136	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C137	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C145	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C146	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C147	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C152	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C165	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C166	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C188	281-0552-00			CAP.,FXD,CER DI:25PF,5%,500V	72982	301-000P2G0250J
C193	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C195	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C196	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C198	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C207	281-0538-00			CAP.,FXD,CER DI:1PF,20%,500V	80009	281-0538-00
C208	281-0528-00			CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C215	281-0589-00			CAP.,FXD,CER DI:170PF,5%,500V	72982	301000Z5D171J
C217	281-0537-00			CAP.,FXD,CER DI:0.68PF,20%,600V	80009	281-0537-00
C220	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C227	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C260	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C301	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C305	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C322	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D
C329	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D
C342	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C348	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C401	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C418	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000C0G0330J
C420	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C421	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C425	281-0160-00			CAP.,VAR,CER DI:7-25PF,350V	72982	538-011B7-25
C427	281-0160-00			CAP.,VAR,CER DI:7-25PF,350V	72982	538-011B7-25
C433	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C455	283-0100-00			CAP.,FXD,CER DI:0.0047UF,10%,200V	56289	273C3
C456	283-0119-00			CAP.,FXD,CER DI:2200PF,5%,200V	72982	855-535B222J
C458	283-0116-00			CAP.,FXD,CER DI:820PF,5%,500V	72982	801-547B821J
C465	283-0211-00			CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N227C104K
C466	283-0187-00			CAP.,FXD,CER DI:0.047UF,10%,400V	72982	8131N401X5R473K
C468	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131-250651103P
C480	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C486	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C492	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C494	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C496	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C509	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C513	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C519	281-0564-00			CAP.,FXD,CER DI:24PF,5%,500V	72982	301-000C0G0240J
C546	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C550	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C559	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C561	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C562	281-0092-00			CAP.,VAR,CER DI:9-35PF	72982	538-011E2P094R
C564	281-0526-00			CAP.,FXD,CER DI:1.5PF,+/-0.5PF,500V	72982	301-000S2K0159D
C569	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C573	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C575	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C586	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C587	281-0097-00			CAP.,VAR,CER DI:9-35PF	72982	538-006E2P094R
C588	281-0526-00			CAP.,FXD,CER DI:1.5PF,+/-0.5PF,500V	72982	301-000S2K0159D
C593	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C595	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C596	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C597	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,30V	72982	814N039-E-104Z
C604	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C611	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C613	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C617	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C618	303-0203-00			RES.,FXD,CMPSN:20K OHM,5%,1W	01121	GB2035
C619	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C622	281-0053-00			CAP.,VAR,PLSTC:0.35-1.37PF	72982	535-060 0.7-3
C630	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C636	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C639	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C700	290-0410-00			CAP.,FXD,ELCTLT:15UF,+50-10%,100V	56289	30D156F100DD4
C702	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	72982	878Y5S102M
C704	283-0189-00			CAP.,FXD,CER DI:0.1UF,20%,400V	72982	8151N401X5R104M
C705	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075651224M
C711	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C720	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C722	290-0312-00			CAP.,FXD,ELCTLT:47UF,10%,35V	56289	150D476X9035S2
C743	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C745	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C746	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C748	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C750	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C752	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	72982	878Y5S102M
C757	290-0305-01			CAP.,FXD,ELCTLT:3UF,10%,150V	56289	109D305X9150C2
C760	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	72982	878Y5S102M
C806	290-0468-00			CAP.,FXD,ELCTLT:250UF,+75-10%,150V	56289	68D10470
C808	290-0507-00			CAP.,FXD,ELCTLT:1800UF,+75-10%,75V	56289	68D10472
C809	290-0507-00			CAP.,FXD,ELCTLT:1800UF,+75-10%,75V	56289	68D10472
C810	285-0555-00			CAP.,FXD,PLSTC:0.1UF,20%,100V	56289	410P10401
C811	290-0581-00			CAP.,FXD,ELCTLT:14,000UF,+75-10%,25V	56289	68D10489
C813	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C814	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C820	285-0555-00			CAP.,FXD,PLSTC:0.1UF,20%,100V	56289	410P10401
C821	290-0508-00			CAP.,FXD,ELCTLT:18,000UF,+100-10%,15V	56289	68D10444
C823	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-547E203Z
C858	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C866	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C880	283-0638-00			CAP.,FXD,MICA D:130PF,1%,100V	00853	D151E131F0
C889	290-0415-00			CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
C923	281-0591-00			CAP.,FXD,CER DI:5600PF,20%,200V	72982	3930-01Z5V0562Z
C950	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C979	281-0591-00			CAP.,FXD,CER DI:5600PF,20%,200V	72982	3930-01Z5V0562Z
C985	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C472J
C1064	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P112
C1079	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
CR26	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR27	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR33	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR42	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR84	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR85	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR124	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR125	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR126	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR130	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR140	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR155	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR160	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR190	152-0071-00			SEMICOND DEVICE:GERMANIUM,15V,40MA	14433	G865
CR238	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR341	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR349	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR460	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR461	152-0269-00			SEMICOND DEVICE:SILICON,VAR VCAP.,4V,33PF	80009	152-0269-00
CR496	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR519	152-0322-00			SEMICOND DEVICE:SILICON,15V	28480	5082-2672
CR520	152-0322-00			SEMICOND DEVICE:SILICON,15V	28480	5082-2672
CR522	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR526	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

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CR528	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	13715	FD7003
CR533	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	13715	FD7003
CR538	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR539	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR543	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	13715	FD7003
CR700	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR716	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR743	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG-12X
CR750	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR752	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR756	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR757	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR806	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR808	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR811	152-0406-00			SEMICOND DEVICE:SILICON,200V,3A	83003	W601
CR820	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR821	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR852	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR861	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR867	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR868	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR875	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR883	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR885	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR888	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR891	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR894	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR896	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR903	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR920	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR924	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR925	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR935	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR941	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR950	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR951	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR952	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR958	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR961	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR980	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR981	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR989	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR1021	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1023	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1024	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1026	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
DL400	119-0288-02			DELAY LINE,ELEC:	80009	119-0288-02
DS1090	150-0047-00			LAMP,INCAND:6.3V,0.2A	08806	398
DS1091	150-0047-00			LAMP,INCAND:6.3V,0.2A	08806	398
DS1092	150-0047-00			LAMP,INCAND:6.3V,0.2A	08806	398
F855	159-0083-00			FUSE,CARTRIDGE:0.15A,250V,FAST-BLOW	71400	AGC 15/100

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F1000	159-0023-00			FUSE,CARTRIDGE:3AG,2A,250V,SLOW-BLOW	71400	MDX 2
F1001	159-0023-00			FUSE,CARTRIDGE:3AG,2A,250V,SLOW-BLOW	71400	MDX 2
F1002	159-0023-00			FUSE,CARTRIDGE:3AG,2A,250V,SLOW-BLOW	71400	MDX 2
FL1000	119-0113-05			FILTER,RFI:	72982	9604-000-9000
L193	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L195	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L197	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L198	108-0604-00			COIL,RF:3.2UH	80009	108-0604-00
L425	108-0707-00			COIL,RF:150NH	80009	108-0707-00
L474	276-0528-00			SHIELDING BEAD,:0.1UH	80009	276-0528-00
L478	276-0528-00			SHIELDING BEAD,:0.1UH	80009	276-0528-00
L482	108-0331-00			COIL,RF:0.75UH	80009	108-0331-00
L722	108-0646-00			COIL,RF:80UH	80009	108-0646-00
L1098	108-0732-00			COIL,TUBE DEFL:	80009	108-0732-00
L1099	119-0288-02			DELAY LINE,ELEC:	80009	119-0288-02
LR473	108-0715-00			COIL,RF:255NH	80009	108-0715-00
LR477	108-0715-00			COIL,RF:255NH	80009	108-0715-00
Q132	151-0199-00			TRANSISTOR:SILICON,PNP	04713	MPS3640
Q142	151-0199-00			TRANSISTOR:SILICON,PNP	04713	MPS3640
Q147	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q150	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q162	151-0199-00			TRANSISTOR:SILICON,PNP	04713	MPS3640
Q167	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q223	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q236	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q238	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q242	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q252	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q314	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q344	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q346	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q407	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q415	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q496	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q506	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q516	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q535	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q541	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q545	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q547	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q555	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q559	151-0274-00			TRANSISTOR:SILICON,NPN	04713	SS7394
Q580	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q584	151-0274-00			TRANSISTOR:SILICON,NPN	04713	SS7394
Q607	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q615	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q619	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q621	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q708	151-0126-00			TRANSISTOR:SILICON,NPN	15818	2N2484
Q712	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q716	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495

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Q764	151-0140-00			TRANSISTOR:SILICON,NPN	02735	36568
Q766	151-0140-00			TRANSISTOR:SILICON,NPN	02735	36568
Q827	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q829	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q835	151-0334-00			TRANSISTOR:SILICON,NPN	80009	151-0334-00
Q850	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q852	151-0276-00			TRANSISTOR:SILICON,PNP	04713	2N5087
Q860	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q863	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q869	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q872	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q874	151-0336-00			TRANSISTOR:SILICON,NPN	21845	93SX288
Q876	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q886	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q896	151-0228-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q900	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q903	151-0336-00			TRANSISTOR:SILICON,NPN	21845	93SX288
Q908	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q909	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q910	151-0292-00			TRANSISTOR:SILICON,NPN	01295	TIS100
Q919	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q926	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q931	151-0260-02			TRANSISTOR:SILICON,NPN	04713	2N5859
Q933	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q936	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q952	151-0134-00			TRANSISTOR:SILICON,PNP	04713	SM3195
Q956	151-0260-02			TRANSISTOR:SILICON,NPN	04713	2N5859
Q958	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q964	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q985	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q988	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q1061	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q1066	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q1070	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q1072	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
R12	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	75042	CEAT0-4991F
R14	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	75042	CEAT0-4991F
R28	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R29	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R33	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R42	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R44	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R46	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R47	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R55	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R56	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R57	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R58	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R59	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R60	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R63	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R65	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	75042	CEAT0-6810F
R82	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105

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R83	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R84	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R85	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R86	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R88	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	75042	CEAT0-2051F
R89	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R90	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R92	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEAT0-2001F
R93	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R95	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R96	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R97	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R98	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R99	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R101	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R102	311-1393-00			RES.,VAR,NONWIR:5K X 5 MEG OHM,20%,0.5W	12697	CM39702
R115	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R123	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R124	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R125	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R126	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R130	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R132	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R133	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R134	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R135	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R136	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R137	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R138	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R140	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R141	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R142	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R143	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R144	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R145	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R146	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R147	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R148	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R149	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R150	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R152	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R154	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R155	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R157	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R159	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R160	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R161	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R162	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R163	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R164	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R165	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R166	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R168	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725

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R170	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R172	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R173	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R174	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R176	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R177	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R178	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R179	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R180	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R182	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R183	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R184	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R186	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R187	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R188	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R189	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R190	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R191	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.50W	01121	EB1225
R192	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R200	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R202	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R204	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R206	321-1068-02			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT2-50R50D
R208	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R209	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R211	322-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.25W	75042	CEBT0-1101F
R212	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R214	322-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.25W	75042	CEBT0-1581F
R215	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R216	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R218	322-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.25W	75042	CEBT0-1101F
R219	321-0741-02			RES.,FXD,FILM:40.9 OHM,0.5%,0.125W	75042	CEAT2-40R90D
R222	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R224	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R225	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R226	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R228	321-0060-00			RES.,FXD,FILM:41.2 OHM,1%,0.125W	75042	CEAT0-41R20F
R230	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	75042	CEAT0-2801F
R232	321-0060-00			RES.,FXD,FILM:41.2 OHM,1%,0.125W	75042	CEAT0-41R20F
R234	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R326	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R238	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R240	323-0149-00			RES.,FXD,FILM:348 OHM,1%,0.50W	75042	CECT0-3480F
R241	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	75042	CEAT0-1581F
R246	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R250	323-0149-00			RES.,FXD,FILM:348 OHM,1%,0.50W	75042	CECT0-3480F
R251	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	75042	CEAT0-1581F
R259	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R261	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R301	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R303	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R305	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R307	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F

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R308	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R310	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R312	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R314	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R315	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R317	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R319	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R320	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	75042	CEAT0-1821F
R321	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R322	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R323	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R324	322-0184-00			RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBT0-8060F
R326	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R327	322-0184-00			RES.,FXD,FILM:806 OHM,1%,0.25W	75042	CEBT0-8060F
R328	321-0061-00			RES.,FXD,FILM:42.2 OHM,1%,0.125W	75042	CEAT0-42R20F
R329	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R330	321-0052-00			RES.,FXD,FILM:34 OHM,1%,0.125W	75042	CEAT0-34R00F
R335	321-0052-00			RES.,FXD,FILM:34 OHM,1%,0.125W	75042	CEAT0-34R00F
R340	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	75042	CEAT0-1651F
R341	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R342	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R343	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R344	321-0040-00			RES.,FXD,FILM:25.5 OHM,1%,0.125W	75042	CEAT0-25R5F
R345	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R346	321-0040-00			RES.,FXD,FILM:25.5 OHM,1%,0.125W	75042	CEAT0-25R5F
R348	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R349	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R350	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	75042	CEAT0-1651F
R352	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R401	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R403	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	80294	3386F-T04-103
R404	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R405	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R407	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R408	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R409	323-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.50W	75042	CECT0-2871F
R411	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	75042	CEAT0-2801F
R413	323-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.50W	75042	CECT0-2871F
R414	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R415	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R416	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R417	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R418	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R420	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R421	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	80294	3329P-L58-501
R423	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R424	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R425	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	62PT-345-0
R427	311-1007-00			RES.,VAR,NONWIR:20 OHM,20%,0.50W	80294	3329HG48-200
R429	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	75042	CEAT0-1500F
R433	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	75042	CEAT0-49R90F
R440	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	75042	CEAT0-7500F
R442	321-0092-00			RES.,FXD,FILM:88.7 OHM,1%,0.125W	75042	CEAT0-88R70F

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R443	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	75042	CEAT0-1211F
R444	321-0092-00			RES.,FXD,FILM:88.7 OHM,1%,0.125W	75042	CEAT0-88R70F
R446	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	75042	CEAT0-63R40F
R447	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	80294	3329P-L58-501
R448	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	75042	CEAT0-63R40F
R450	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	75042	CEAT0-7500F
R452	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R453	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R455	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R456	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R458	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R459	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R460	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R461	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R462	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R463	323-0150-00			RES.,FXD,FILM:357 OHM,1%,0.5W	75042	CEAT0-3570F
R465	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R466	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R468	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R474	310-0701-00			RES.,FXD,WW:430 OHM,1%,8W	80009	310-0701-00
R478	310-0701-00			RES.,FXD,WW:430 OHM,1%,8W	80009	310-0701-00
R480	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R484	321-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.125W	75042	CEAT0-1101F
R486	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	62PT-345-0
R488	323-0054-00			RES.,FXD,FILM:35.7 OHM,1%,0.50W	75042	CECT0-35R70F
R490	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R491	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R492	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R495	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R496	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R501	321-1068-01			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT0-50R50D
R502	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R503	321-1068-01			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	75042	CEAT0-50R50D
R505	323-0187-00			RES.,FXD,FILM:866 OHM,1%,0.50W	75042	CECT0-8660F
R506	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R508	321-0160-00			RES.,FXD,FILM:453 OHM,1%,0.125W	75042	CEAT0-4530F
R509	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	80294	3386F-T04-102
R510	321-0157-00			RES.,FXD,FILM:422 OHM,1%,0.125W	75042	CEAT0-4220F
R512	323-0190-00			RES.,FXD,FILM:931 OHM,1%,0.50W	75042	CECT0-9310F
R513	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	80294	3386F-T04-101
R514	323-0190-00			RES.,FXD,FILM:931 OHM,1%,0.50W	75042	CECT0-9310F
R516	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R517	323-0187-00			RES.,FXD,FILM:866 OHM,1%,0.50W	75042	CECT0-8660F
R519	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R522	323-0206-00			RES.,FXD,FILM:1.37K OHM,1%,0.50W	75042	CECT0-1371F
R524	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R526	323-0206-00			RES.,FXD,FILM:1.37K OHM,1%,0.50W	75042	CECT0-1371F
R528	321-0320-00			RES.,FXD,FILM:21K OHM,1%,0.125W	75042	CEAT0-2102F
R529	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	75042	CEAT0-6191F
R531	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	80294	3386F-T04-102
R532	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	75042	CEAT0-6191F
R533	321-0320-00			RES.,FXD,FILM:21K OHM,1%,0.125W	75042	CEAT0-2102F
R535	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	75042	CEAT0-2151F

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R537	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R538	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	75042	CEAT0-1001F
R539	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R541	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	75042	CEAT0-2151F
R543	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R546	303-0470-00			RES.,FXD,CMPSN:47 OHM,5%,1W	01121	GB4705
R550	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R551	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R553	323-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.50W	75042	CECT0-47R50F
R555	323-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.50W	75042	CECT0-2491F
R556	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R558	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R559	323-0097-00			RES.,FXD,FILM:100 OHM,1%,0.50W	75042	CECT0-1000F
R561	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	75042	CEAT0-9090F
R562	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R564	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R565	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R567	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R569	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	75042	CEAT0-4021F
R570	321-0830-03			RES.,FXD,FILM:2.41K OHM,0.25%,0.125W	75042	CEAT2-2411C
R572	321-0273-00			RES.,FXD,FILM:6.81K OHM,1%,0.125W	75042	CEAT0-6811F
R573	323-0352-00			RES.,FXD,FILM:45.3K OHM,1%,0.50W	75042	CECT0-4532F
R575	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R576	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R578	323-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.50W	75042	CECT0-47R50F
R580	323-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.50W	75042	CECT0-2491F
R581	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R583	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R584	323-0097-00			RES.,FXD,FILM:100 OHM,1%,0.50W	75042	CECT0-1000F
R586	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	75042	CEAT0-9090F
R587	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R588	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R589	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R591	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R593	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R595	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R597	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R599	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R602	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R604	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R605	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R609	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R611	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R613	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R615	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R617	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R620	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R622	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R623	323-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.50W	75042	CECT0-1742F
R625	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R630	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3386F-T04-104
R633	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	80294	3386F-T04-502
R636	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3386F-T04-104

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R638	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R639	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R700	315-0434-00			RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R701	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R702	307-0359-00			RES.,FXD,FILM:HV DIVIDER	80009	307-0359-00
R705	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R706	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R708	315-0395-00			RES.,FXD,CMPSN:3.9M OHM,5%,0.25W	01121	CB3955
R709	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R713	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R714	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R716	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R745	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R748	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R754	301-0915-00			RES.,FXD,CMPSN:9.1M OHM,5%,0.50W	01121	EB9155
R758	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R759	311-1134-00			RES.,VAR,NONWIR:50K OHM,20%,0.5W	73138	72XW-51-0-503M
R763	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R765	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R805	307-0113-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
R806	302-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.50W	01121	EB4731
R808	302-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.50W	01121	EB2231
R809	302-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.50W	01121	EB2231
R811	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R814	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R821	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R822	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R823	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R824	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R826	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R827	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R830	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R831	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R833	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R837	307-0054-00			RES.,FXD,CMPSN:3.6 OHM,5%,0.50W	01121	EB36GB
R838	307-0054-00			RES.,FXD,CMPSN:3.6 OHM,5%,0.50W	01121	EB36GB
R853	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R855	323-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.50W	75042	CECT0-1622F
R856	323-0289-00			RES.,FXD,FILM:10K OHM,1%,0.50W	75042	CECT0-1002F
R858	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R859	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R860	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R862	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R864	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R866	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R867	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R870	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R872	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R875	308-0677-00			RES.,FXD,WW:1 OHM,5%,2W	75042	BWH-1R000J
R876	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R877	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R878	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R879	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245

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R880	323-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.50W	75042	CECT0-6651F
R881	311-1223-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	80294	3386F-T04-251
R882	323-0206-00			RES.,FXD,FILM:1.37K OHM,1%,0.50W	75042	CECT0-1371F
R883	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	75042	CEAT0-2051F
R884	323-0306-00			RES.,FXD,FILM:15K OHM,1%,0.50W	75042	CECT0-1502F
R886	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R889	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R890	323-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.50W	75042	CECT0-5491F
R891	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R892	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R894	315-0245-00			RES.,FXD,CMPSN:2.4M OHM,5%,0.25W	01121	CB2455
R896	301-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.50W	01121	EB3635
R898	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R901	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R903	308-0677-00			RES.,FXD,WW:1 OHM,5%,2W	75042	BWH-1R000J
R904	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R906	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R907	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R908	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R910	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R911	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R912	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R915	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	75042	CEAT9-1202B
R916	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R918	301-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.50W	01121	EB6835
R921	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R922	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R923	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R924	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R927	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R932	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R935	308-0678-00			RES.,FXD,WW:0.1 OHM,5%,2W	75042	BWH-R1000J
R936	301-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.50W	01121	EB2735
R937	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R938	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R939	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R940	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R942	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R945	321-0332-07			RES.,FXD,FILM:28K OHM,0.1%,0.125W	75042	CEAT9-2802B
R946	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	75042	CEAT9-1202B
R948	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	01121	CB9145
R950	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R952	301-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.50W	01121	EB3035
R954	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R956	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R957	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R958	308-0678-00			RES.,FXD,WW:0.1 OHM,5%,2W	75042	BWH-R1000J
R959	308-0680-00			RES.,FXD,WW:0.045 OHM,10%,3W	91637	LVR2-DR0450K
R961	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R963	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R966	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R967	315-0364-00			RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
R970	321-0926-07			RES.,FXD,FILM:4K OHM,0.1%,0.125W	75042	CEAT9-4001B

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R971	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	75042	CEAT9-4002B
R973	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R975	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R977	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R979	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R980	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R983	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R985	304-0470-00			RES.,FXD,CMPSN:47 OHM,10%,1W	01121	GB4701
R986	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R989	308-0678-00			RES.,FXD,WW:0.1 OHM,5%,2W	75042	BWH-R1000J
R991	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R993	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R994	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R995	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1018	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1019	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1020	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R1022	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R1025	311-0566-00			RES.,FXD,NONWIR:5K OHM,20%,0.5W	71590	BA147-011
R1045	311-1393-00			RES.,FXD,NONWIR:5K X 5 MEG OHM,20%,0.5W	12697	CM39702
R1061	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1062	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1063	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R1066	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R1067	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R1069	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R1071	323-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.50W	75042	CECT0-4991F
R1073	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1074	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1076	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1077	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	80294	3386F-T04-502
R1079	321-0102-00			RES.,FXD,FILM:113 OHM,1%,0.125W	75042	CEAT0-1130F
R1087	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R1095	311-1055-00			RES.,VAR,NONWIR:1K OHM 20%,0.50W	12697	381-CM40034
RT417	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
RT418	307-0126-00			RES.,THERMAL:100 OHM,10%	04239	2D204
RT459	307-0126-00			RES.,THERMAL:100 OHM,10%	04239	2D204
RT461	307-0181-00			RES.,THERMAL:100K OHM,10%,4MW/DEG C	50157	JP-51J2
S1000	260-0907-00			SWITCH,THRMSTC:OPEN 97.8,CL 75.6,10A,240V	93410	110228
S1001	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
S1011	260-1379-00			SWITCH,PUSH:TRIG SOURCE	71590	2KBC120000-595
S1021	260-1378-00			SWITCH,PUSH:VERT MODE	71590	2KBC140000-608
S1030	311-1055-00			RES.,VAR,NONWIR:1K OHM 20%,0.50W	12697	381-CM40034
T738	120-0823-00			XFMR,PWR,SDN AND SU:	80009	120-0823-00
T801	120-0730-00			XFMR,PWR,STPDN:	80009	120-0730-00
T1000	120-0794-00			XFMR,TORIOD:6 TURNS	80009	120-0794-00
U55	155-0011-00			MICROCIRCUIT,DI:ML,CLOCK AND CHOP BLANKING	80009	155-0011-00
U99	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	86684	CA3046
U123	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U156	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U180	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	86684	CA3046
U214	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHANNEL SW	80009	155-0022-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U324	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHANNEL SW	80009	155-0022-00
U450	155-0080-00			MICROCIRCUIT,LI:HYBRID	80009	155-0080-00
U741	119-0401-00			MULTIPLIER,HV:	80009	119-0401-00
U973	156-0065-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	80009	156-0065-00
V1099	154-0672-00			ELECTRON TUBE:P31	80009	154-0672-00
VR244	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR254	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR851	152-0283-00			SEMICOND DEVICE:ZENER,0.4W,43V,5%	04713	1N976B
VR890	152-0124-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	1N938A

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

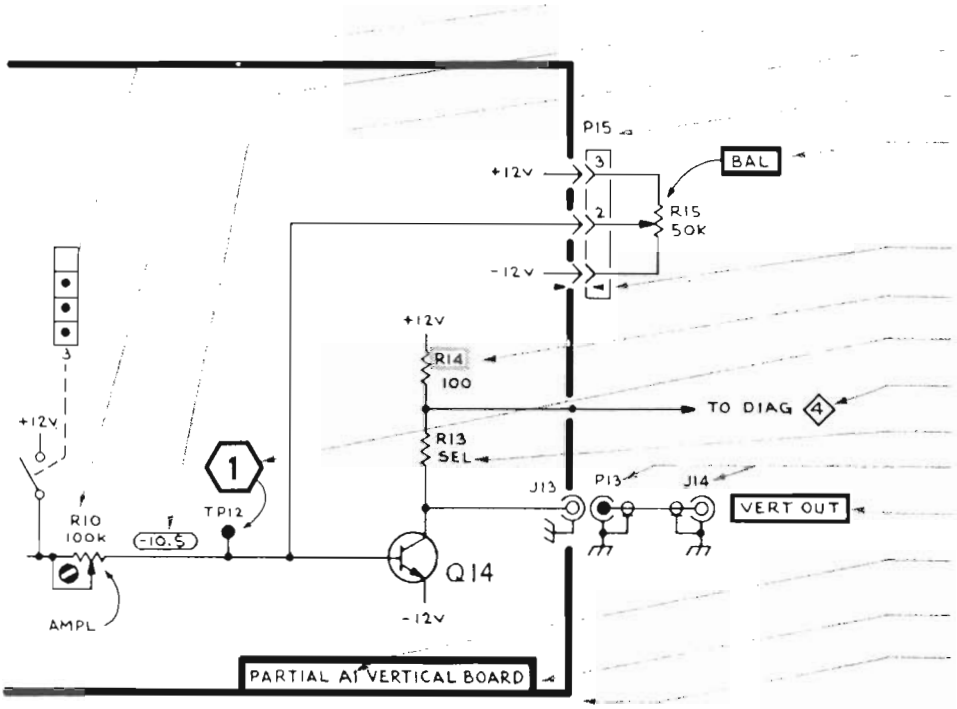
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following 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.)	RT	Thermistor
AT	Attenuator, fixed or variable	HR	Heater	S	Switch
B	Motor	HY	Hybrid circuit	T	Transformer
BT	Battery	J	Connector, stationary portion	TC	Thermocouple
C	Capacitor, fixed or variable	K	Relay	TP	Test point
CB	Circuit breaker	L	Inductor, fixed or variable	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	V	Electron tube
DL	Delay line	M	Meter	VR	Voltage regulator (zener diode, etc.)
DS	Indicating device (lamp)	P	Connector, movable portion	Y	Crystal
E	Spark Gap	Q	Transistor or silicon-controlled rectifier	Z	Phase shifter
F	Fuse				
FL	Filter	R	Resistor, fixed or variable		

The following special symbols are used on the diagrams:



VERTICAL AMPLIFIER 2 CMO 1274

Cam Switch Closure Chart

Internal Screwdriver Adjustment

Test Voltage

Plug to E.C. Board

Panel Adjustment

Plug Index

Modified Component—See Parts Lis

Refer to Waveform

Refer to Diagram Number

SEL Value Selected at Factory

Coaxial Connector

Panel Connector

Assembly Number

Board Name

Etched Circuit Board Outlined in Black

Schematic Name and Number

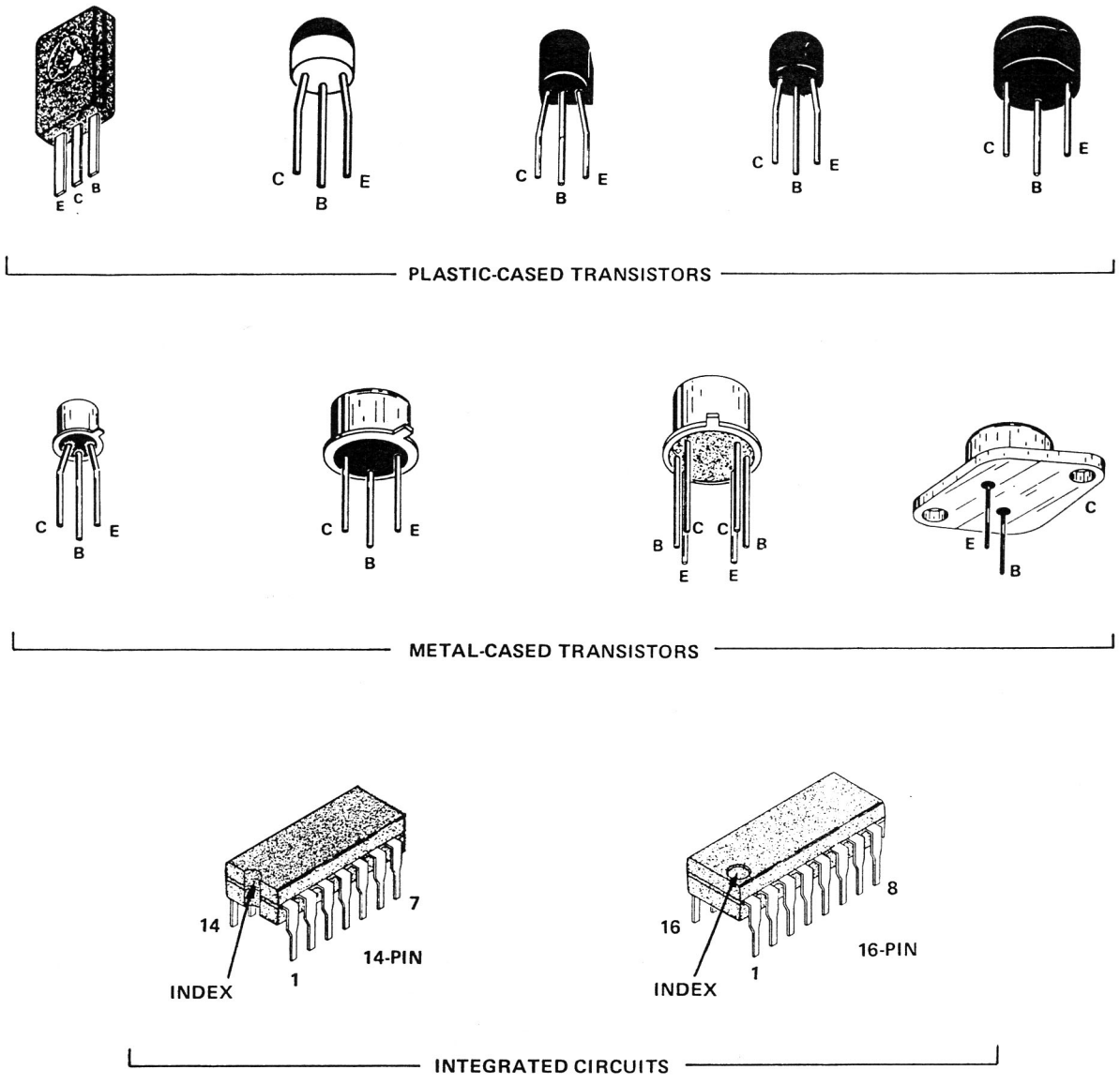
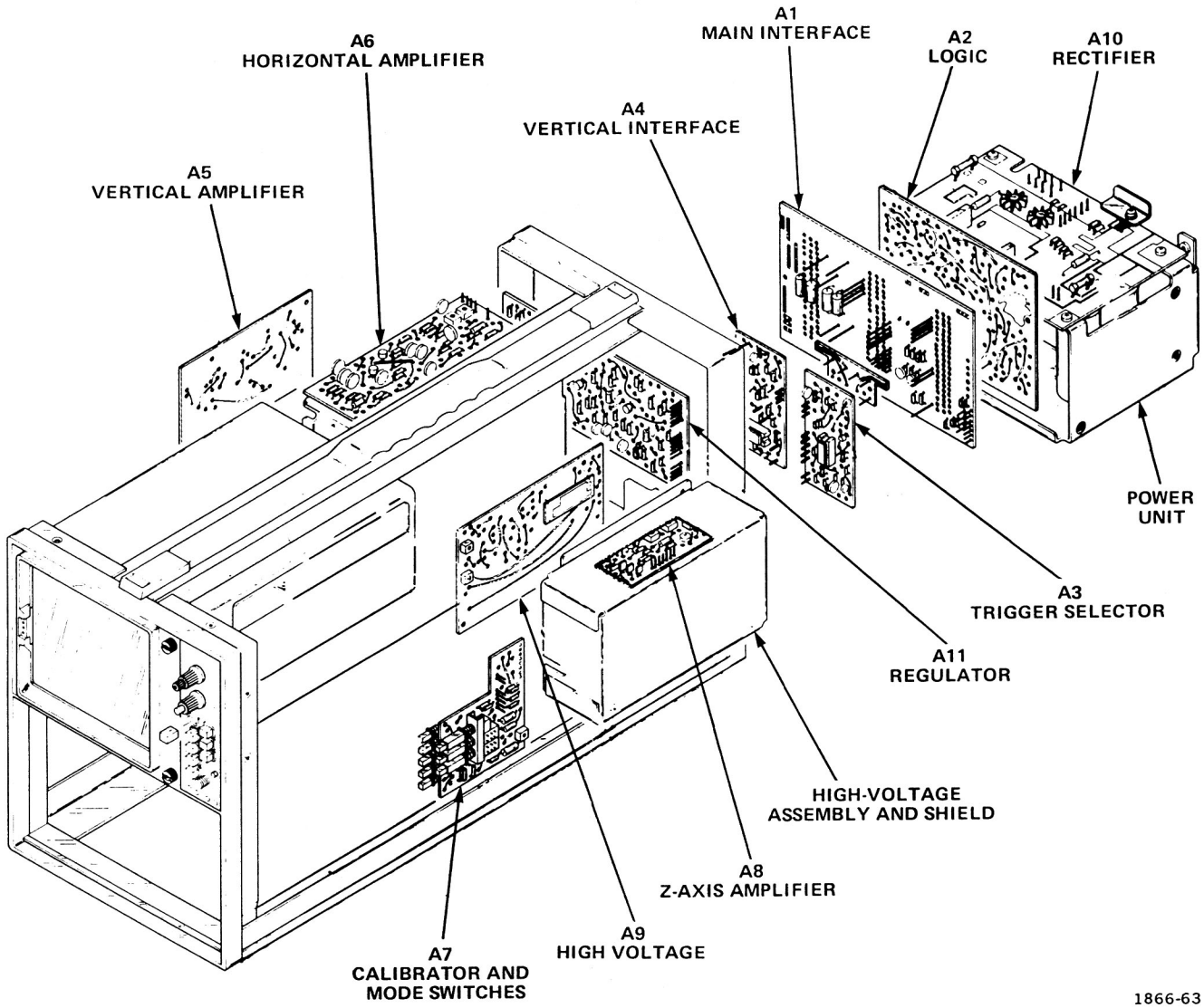


Figure 7-1. Semiconductor lead configurations.



66-62

Figure 7-2. Locations of circuit boards and assemblies in the Oscilloscope.

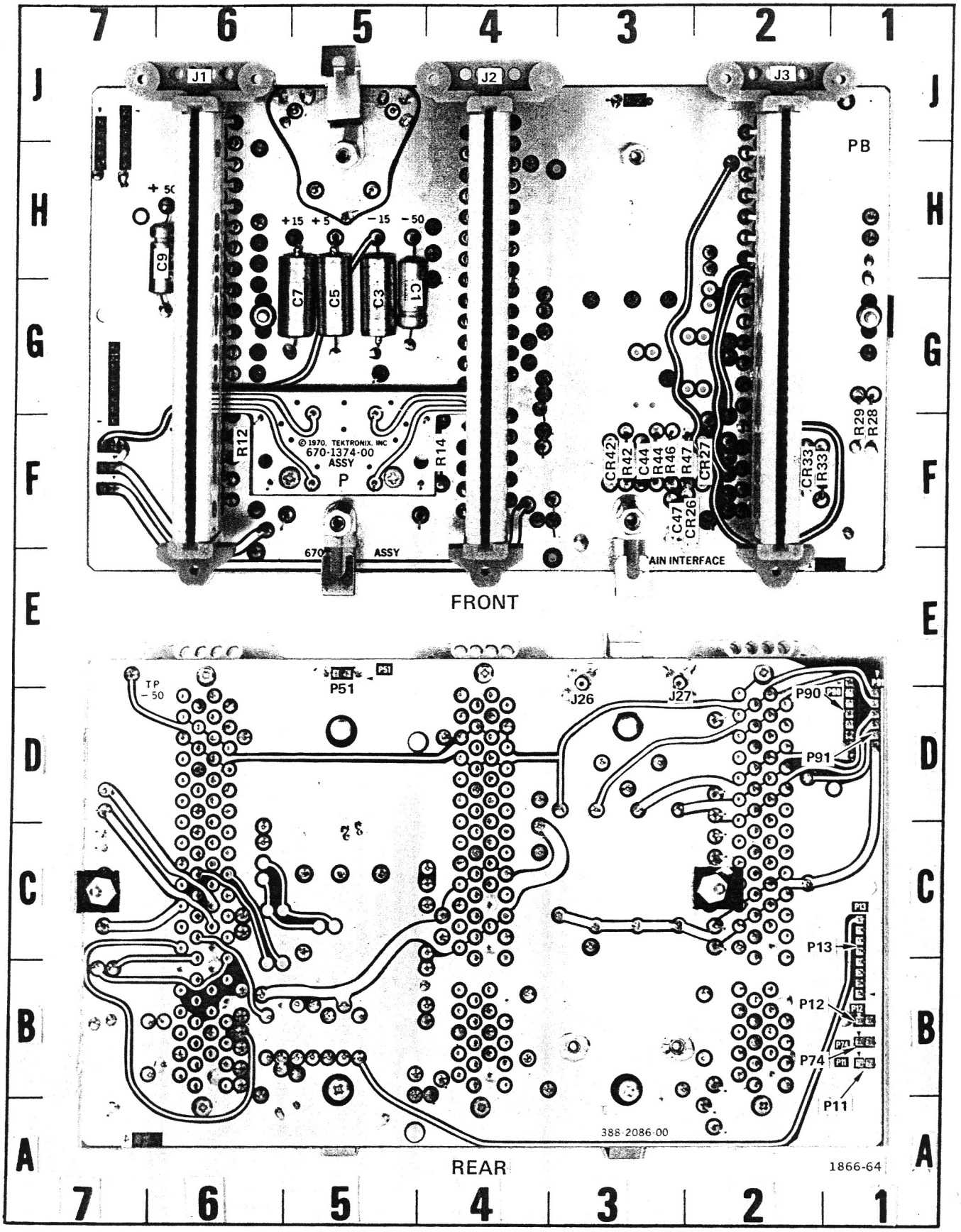
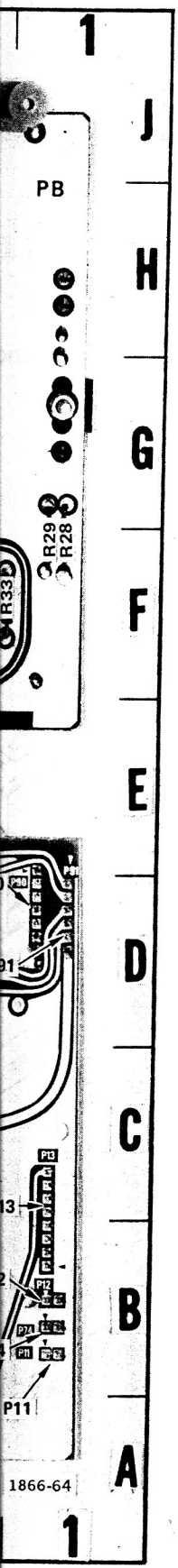
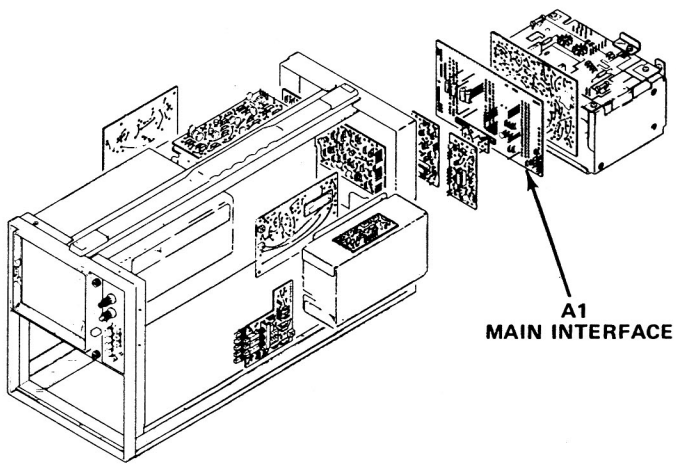


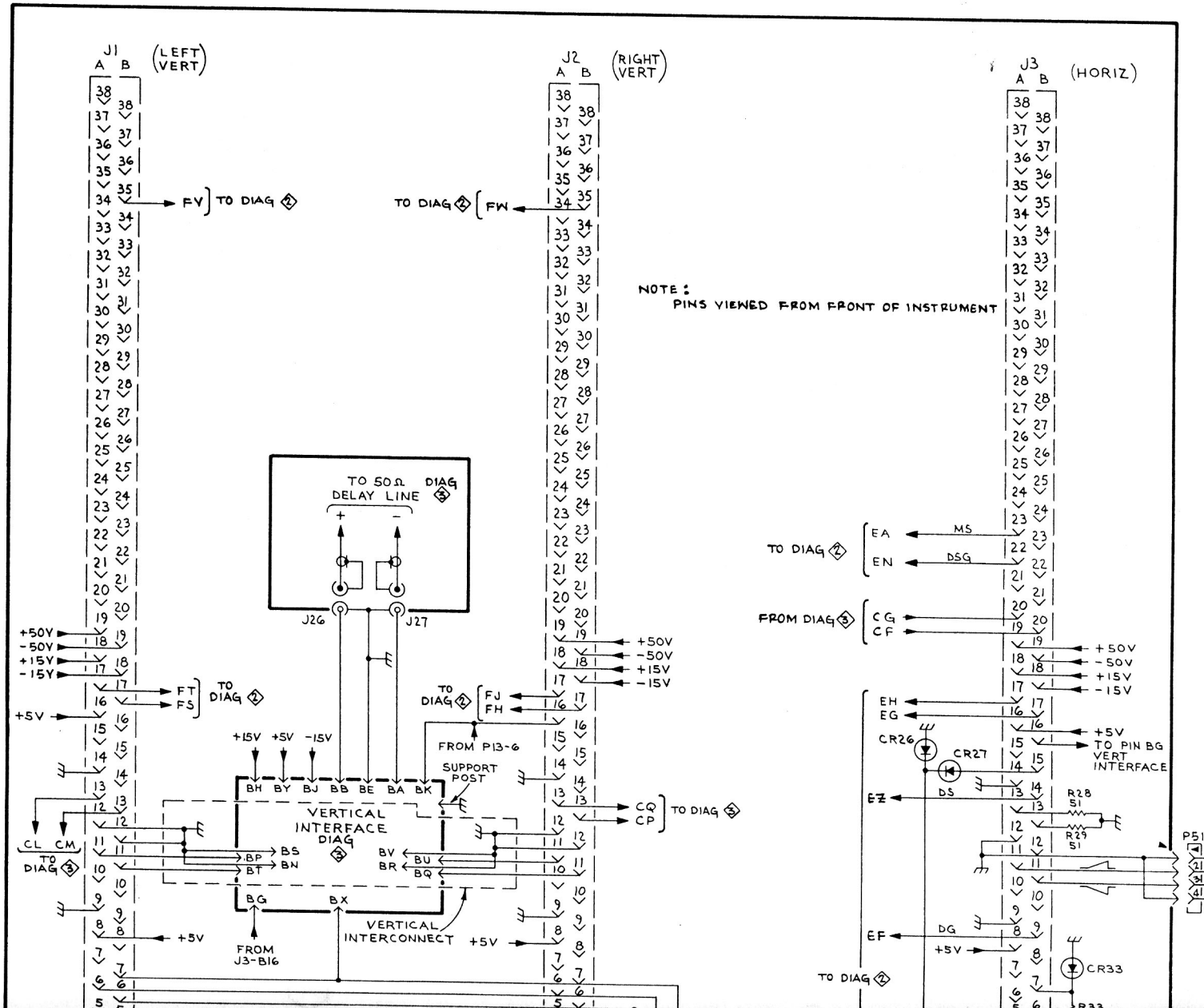
Figure 7-3. A1-Main Interface circuit board assembly.

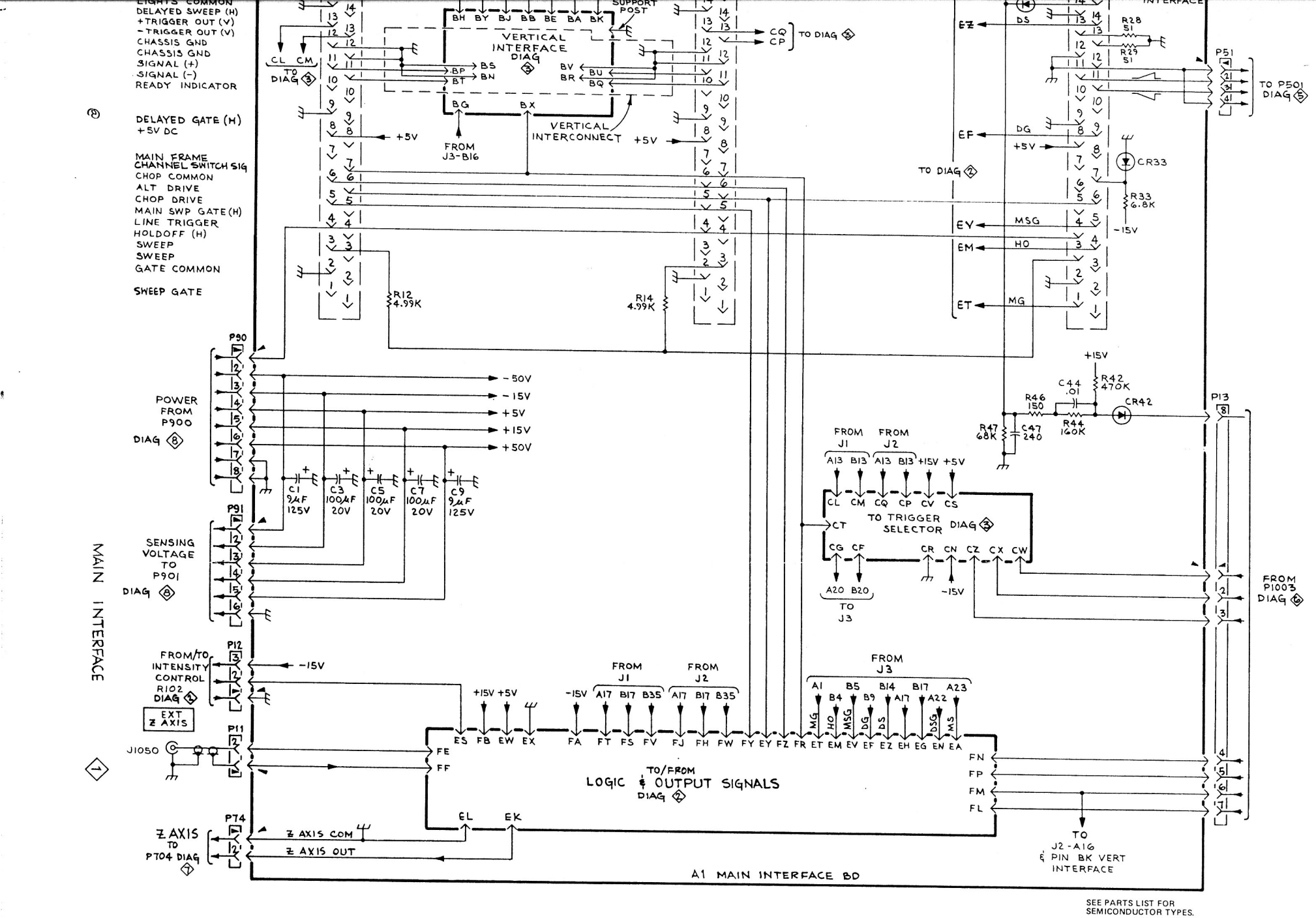


CKT NO	GRID COORD	CKT NO	GRID COORD
C1	5G	P11	1B
C3	5G	P12	1B
C5	5G	P13	1C
C7	5G	P51	5E
C9	6H	P74	1B
C44	3F	P90	1D
C47	3F	P91	1D
CR26	3F	R12	6F
CR27	2F	R14	4F
CR33	2F	R28	1F
CR42	3F	R29	1F
		R33	2F
J1	6J	R42	3F
J2	4J	R44	3F
J3	2J	R46	3F
J26	3E	R47	3F
J27	3E		

INDEX FOR FIGURE 7-3.




J1 (LEFT VERT)
J2 (RIGHT VERT)
J3 (HORIZ)
PLUG-IN MODE
MAIN SWEEP (H)
DELAYED SWEEP GATE (H)
+ TRIGGER IN (H)
- TRIGGER IN (H)
+50V DC
-50V DC
+15V DC
-15V DC
AUX Z AXIS
AUX-Z AXIS COMMON
MAIN FRAME MODE
AUX Y AXIS
SINGLE SWP RESET
LIGHTS COMMON
DELAYED SWEEP (H)
+TRIGGER OUT (V)
-TRIGGER OUT (V)
CHASSIS GND
CHASSIS GND
SIGNAL (+)
SIGNAL (-)
READY INDICATOR
DELAYED GATE (H)
+5V DC
MAIN FRAME CHANNEL SWITCH SIG
CHOP COMMON
ALT DRIVE
CHOP DRIVE
TO 50Ω DELAY LINE DIAG 3
J26
J27
VERTICAL INTERFACE DIAG 3
SUPPORT POST
FROM P13-6
FROM J3-B16
VERTICAL INTERCONNECT
TO DIAG 2
TO DIAG 3
NOTE: PINS VIEWED FROM FRONT OF INSTRUMENT
MS
DSG
TO PIN BG VERT INTERFACE
CR26
CR27
CR33
R28 51
R29 51
P51
TO P501 DIAG 5


LIGHTS COMMON
DELAYED SWEEP (H)
+TRIGGER OUT (V)
-TRIGGER OUT (V)
CHASSIS GND
CHASSIS GND
SIGNAL (+)
SIGNAL (-)
READY INDICATOR
DELAYED GATE (H)
+5V DC
MAIN FRAME CHANNEL SWITCH SIG
CHOP COMMON
ALT DRIVE
CHOP DRIVE
MAIN SWP GATE (H)
LINE TRIGGER
HOLDOFF (H)
SWEEP
SWEEP
GATE COMMON
SWEEP GATE
VERTICAL INTERFACE DIAG 3
VERTICAL INTERCONNECT
FROM J3-B16
+5V
R12 4.99K
R14 4.99K
TO DIAG 2
CR33
R33 6.8K
-15V
TO P501 DIAG 5
R28 51
R29 51
R42 470K
C44 .01
R46 150
R44 140K
CR42
R47 68K
C47 240
+15V
FROM J1
FROM J2
TO TRIGGER SELECTOR DIAG 3
TO J3
FROM P1003 DIAG 6
POWER FROM P900 DIAG 8
-50V
-15V
+5V
+15V
+50V
C1 9µF 125V
C3 100µF 20V
C5 100µF 20V
C7 100µF 20V
C9 9µF 125V
SENSING VOLTAGE TO P901 DIAG 8
FROM/TO INTENSITY CONTROL R102 DIAG 4
EXT Z AXIS
J1050
FROM J3
TO/FROM LOGIC & OUTPUT SIGNALS DIAG 2
Z AXIS TO P704 DIAG 7
Z AXIS COM
Z AXIS OUT
TO J2-A16 & PIN BK VERT INTERFACE
A1 MAIN INTERFACE BD
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
MAIN INTERFACE
1

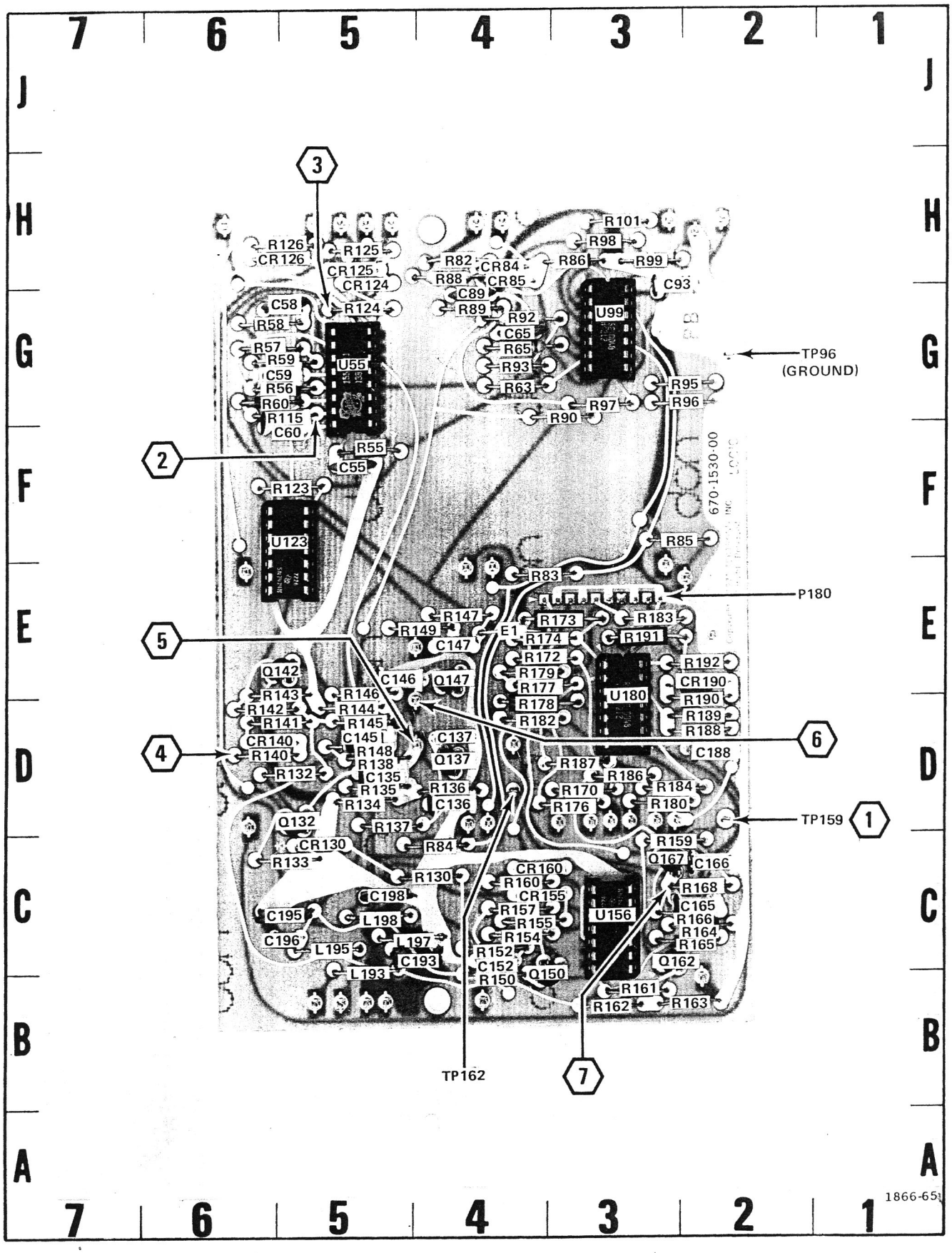
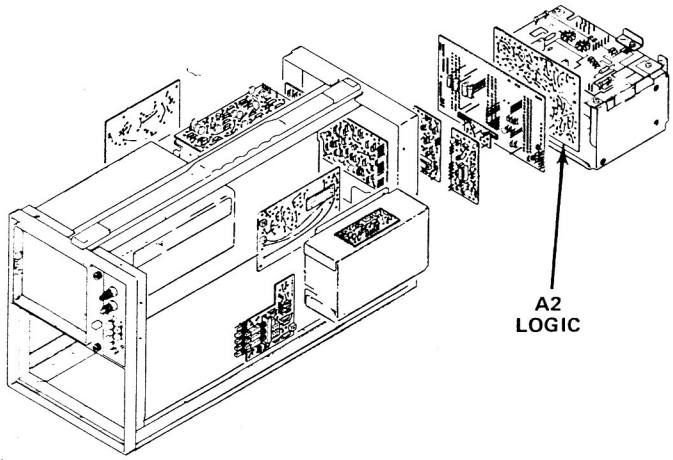


Figure 7-4. A2-Logic circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C55	5F	CR130	5C	R65	4G	R136	4D	R173	3E
C58	6G	CR140	6D	R82	4H	R137	5D	R174	4E
C59	6G	CR155	4C	R83	3E	R138	5D	R176	3D
C60	5F	CR160	4C	R84	4C	R140	6D	R177	4E
C65	4G	CR190	2E	R85	2F	R141	6D	R178	4D
C89	4G			R86	3H	R143	5E	R179	4E
C93	3G	L193	5B	R88	4H	R144	5D	R180	3D
C135	5D	L195	5C	R89	4G	R145	5D	R182	4D
C136	4D	L197	5C	R90	3G	R146	5D	R183	3E
C137	4D	L198	5C	R92	4G	R147	4E	R184	3D
C145	5D			R93	4G	R148	5D	R186	2D
C146	5E	P180	3E	R95	3G	R149	4E	R187	3D
C147	4E	Q132	5D	R96	3G	R150	5B	R188	2D
C152	4C	Q137	4D	R97	3G	R152	4C	R189	2D
C165	3C	Q142	6E	R98	3H	R154	4C	R190	2D
C166	2C	Q147	4E	R99	3H	R155	4C	R191	3E
C188	2D	Q150	4B	R101	3H	R157	4C	R192	2E
C193	5C	Q162	3C	R115	6G	R159	3C		
C195	6C	Q167	3C	R123	6F	R160	4C	TP96	2G
C196	6C			R124	5G	R161	3B	TP159	2D
C198	5C	R55	5F	R125	5H	R162	3B	TP162	4D
		R56	6G	R126	6H	R163	3B		
CR84	4H	R57	6G	R130	4C	R165	2C	U55	5G
CR85	4H	R58	6G	R132	5D	R166	2C	U99	3G
CR124	5H	R59	6G	R133	5D	R168	2C	U123	6F
CR125	5H	R60	6G	R134	5D	R170	3D	U156	3G
CR126	6H	R63	4G	R135	5D	R172	4E	U180	3D

INDEX FOR FIGURE 7-4.



WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

WAVEFORMS

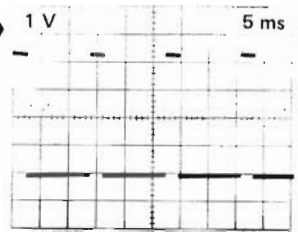
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

NOTE

Voltages and waveforms are not absolute and may vary between instruments.

1



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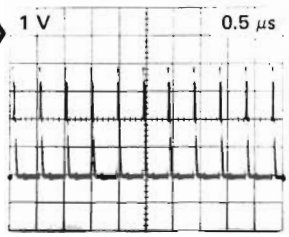

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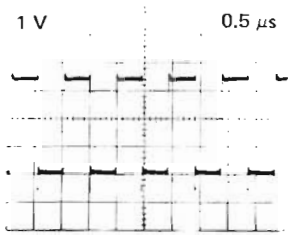

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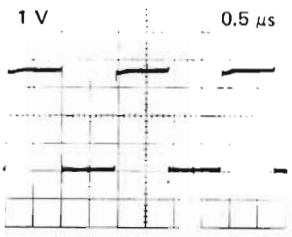

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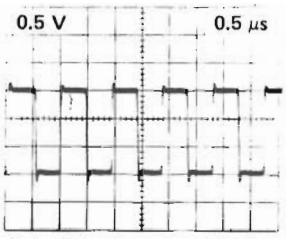
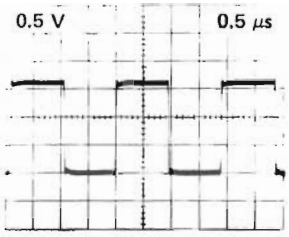


SET VERT MODE TO CHOP

6



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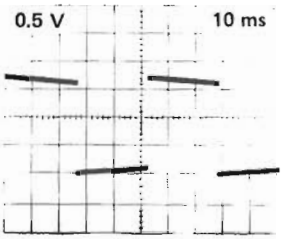
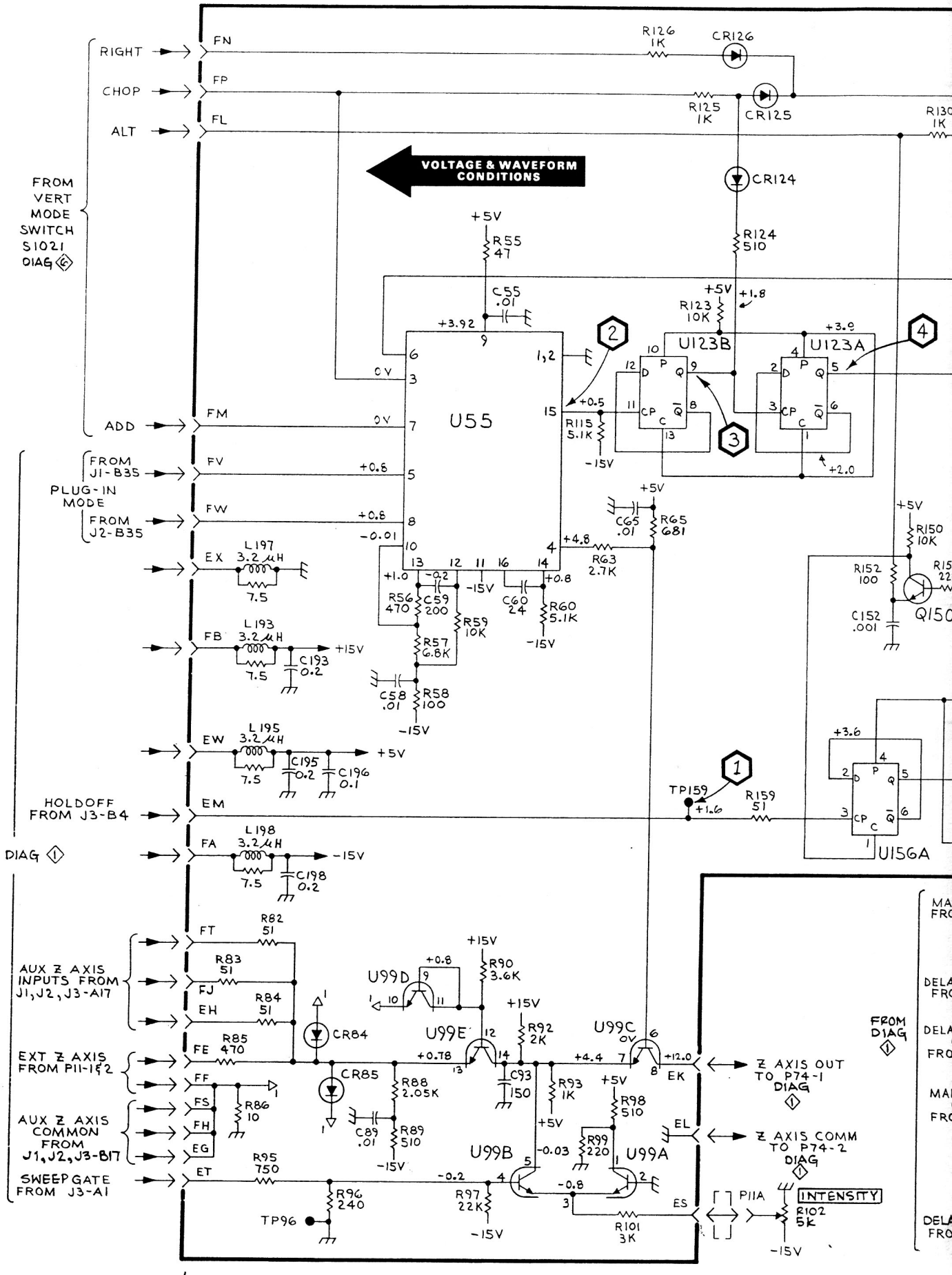
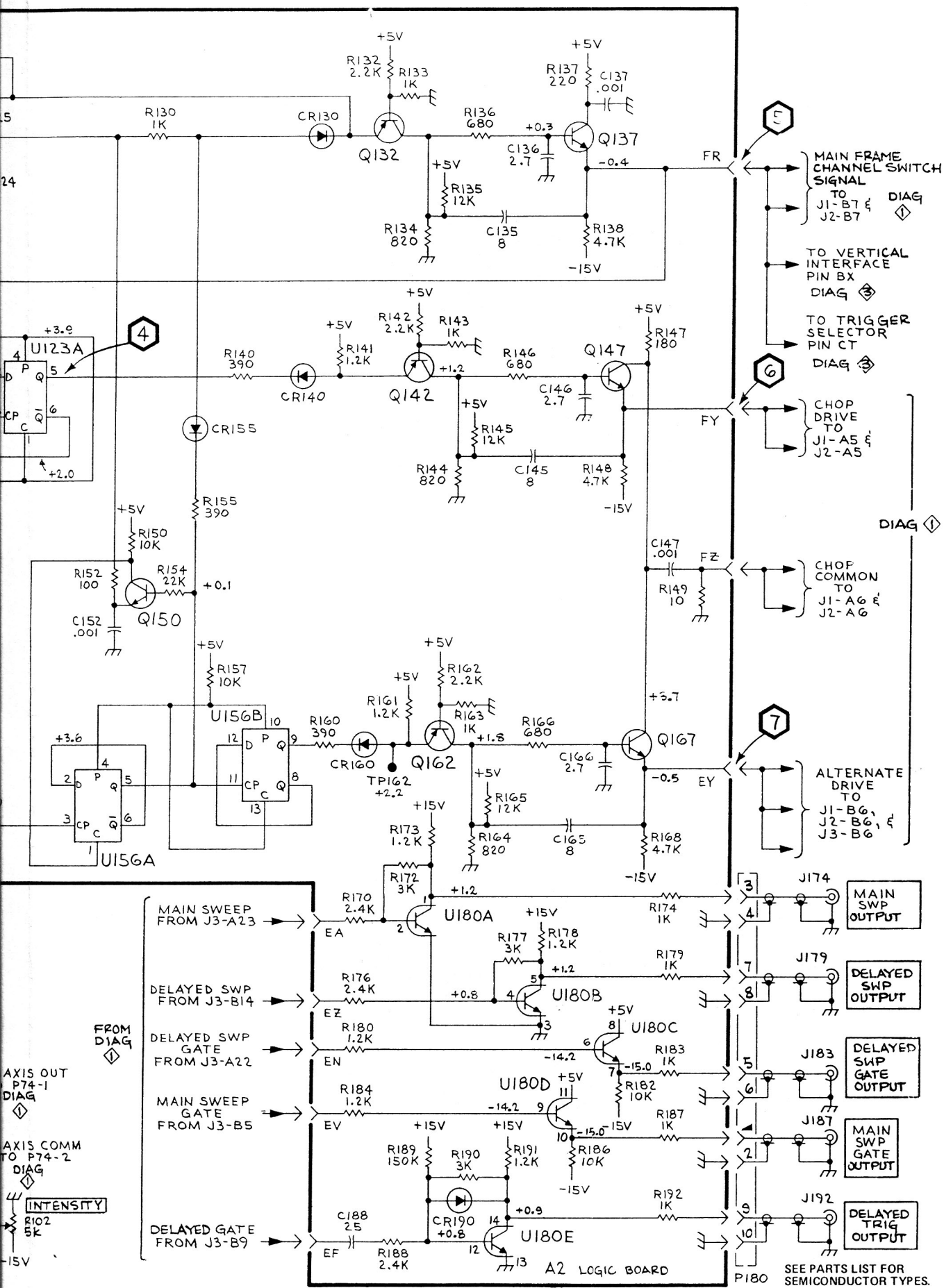


SET VERT MODE TO ALT


VOLTAGE & WAVEFORM CONDITIONS
RIGHT
CHOP
ALT
FROM VERT MODE SWITCH S1021 DIAG 16
ADD
FROM J1-B35
PLUG-IN MODE
FROM J2-B35
HOLDOFF FROM J3-B4
DIAG 1
AUX Z AXIS INPUTS FROM J1,J2,J3-A17
EXT Z AXIS FROM P11-1&2
AUX Z AXIS COMMON FROM J1,J2,J3-B17
SWEEP GATE FROM J3-A1
FN
FP
FL
FM
FV
FW
EX
FB
EW
EM
FA
FT
FJ
EH
FE
FF
FS
FH
EG
ET
R126 1K
CR126
R125 1K
CR125
CR124
R124 510
R55 47
C55 .01
R123 10K
U55
U123B
U123A
R115 5.1K
L197 3.2µH
L193 3.2µH
L195 3.2µH
L198 3.2µH
7.5
C193 0.2
C195 0.2
C196 0.1
C198 0.2
R56 470
C59 200
R59 10K
R57 6.8K
C58 .01
R58 100
C60 24
R60 5.1K
RG3 2.7K
CG5 .01
RG5 681
R150 10K
R152 100
C152 .001
Q150
U156A
TP159
R159 51
R82 51
R83 51
R84 51
R85 470
R86 10
R88 2.05K
C89 .01
R89 510
R90 3.6K
R92 2K
C93 150
R93 1K
R98 510
R99 220
R95 750
R96 240
TP96
R97 22K
R101 3K
R102 5K
INTENSITY
U99D
U99E
U99C
U99B
U99A
CR84
CR85
Z AXIS OUT TO P74-1 DIAG 1
Z AXIS COMM TO P74-2 DIAG 1
FROM DIAG 1
P11A
+5V
+15V
-15V
0V

OS-245(P)/U



LOGIC AND OUTPUT SIGNALS 2

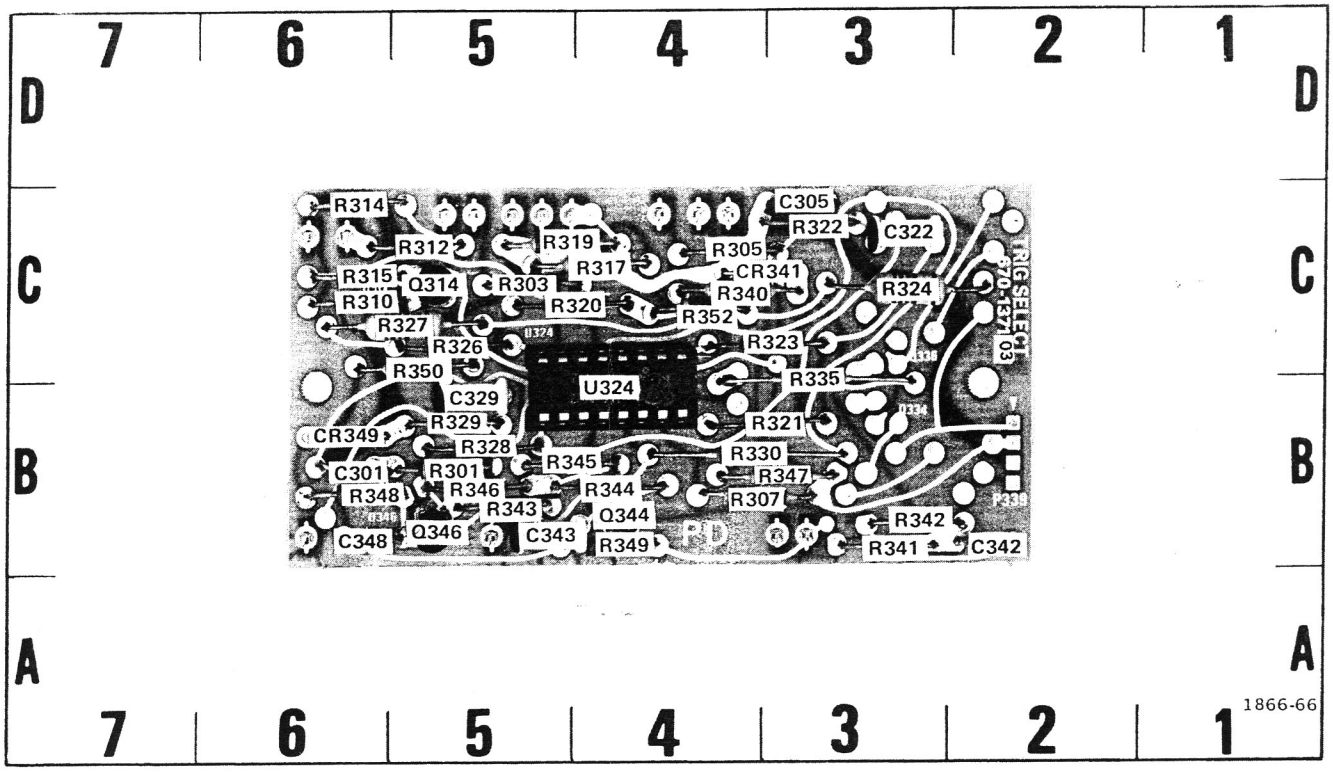


Figure 7-5. A3-Trigger Selector circuit board assembly.

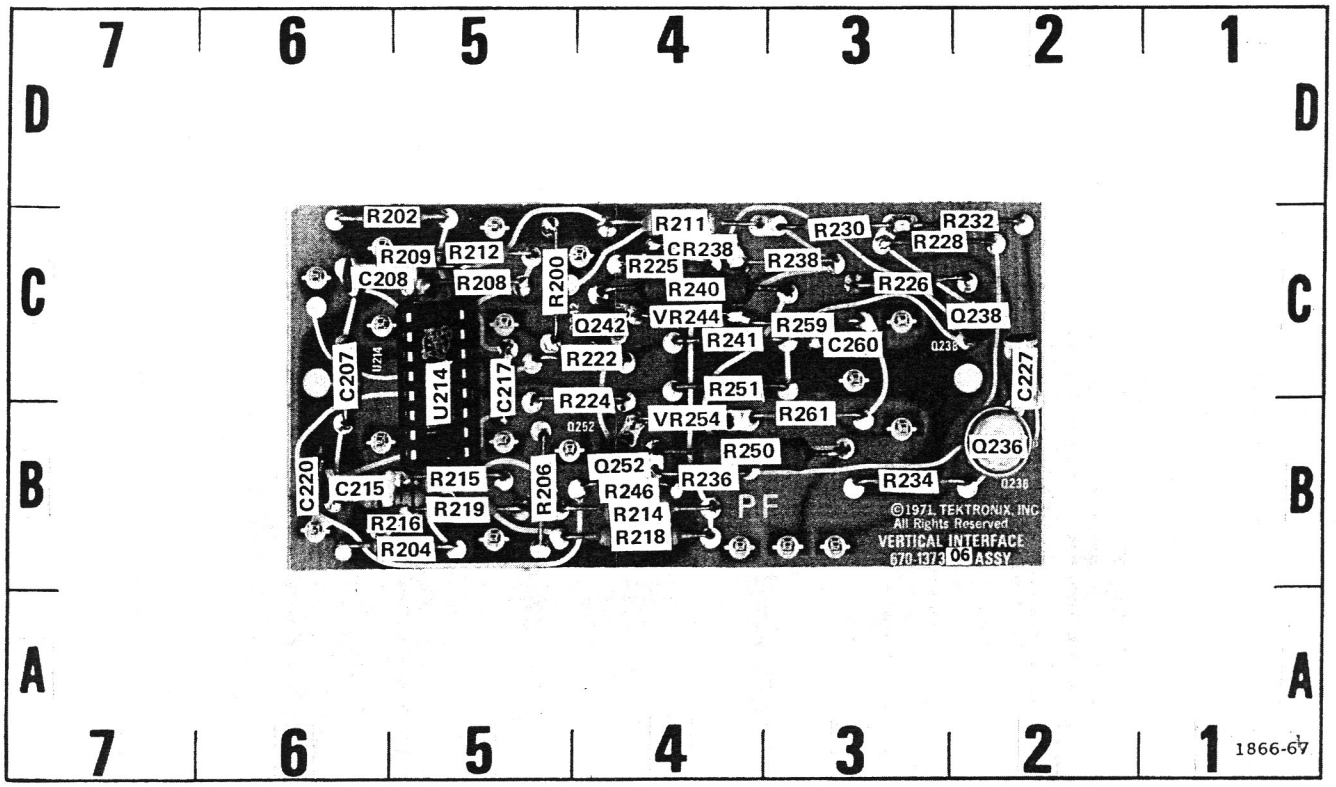


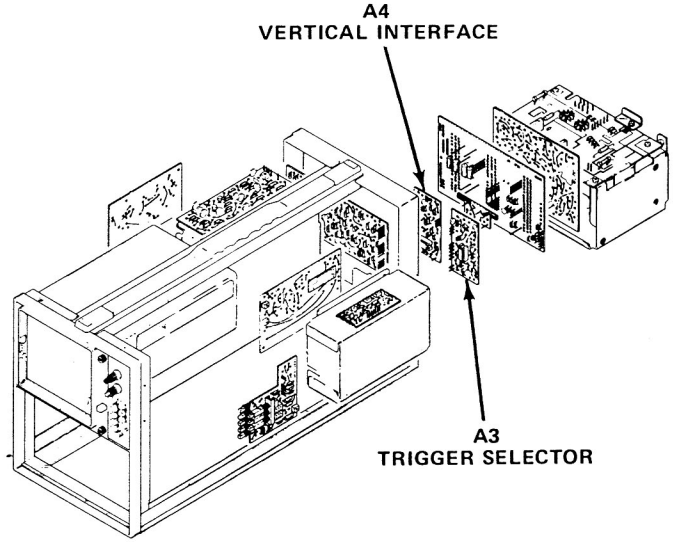
Figure 7-6. A4-Vertical Interface circuit board assembly.

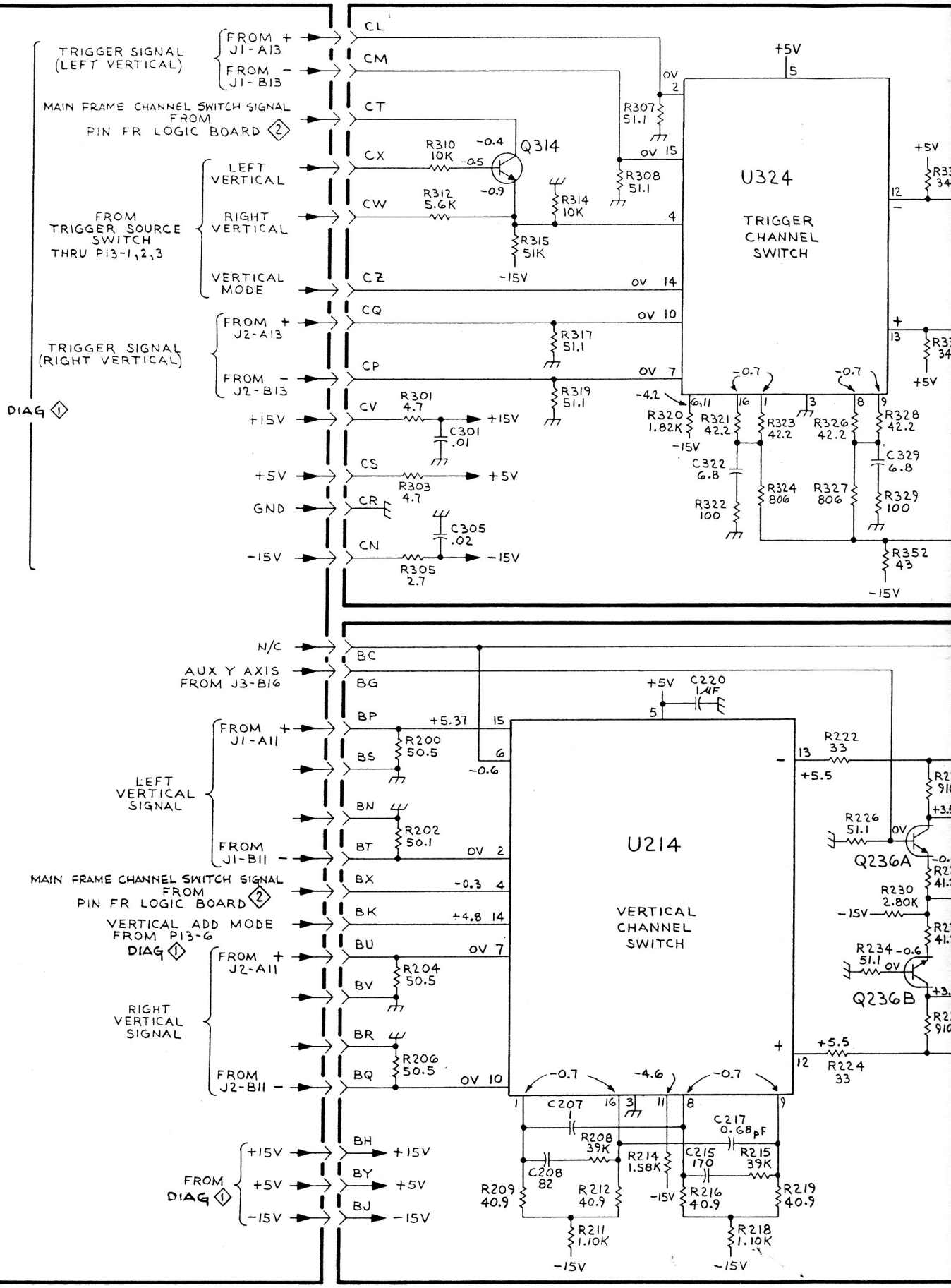
CKT NO	GRID COORD	CKT NO	GRID COORD
C301	6B	R321	3C
C305	3C	R322	3C
C322	3G	R323	3C
C329	5B	R324	3B
C342	2B	R326	5C
C343	5B	R327	5C
C348	6B	R328	5B
		R329	5B
CR341	4C	R330	4B
CR349	6B	R335	3C
		R340	4C
Q314	5C	R341	3B
Q344	4B	R342	2B
Q346	5B	R343	5B
		R344	4B
R301	5B	R345	5B
R303	5C	R346	5B
R305	4C	R348	6B
R307	3B	R349	4B
R308	3B	R350	5C
R310	6C	R352	4C
R312	5C		
R314	6C	U324	4B
R315	6C		
R317	4C		
R319	5C		
R320	5C		

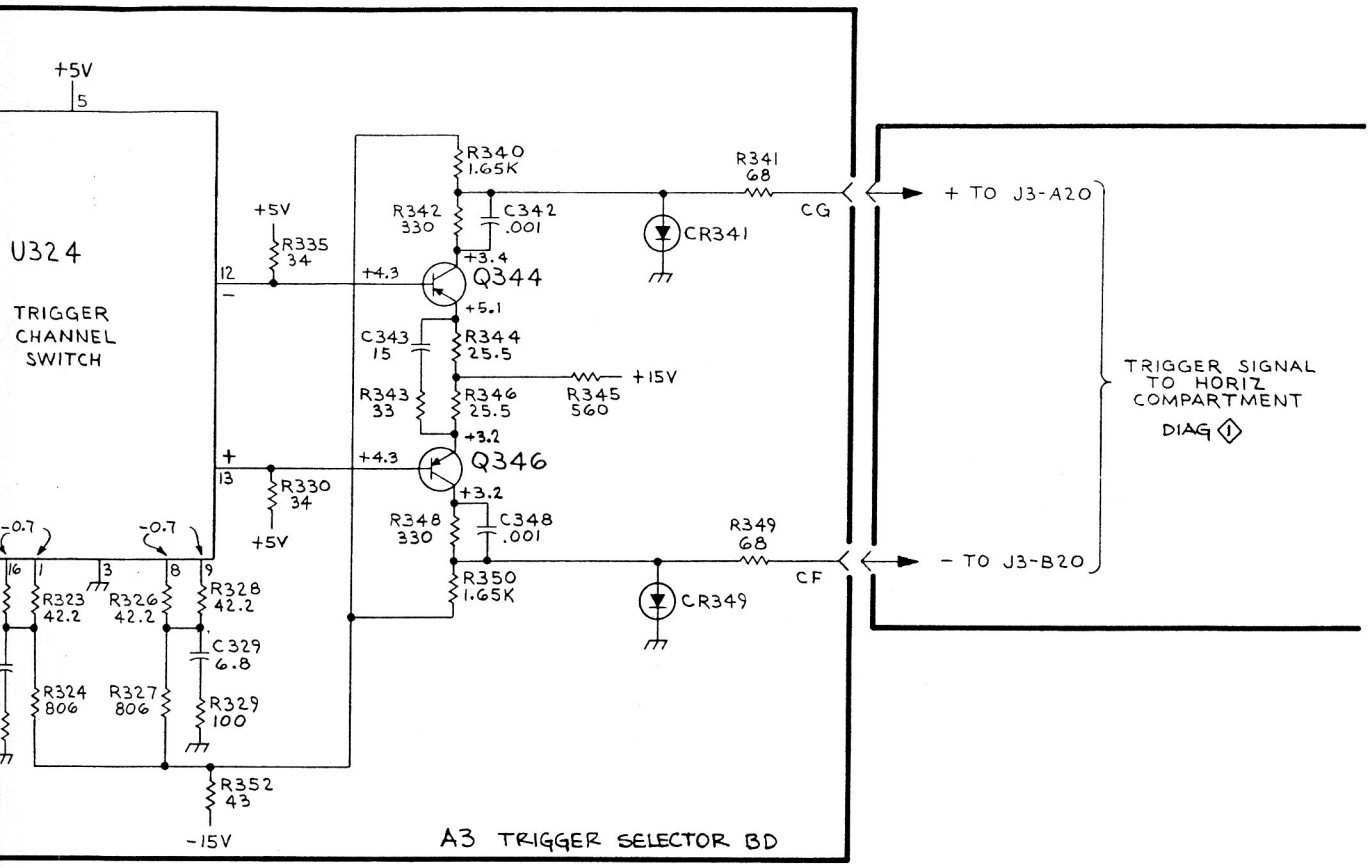
INDEX FOR FIGURE 7-5.

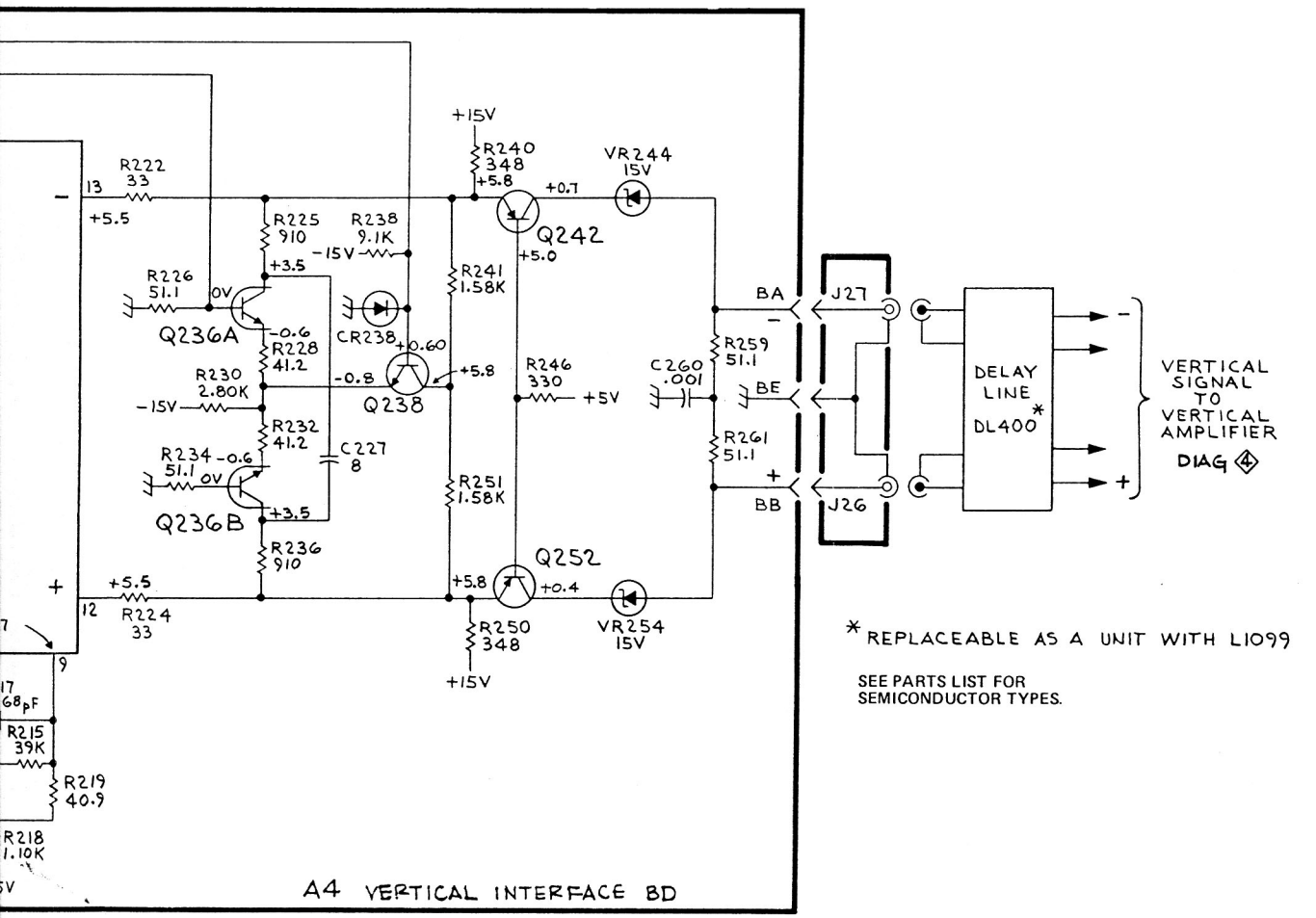
CKT NO	GRID COORD	CKT NO	GRID COORD
C207	6C	R218	4B
C208	6C	R219	5B
C215	6B	R222	4C
C217	5C	R224	4B
C220	6B	R225	4C
C227	2C	R226	3C
C260	3C	R228	3C
		R230	3C
CR238	4C	R232	2C
		R234	3B
Q236	2B	R236	4B
Q238	2C	R238	3C
Q242	4C	R240	4C
Q252	4B	R241	4C
		R246	4B
R200	5C	R250	4B
R202	5C	R251	4C
R204	5B	R259	3C
R206	5B	R261	3B
R208	5C		
R209	5C	U214	5C
R211	5C		
R212	5C	VR244	4C
R214	4B	VR254	4B
R215	5B		
R216	5B		

INDEX FOR FIGURE 7-6




TRIGGER SIGNAL (LEFT VERTICAL)
FROM + J1-A13
FROM − J1-B13
MAIN FRAME CHANNEL SWITCH SIGNAL FROM PIN FR LOGIC BOARD ②
FROM TRIGGER SOURCE SWITCH THRU P13-1,2,3
LEFT VERTICAL
RIGHT VERTICAL
VERTICAL MODE
TRIGGER SIGNAL (RIGHT VERTICAL)
FROM + J2-A13
FROM − J2-B13
DIAG ①
+15V
+5V
GND
−15V
CL
CM
CT
CX
CW
CZ
CQ
CP
CV
CS
CR
CN
R301 4.7
R303 4.7
R305 2.7
C301 .01
C305 .02
R307 51.1
R308 51.1
R310 10K
Q314
R312 5.6K
R314 10K
R315 51K
R317 51.1
R319 51.1
U324
TRIGGER CHANNEL SWITCH
R320 1.82K
R321 42.2
R322 100
R323 42.2
R324 806
R326 42.2
R327 806
R328 42.2
R329 100
C322 6.8
C329 6.8
R352 43
N/C
AUX Y AXIS FROM J3-B16
BC
BG
BP
BS
BN
BT
BX
BK
BU
BV
BR
BQ
BH
BY
BJ
LEFT VERTICAL SIGNAL
RIGHT VERTICAL SIGNAL
VERTICAL ADD MODE FROM P13-6 DIAG ①
R200 50.5
R202 50.1
R204 50.5
R206 50.5
U214
VERTICAL CHANNEL SWITCH
C220 1μF
R222 33
R224 33
R226 51.1
Q236A
Q236B
R230 2.80K
R234 51.1
C207 1
C208 82
C217 0.68pF
C215 170
R208 39K
R209 40.9
R211 1.10K
R212 40.9
R214 1.58K
R215 39K
R216 40.9
R218 1.10K
R219 40.9





* REPLACEABLE AS A UNIT WITH L1099

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

@

TRIGGER SELECTOR & VERTICAL INTERFACE 3

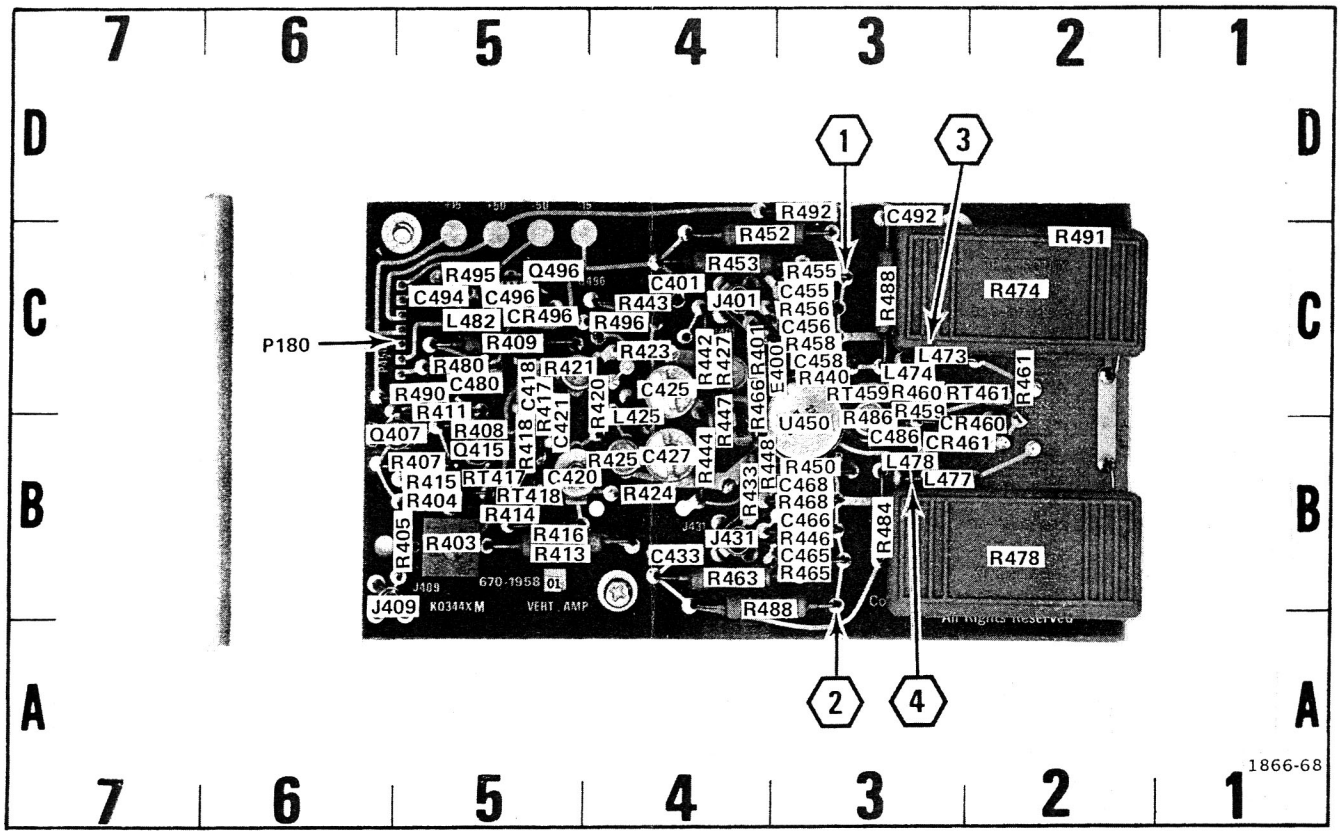
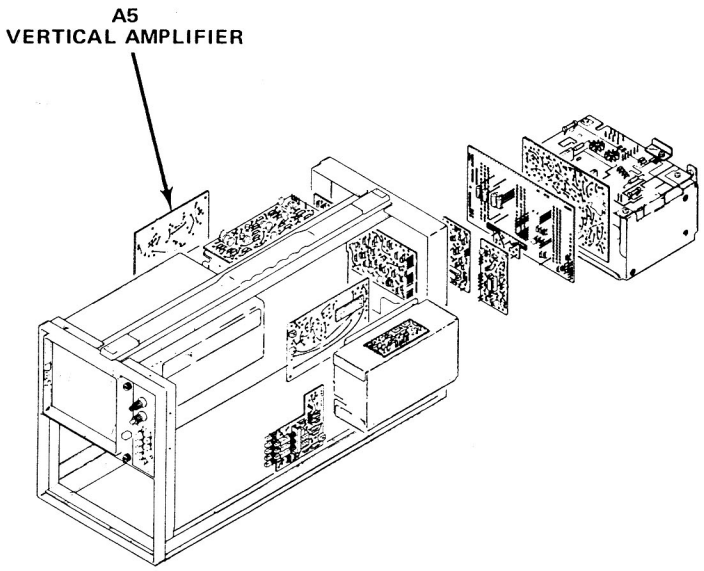


Figure 7-7. A5-Vertical Amplifier circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C401	4C	J409	6B	R416	5B	R462	4B
C418	5C	J431	4B	R417	5C	R463	4B
C420	5B			R418	5B	R465	3B
C421	5B	L425	4B	R420	4C	R466	4C
C425	4C	L473	3C	R421	5C	R468	3B
C427	4B	L474	3C	R423	4C	R474	2C
C433	4B	L477	3B	R424	4B	R478	2B
C455	3C	L478	3B	R425	4B	R480	5C
C456	3C	L482	6C	R427	4C	R484	3B
C458	3C			R429	4B*	R486	3B
C465	3B	P450	5C	R433	4B	R488	4B
C466	3B			R440	3C	R490	5C
C468	3B	Q407	5B	R442	4C	R491	2C
C480	5C	Q415	5B	R443	4C	R492	3D
C486	3B	Q496	5C	R444	4B	R465	5C
C492	3C			R446	3B	R496	4C
C494	5C	R401	4C	R447	4B		
C496	5C	R403	5B	R448	8C	RT417	5B
		R404	5B	R450	3B	RT418	5B
CR460	2B	R405	5B	R452	4C	RT459	3C
CR461	2B	R407	5B	R453	4C	RT461	2C
CR496	2B	R408	5B	R455	3C		
CR460	2B	R409	5C	R456	3C	U450	2B
CR461	2B	R411	5C	R458	3C		
CR496	5C	R413	5B	R459	3C		
		R414	5B	R460	3C		
J401	4C	R415	5B	R461	2C		

*LOCATED ON BACK OF BOARD

INDEX FOR FIGURE 7-7.


A5
VERTICAL AMPLIFIER

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

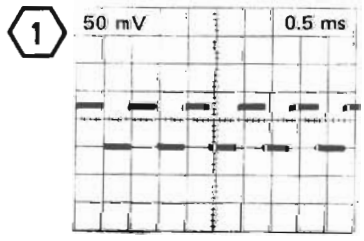
WAVEFORMS

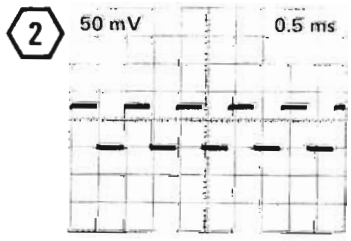
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

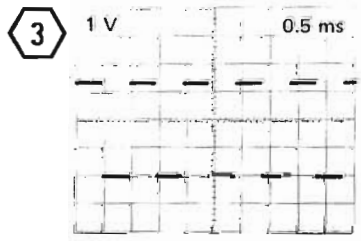
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

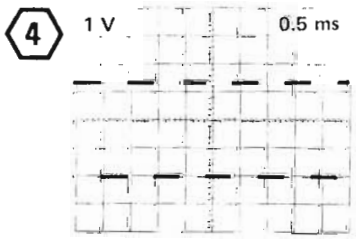
NOTE

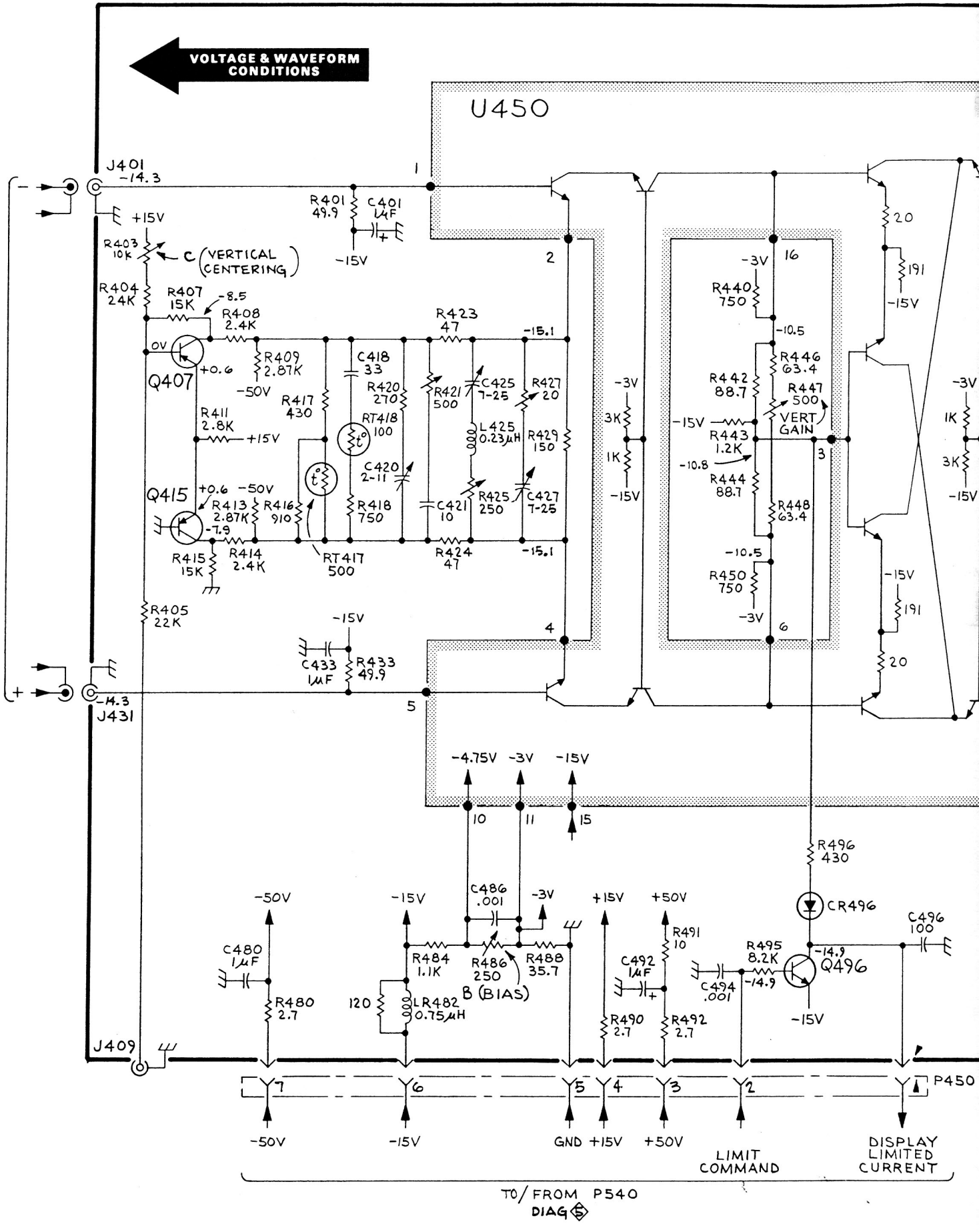
Voltages and waveforms are not absolute and may vary between instruments.



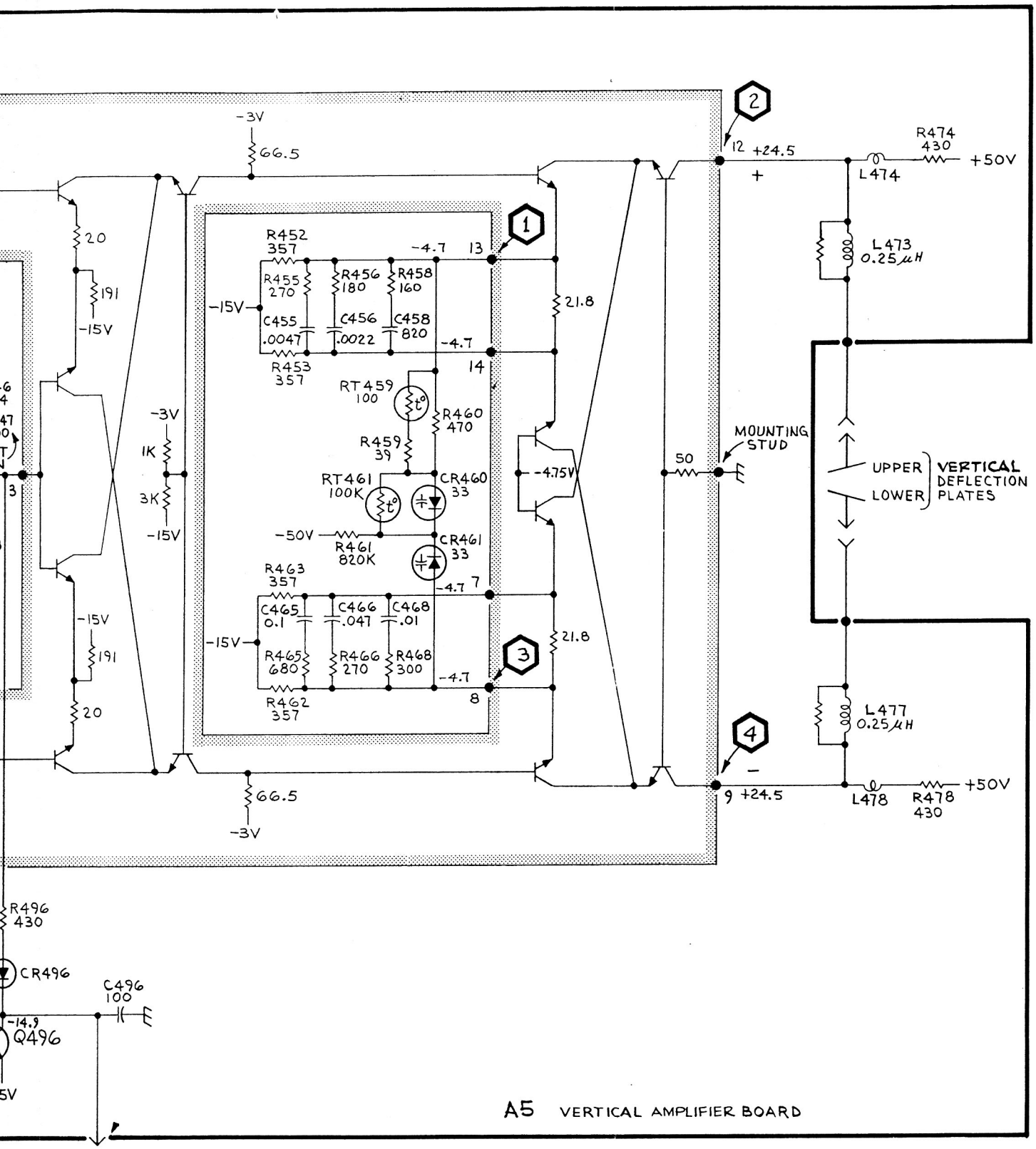







VOLTAGE & WAVEFORM CONDITIONS
U450
J401
-14.3
+15V
R403 10k
C (VERTICAL CENTERING)
R404 24K
R407 15K
-8.5
R408 2.4K
R401 49.9
C401 1μF
-15V
R423 47
-15.1
R409 2.87K
C418 33
R420 270
R421 500
C425 7-25
R427 20
R429 150
L425 0.23μH
RT418 100
C420 2-11
R417 430
R411 2.8K
+15V
Q407
0V
+0.6
-50V
Q415
+0.6
-50V
R413 2.87K
R416 910
-7.9
R414 2.4K
R415 15K
RT417 500
R418 750
C421 10
R425 250
C427 7-25
R424 47
-15.1
R405 22K
-15V
C433 1μF
R433 49.9
-14.3
J431
VERTICAL SIGNAL FROM DELAY LINE DIAG 3
-3V
3K
1K
-15V
-3V
16
R440 750
-10.5
R446 63.4
R442 88.7
R447 500 VERT GAIN
-15V
R443 1.2K
-10.8
R444 88.7
R448 63.4
-10.5
R450 750
-3V
6
3
20
191
-15V
-3V
1K
3K
-15V
-15V
191
20
-4.75V
-3V
-15V
10
11
15
R496 430
CR496
C496 100
-50V
-15V
C486 .001
-3V
+15V
+50V
C480 1μF
R484 1.1K
R486 250
B (BIAS)
R488 35.7
R491 10
C492 1μF
R495 8.2K
-14.9
Q496
C494 .001
-14.9
-15V
120
LR482 0.75μH
R480 2.7
R490 2.7
R492 2.7
J409
P450
7
6
5
4
3
2
-50V
-15V
GND
+15V
+50V
LIMIT COMMAND
DISPLAY LIMITED CURRENT
TO/FROM P540
DIAG 5

@



A5 VERTICAL AMPLIFIER BOARD

NOTE:
VERTICAL AMPLIFIER BD & U450
ARE MOUNTED TO HEATSINK

SEE PARTS LIST FOR
SEMICONDUCTOR TYPES.

VERTICAL AMPLIFIER ④

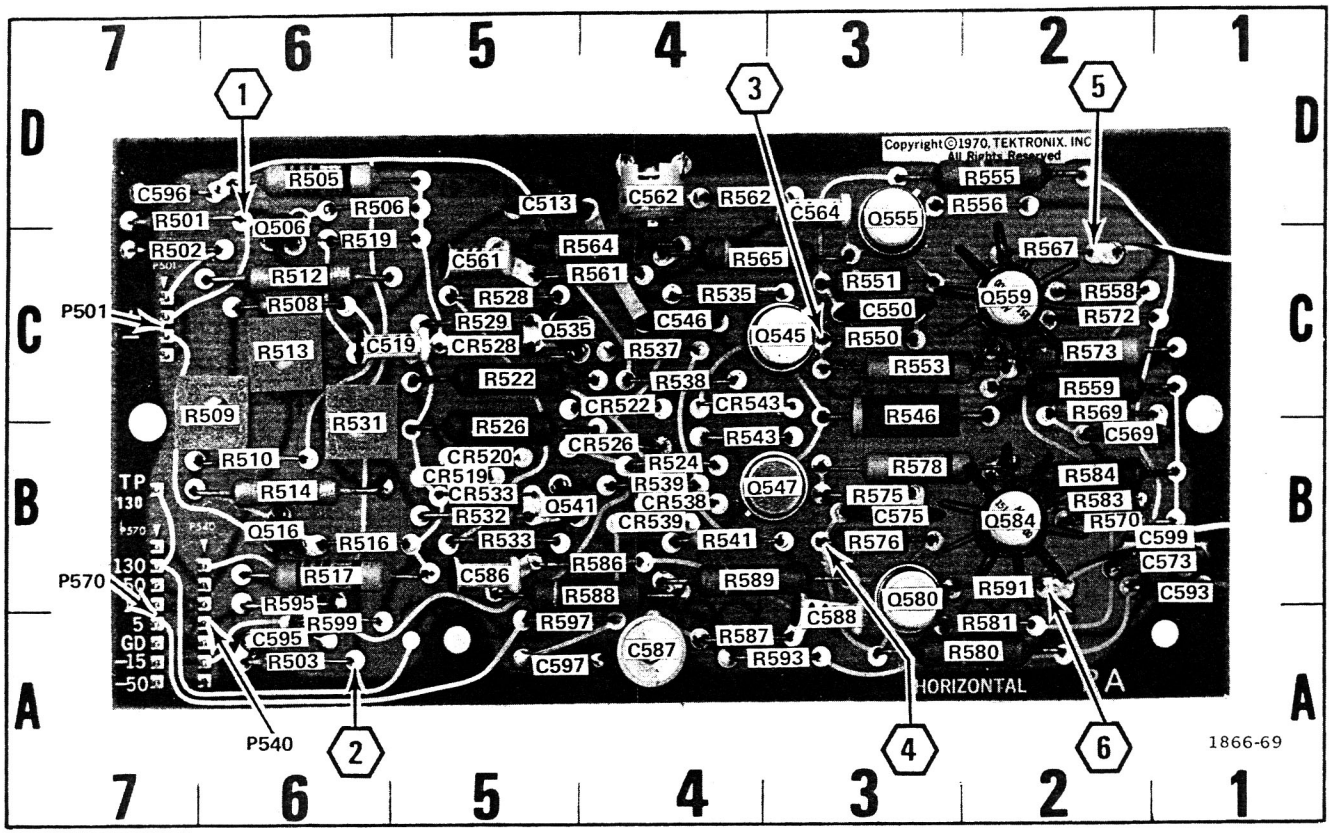
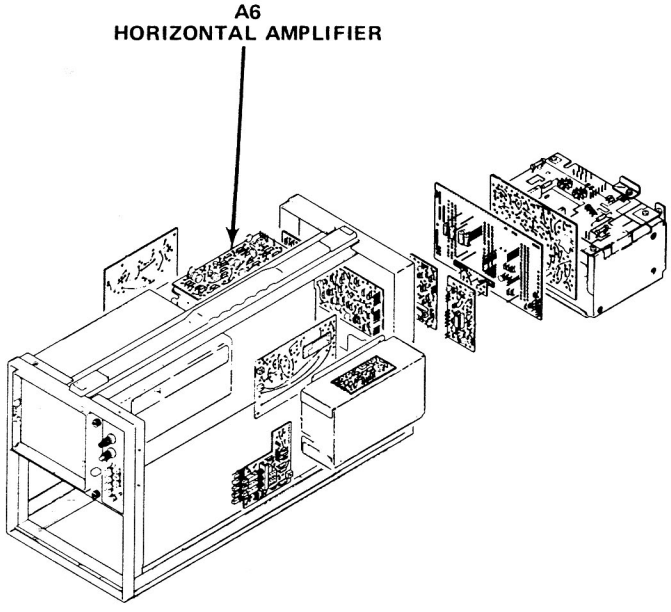


Figure 7-8. A6-Horizontal Amplifier circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C513	5D	CR543	4C	R514	6B	R562	4D
C519	5C			R516	6B	R564	4C
C546	4C	P501	7C	R517	6B	R565	4C
C550	3C	P540	A7	R519	6C	R567	2C
C561	5C	P570	A7	R522	5C	R569	2C
C562	4D			R524	4B	R570	2B
C564	3D	Q506	6C	R526	5B	R572	2C
C569	2B	Q516	6B	R528	5C	R573	2C
C573	1B	Q535	5C	R529	5C	R575	3B
C575	3B	Q541	5B	R531	6B	R576	3B
C586	5B	Q545	3C	R532	5B	R578	3B
C587	4A	Q547	3B	R533	5B	R580	2A
C588	3A	Q555	3D	R535	4C	R581	2A
C593	1B	Q559	2C	R537	4C	R583	2B
C595	6A	Q580	3B	R538	4C	R584	2B
C596	7D	Q584	2B	R539	4B	R586	4B
C597	5A			R541	4B	R587	4A
C599	1B	R501	7D	R543	4B	R588	4B
		R502	7C	R546	4C	R589	4B
CR519	5B	R503	6A	R550	3C	R591	2B
CR520	5B	R505	6D	R551	3C	R593	3A
CR522	4C	R506	6D	R553	3C	R595	6B
CR526	4B	R508	6C	R555	2D	R597	5A
CR528	5C	R509	6C	R556	2D	R599	6A
CR533	5B	R510	6B	R558	2C		
CR538	4B	R512	6C	R559	2C		
CR539	4B	R513	6C	R561	4C		

INDEX FOR FIGURE 7-8.


A6
HORIZONTAL AMPLIFIER

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

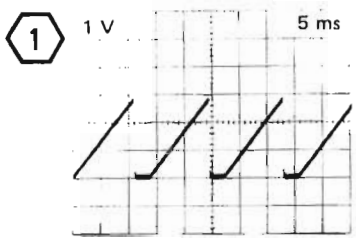
WAVEFORMS

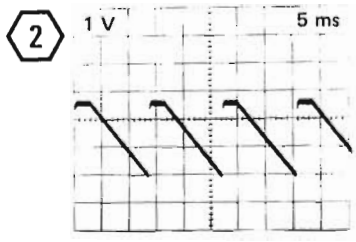
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

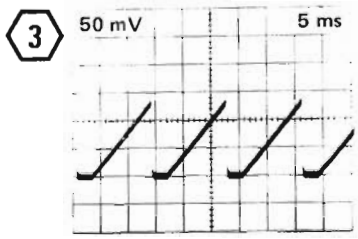
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

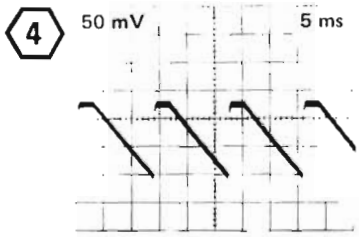
NOTE

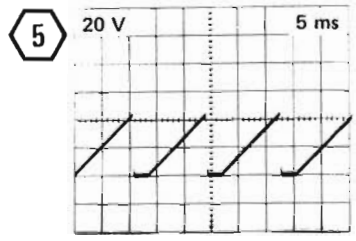
Voltages and waveforms are not absolute and may vary between instruments.

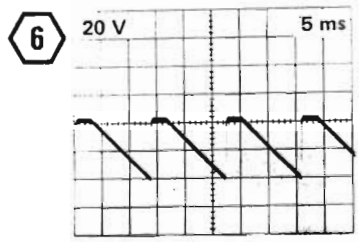


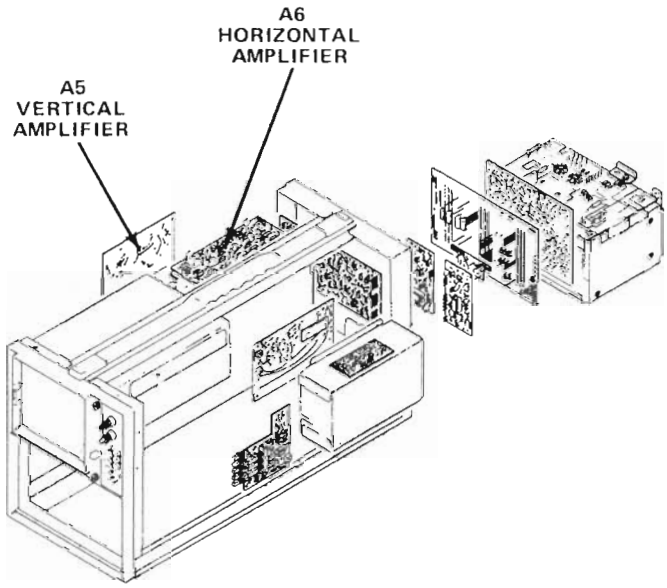


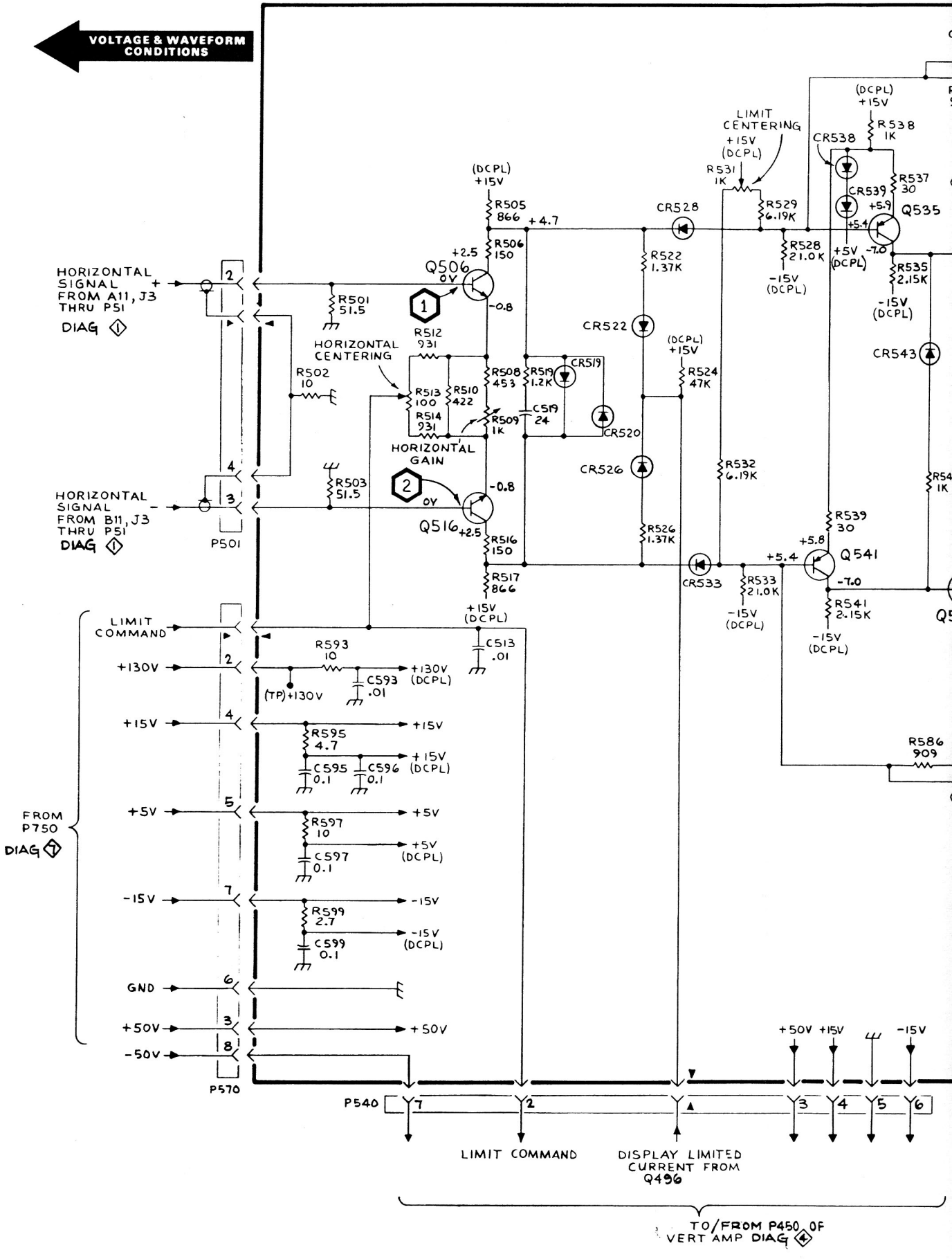






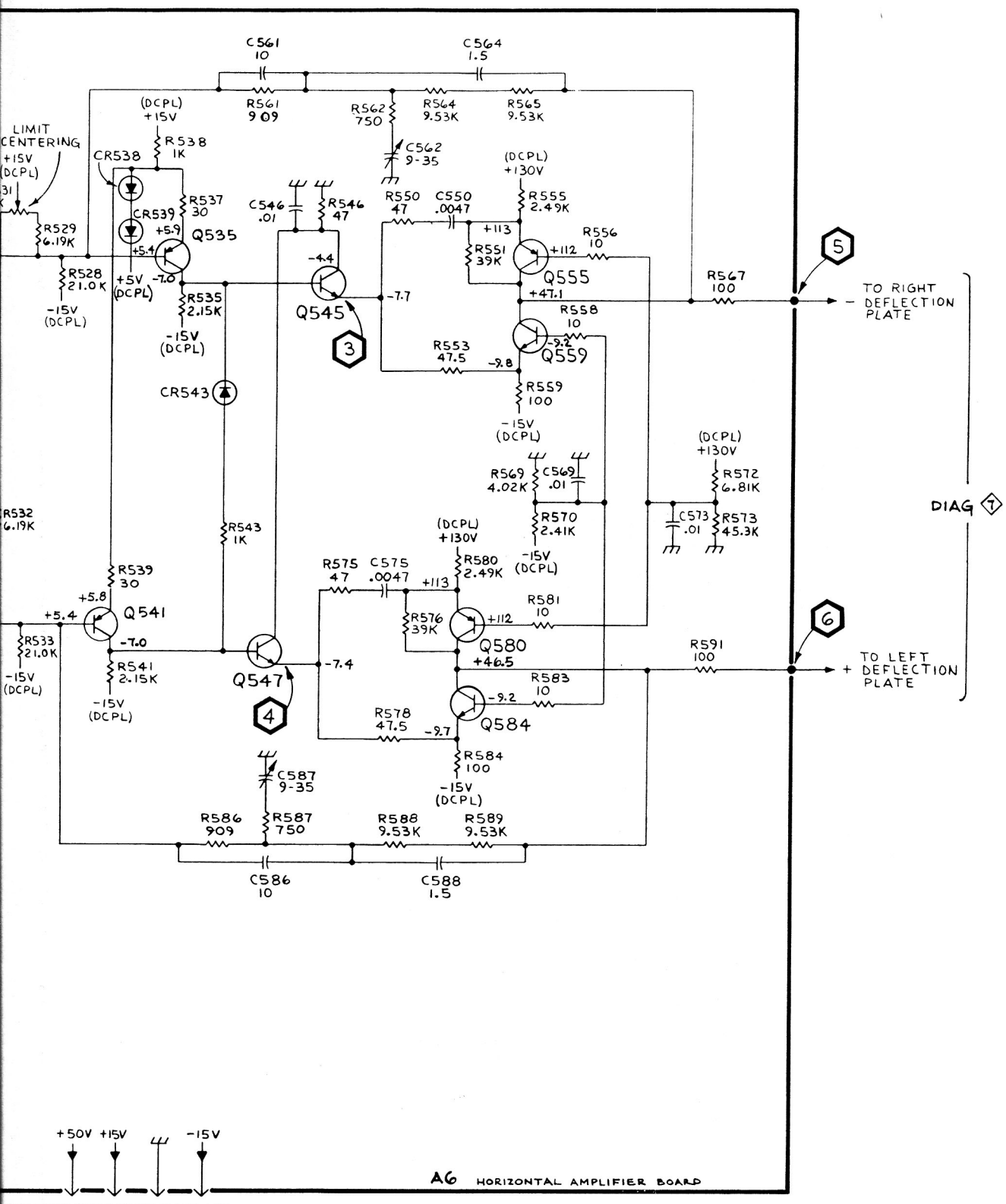



A6
HORIZONTAL
AMPLIFIER
A5
VERTICAL
AMPLIFIER


VOLTAGE & WAVEFORM CONDITIONS
HORIZONTAL SIGNAL + FROM A11, J3 THRU P51
DIAG 1
HORIZONTAL SIGNAL - FROM B11, J3 THRU P51
DIAG 1
P501
LIMIT COMMAND
+130V
+15V
+5V
-15V
GND
+50V
-50V
FROM P750
DIAG 7
P570
HORIZONTAL CENTERING
HORIZONTAL GAIN
LIMIT CENTERING
(DCPL) +15V
+5V (DCPL)
-15V (DCPL)
(TP)+130V
Q506
Q516
Q535
Q541
CR519
CR520
CR522
CR526
CR528
CR533
CR538
CR539
CR543
P540
LIMIT COMMAND
DISPLAY LIMITED CURRENT FROM Q496
TO/FROM P450 OF VERT AMP DIAG 4

OS-245(P)/U

@



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

HORIZONTAL AMPLIFIER 5

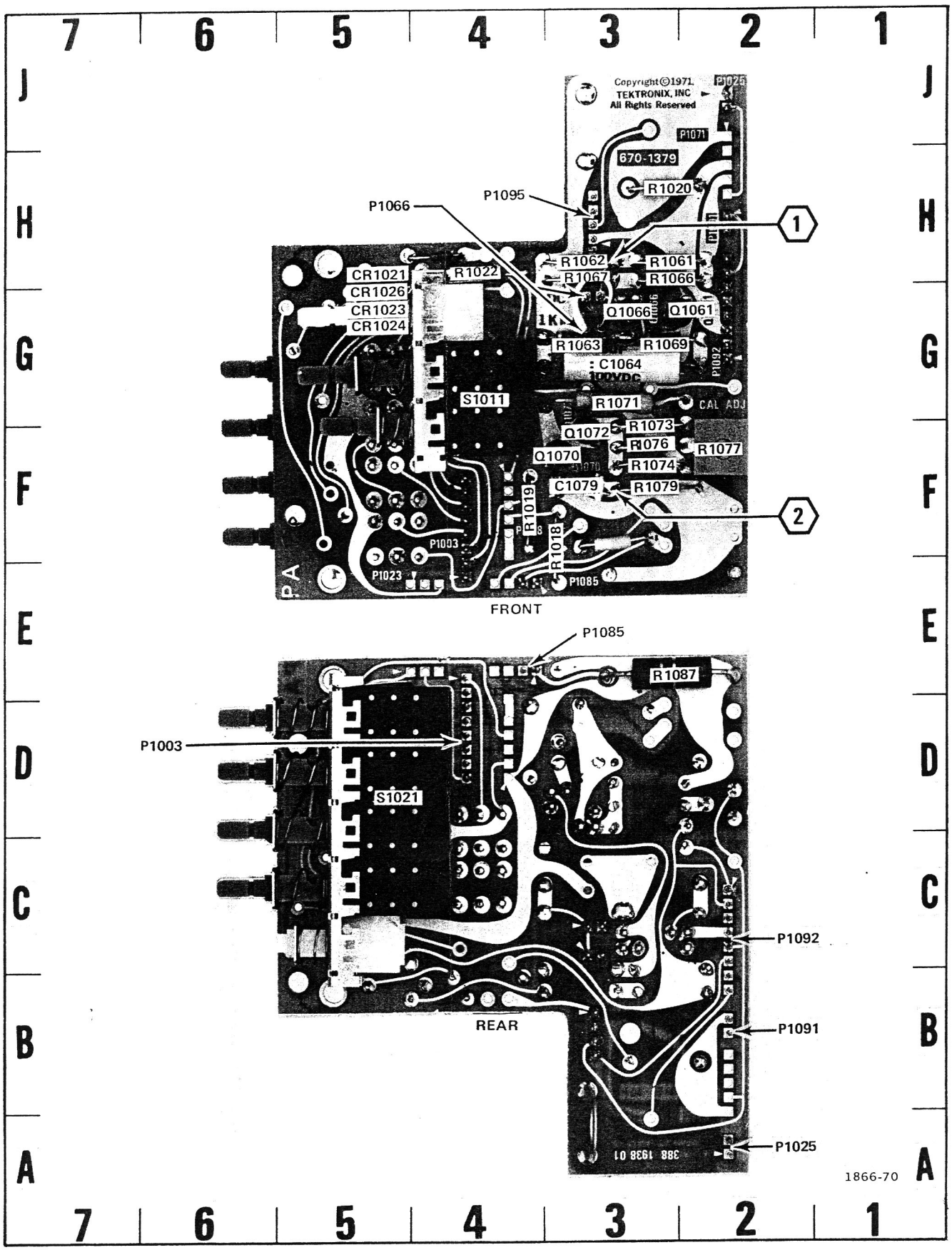
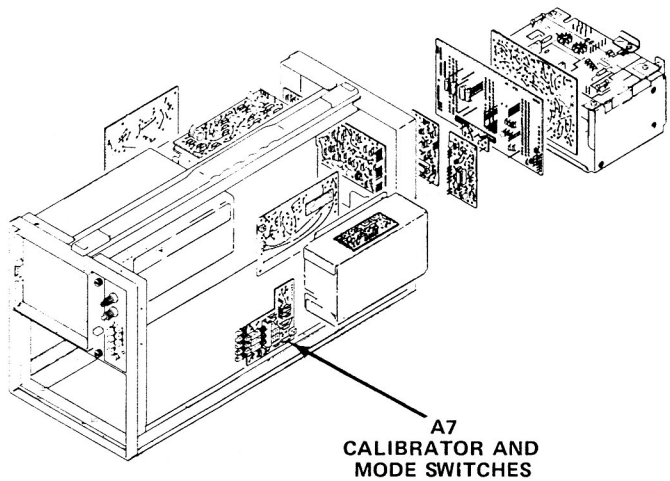


Figure 7-9. A7-Calibrator and Mode Switches circuit board assembly.



CKT NO	GRID COORD	CKT NO	GRID COORD
C1064	3G	R1020	3H
C1079	3F	R1022	4H
		R1061	3H
CR1021	5H	R1062	3H
CR1023	5G	R1063	3G
CR1024	5G	R1066	3H
CR1026	5G	R1067	3H
		R1069	3G
P1003	4D	R1071	3G
P1025	2A	R1073	3F
P1066	3G	R1074	3F
P1091	2B	R1076	3F
P1092	2C	R1077	2F
P1095	3H	R1079	3F
		R1087	2E
Q1061	2G		
Q1066	7G	S1011	4G
Q1070	4F	S1021	5D
Q1072	4F		
R1018	3F		
R1019	4F		

INDEX FOR FIGURE 7-9.

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

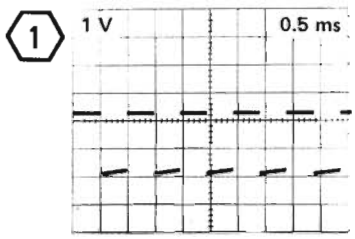
WAVEFORMS

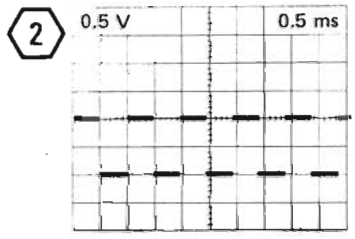
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

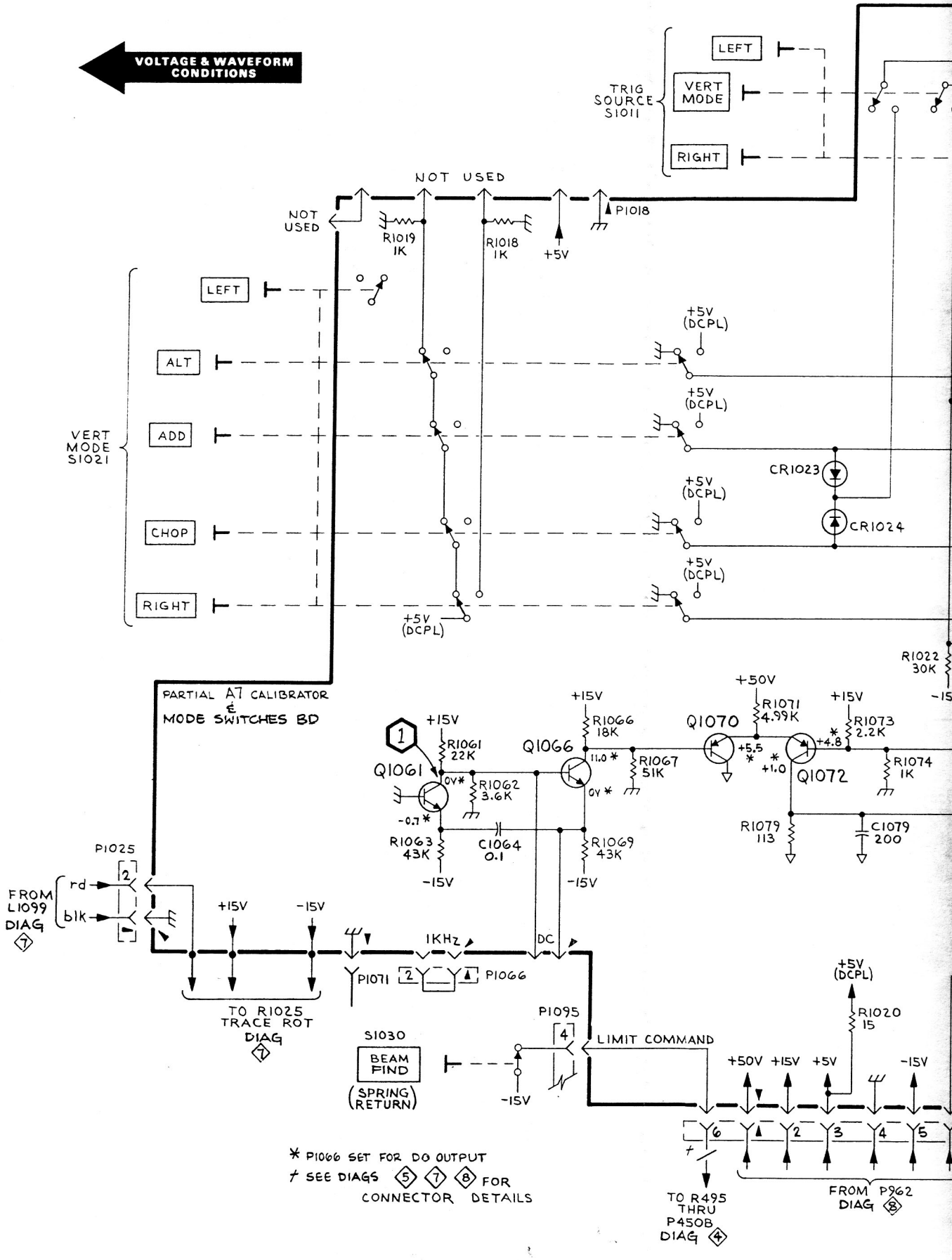
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

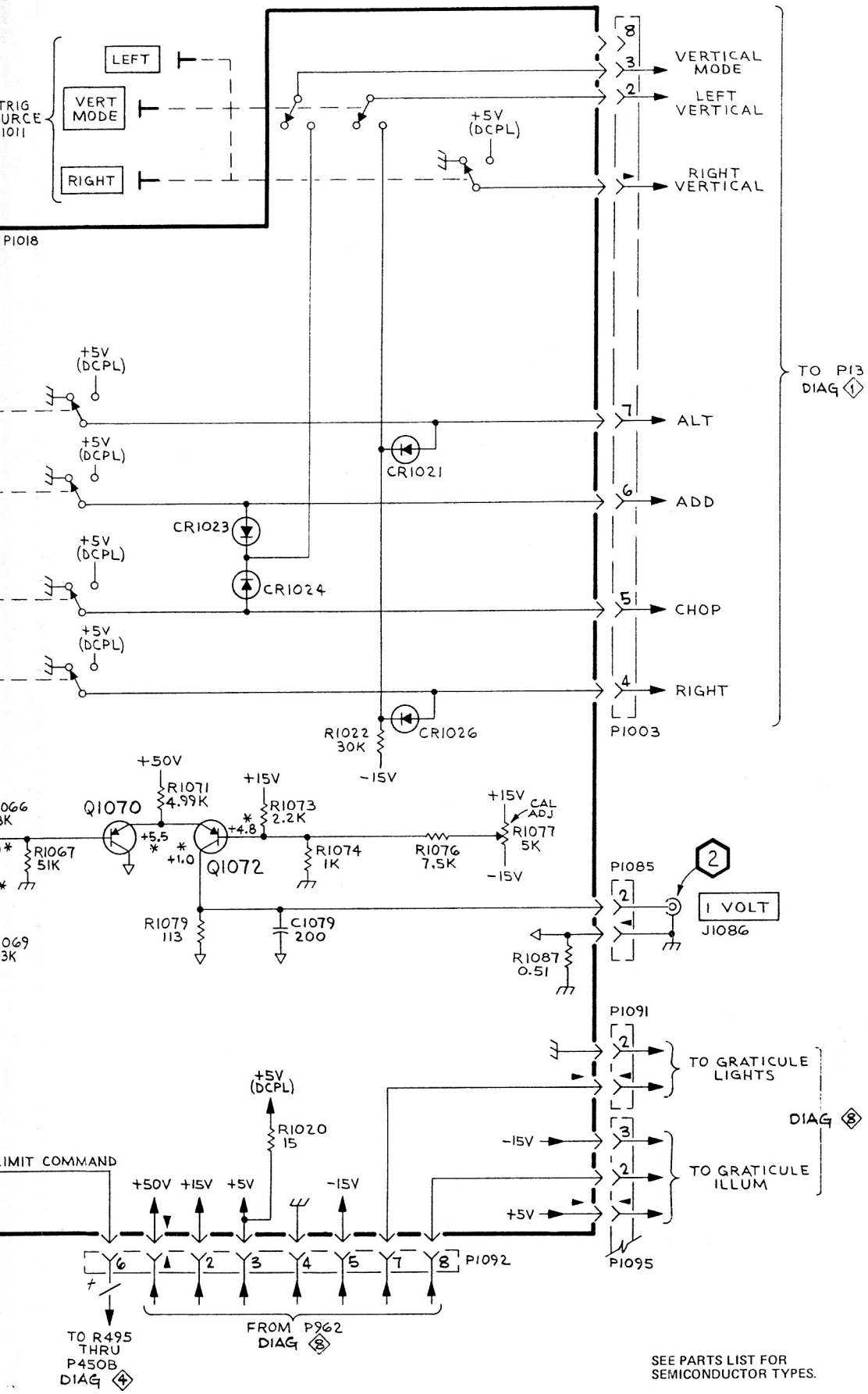
NOTE

Voltages and waveforms are not absolute and may vary between instruments.






VOLTAGE & WAVEFORM CONDITIONS
TRIG SOURCE S1011
LEFT
VERT MODE
RIGHT
NOT USED
NOT USED
R1019 1K
R1018 1K
+5V
P1018
VERT MODE S1021
LEFT
ALT
ADD
CHOP
RIGHT
+5V (DCPL)
CR1023
CR1024
PARTIAL A7 CALIBRATOR & MODE SWITCHES BD
R1022 30K
+50V
+15V
R1071 4.99K
R1073 2.2K
Q1070
Q1072
R1074 1K
R1066 18K
Q1066
R1067 51K
R1061 22K
Q1061
R1062 3.6K
R1063 43K
C1064 0.1
R1069 43K
R1079 113
C1079 200
-15V
P1025
FROM L1099 DIAG 7
rd
blk
1KHz
DC
P1071
P1066
TO R1025 TRACE ROT DIAG 7
P1095
S1030
BEAM FIND
(SPRING RETURN)
LIMIT COMMAND
R1020 15
FROM P962 DIAG 8
TO R495 THRU P450B DIAG 4
* P1066 SET FOR DO OUTPUT
† SEE DIAGS 5 7 8 FOR CONNECTOR DETAILS



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

CALIBRATOR & FRONT PANEL SWITCHING 6

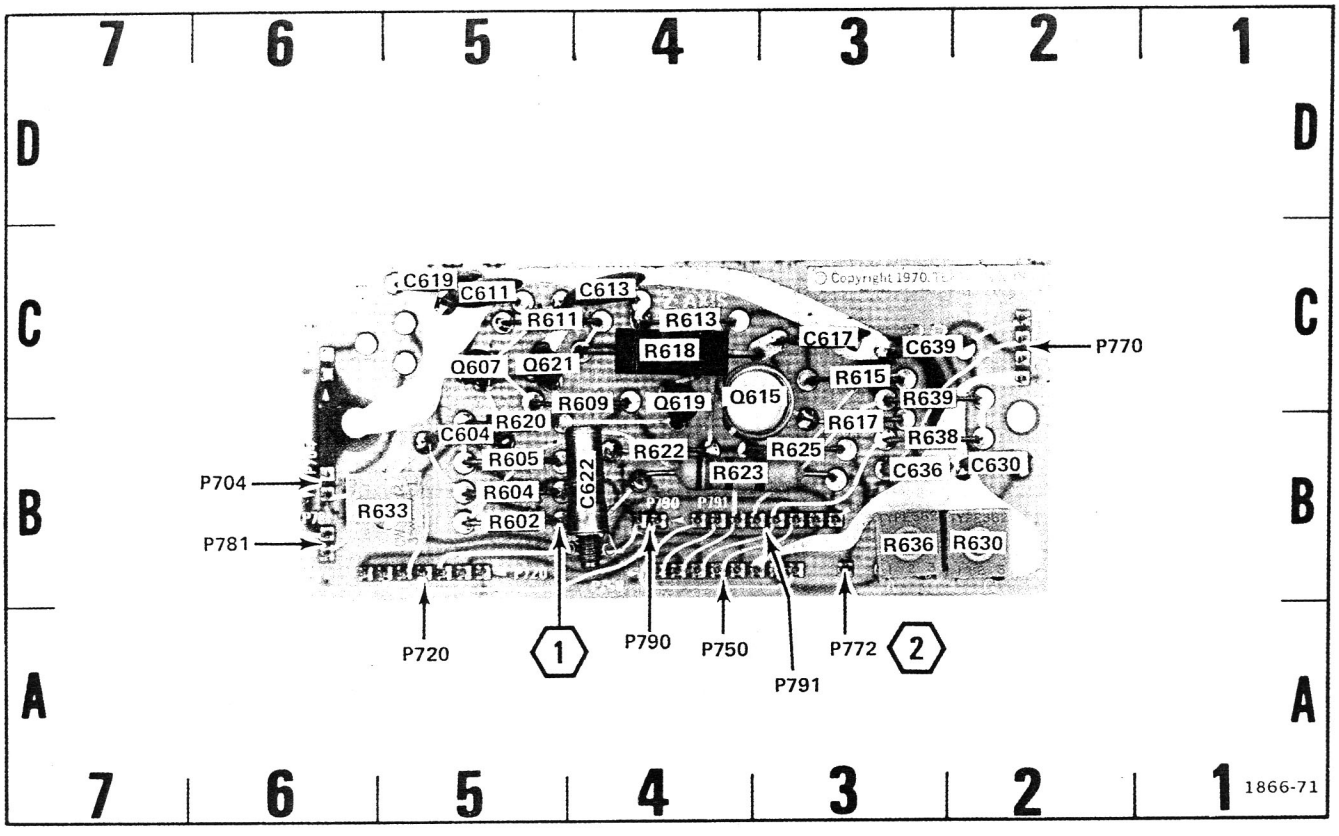


Figure 7-10. A8-Z-Axis Amplifier circuit board assembly.

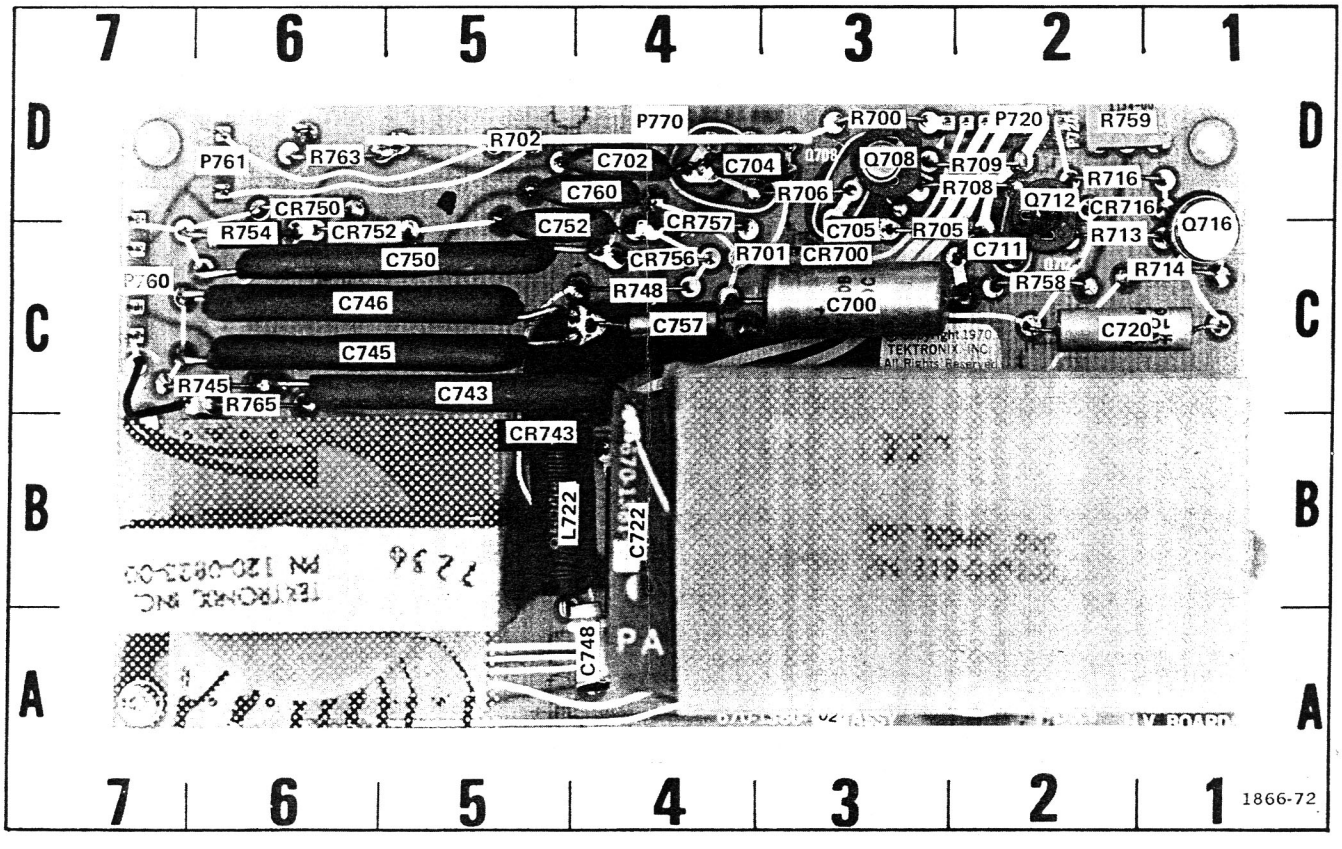
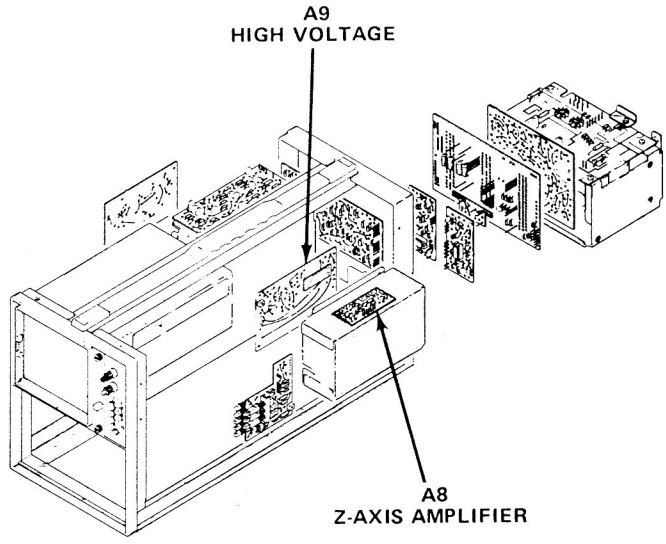


Figure 7-11. A9-High Voltage circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD
C604	5B	Q619	4C
C611	5C	Q621	5C
C613	4C		
C617	3C	R602	5B
C619	5C	R604	5B
C622	4B	R605	5B
C630	2B	R609	4C
C636	3B	R611	5C
C639	3C	R613	4C
		R615	3C
P704	6B	R617	3B
P720	5B	R618	4C
P750	4B	R620	5B
P770	2C	R622	4B
P772	3B	R623	4B
P781	6B	R625	3B
P790	4B	R630	2B
P791	3B	R633	5B
		R636	3B
Q607	5C	R638	3B
Q615	3C	R639	3C

INDEX FOR FIGURE 7-10.



CKT NO	GRID COORD	CKT NO	GRID COORD
C700	3C	P761	7D
C702	4D	P770	4D
C704	4D		
C705	3C	Q708	3D
C711	2C	C712	2D
C720	2C	Q716	1C
C722	4B	Q764	4A*
C743	5C	Q766	3A*
C745	6C		
C746	6C	R700	3D
C748	4A	R701	3C
C750	5C	R702	5D
C752	5C	R705	3C
C757	4C	R706	3D
C760	4D	R708	2D
		R709	2D
CR700	3C	R713	2C
CR716	2D	R714	1C
CR743	5B	R716	2D
CR750	6D	R745	6C
CR752	6C	R748	4C
CR756	4C	R754	6C
CR757	4C	R758	2C
		R759	2D
L722	5B	R763	6D
		R765	6C
P720	2D		
P760	7C		
P761	7D		

*LOCATED ON BACK OF BOARD

INDEX FOR FIGURE 7-11.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6006 or P6054 10X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

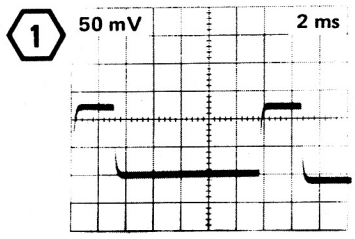
WAVEFORMS

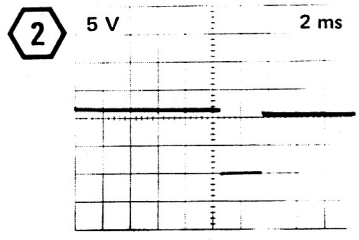
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 1 ms/division sweep rate.

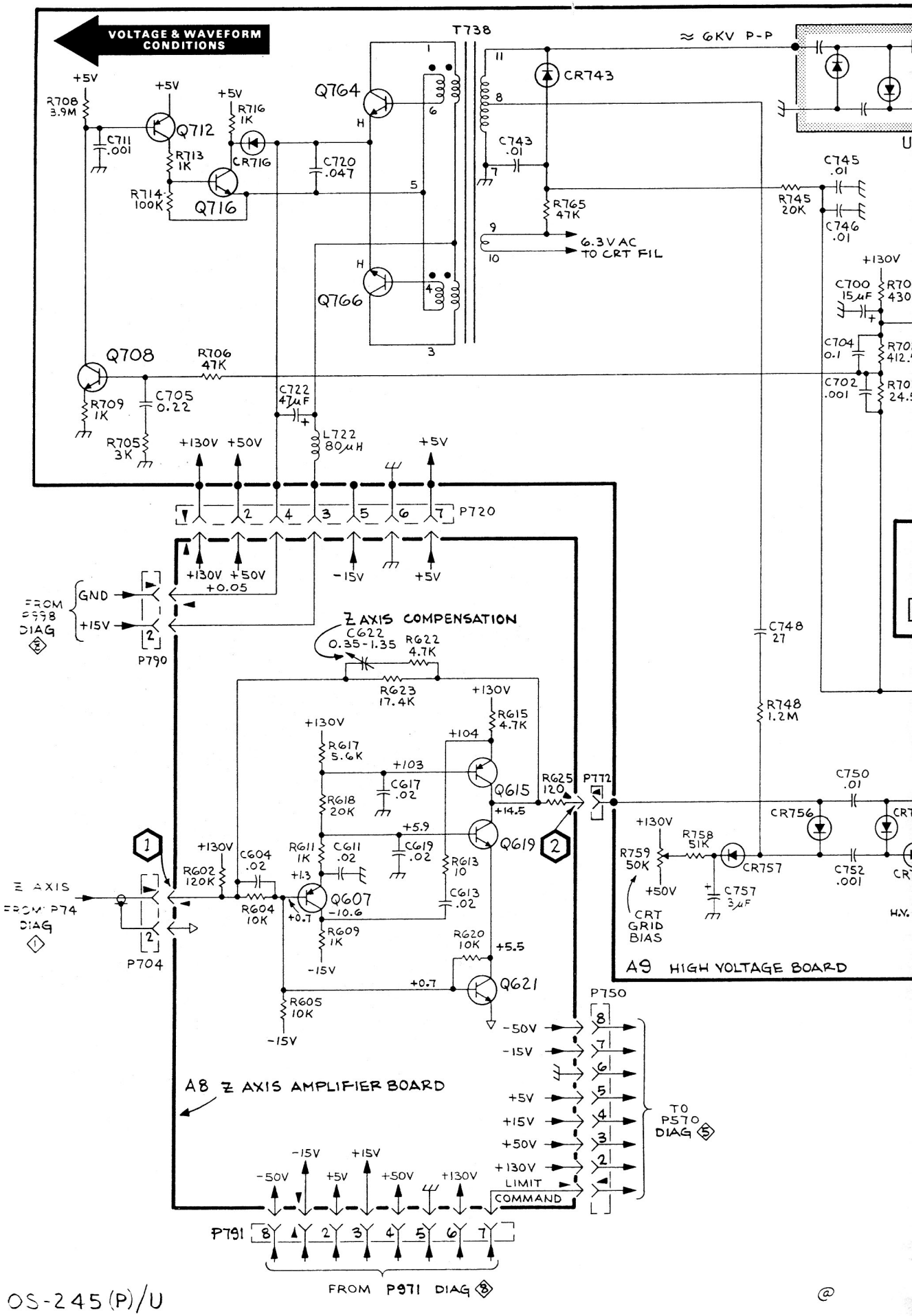
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input.

NOTE

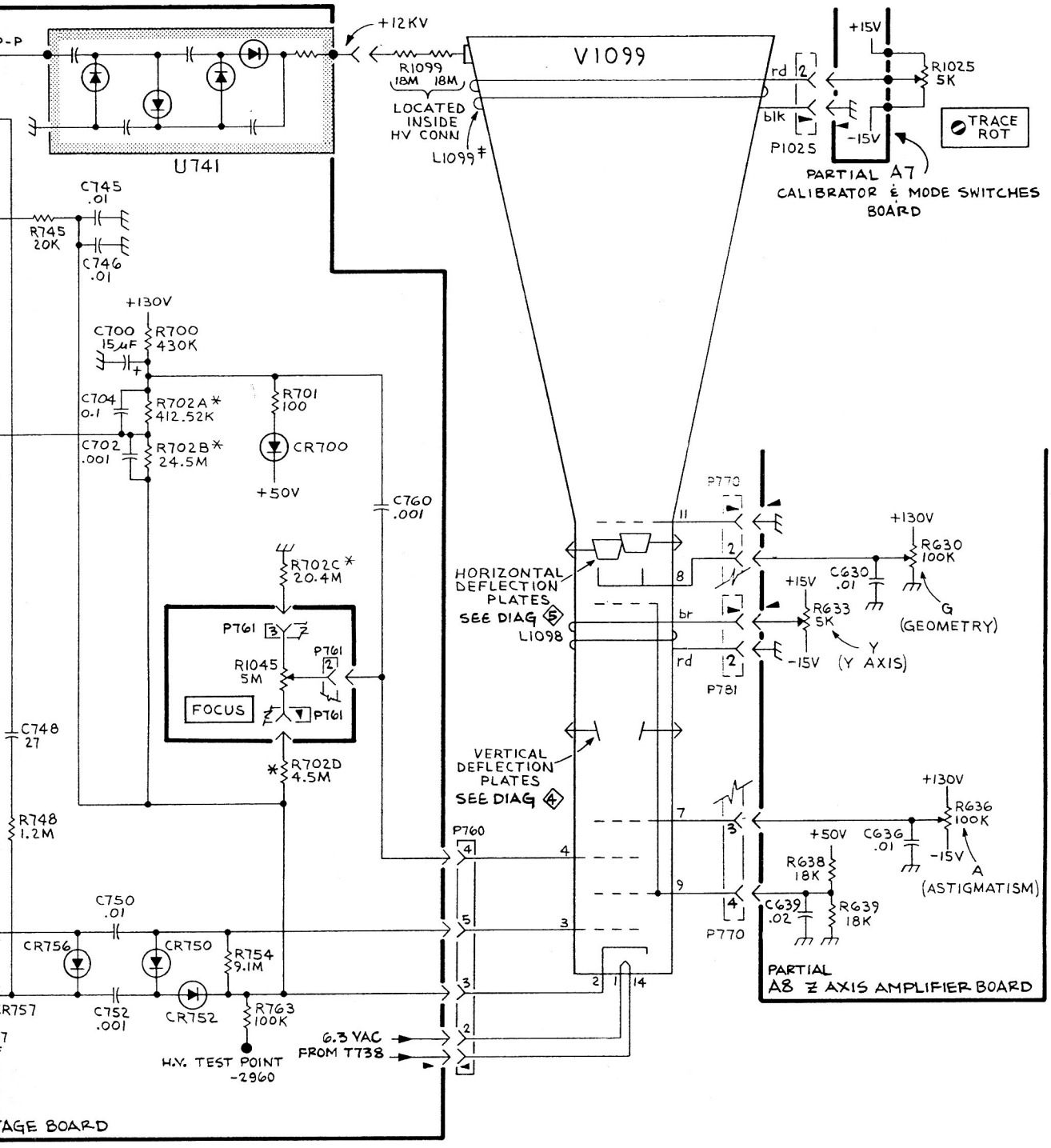
Voltages and waveforms are not absolute and may vary between instruments.






VOLTAGE & WAVEFORM CONDITIONS
T738
≈ 6KV P-P
CR743
Q764
Q766
Q712
Q716
Q708
R708 3.9M
C711 .001
R713 1K
CR716
R714 100K
C720 .047
C743 .01
R765 47K
6.3V AC TO CRT FIL
C745 .01
R745 20K
C746 .01
+130V
C700 15μF
C704 0.1
C702 .001
R706 47K
R709 1K
C705 0.22
R705 3K
C722 47μF
L722 80μH
+130V +50V
+5V
P720
-15V
FROM 8598 DIAG 2
GND
+15V
P790
Z AXIS COMPENSATION
C622 0.35-1.35
RG622 4.7K
RG623 17.4K
C748 27
R748 1.2M
RG615 4.7K
RG617 5.6K
RG618 20K
C617 .02
Q615
RG625 120
P772
Q619
C750 .01
CR756
R758 51K
R759 50K
CR757
C752 .001
C757 3μF
CRT GRID BIAS
Z AXIS FROM P74 DIAG 1
P704
RG602 120K
C604 .02
RG604 10K
RG611 1K
C611 .02
C619 .02
RG613 10
C613 .02
Q607
RG609 1K
RG620 10K
Q621
RG605 10K
A9 HIGH VOLTAGE BOARD
A8 Z AXIS AMPLIFIER BOARD
P750
-50V
-15V
+5V
+15V
+50V
+130V
LIMIT COMMAND
TO P570 DIAG 5
P791
FROM P971 DIAG 8

OS-245(P)/U



* THICK FILM RESISTOR

≠ REPLACEABLE AS A UNIT WITH DL400

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

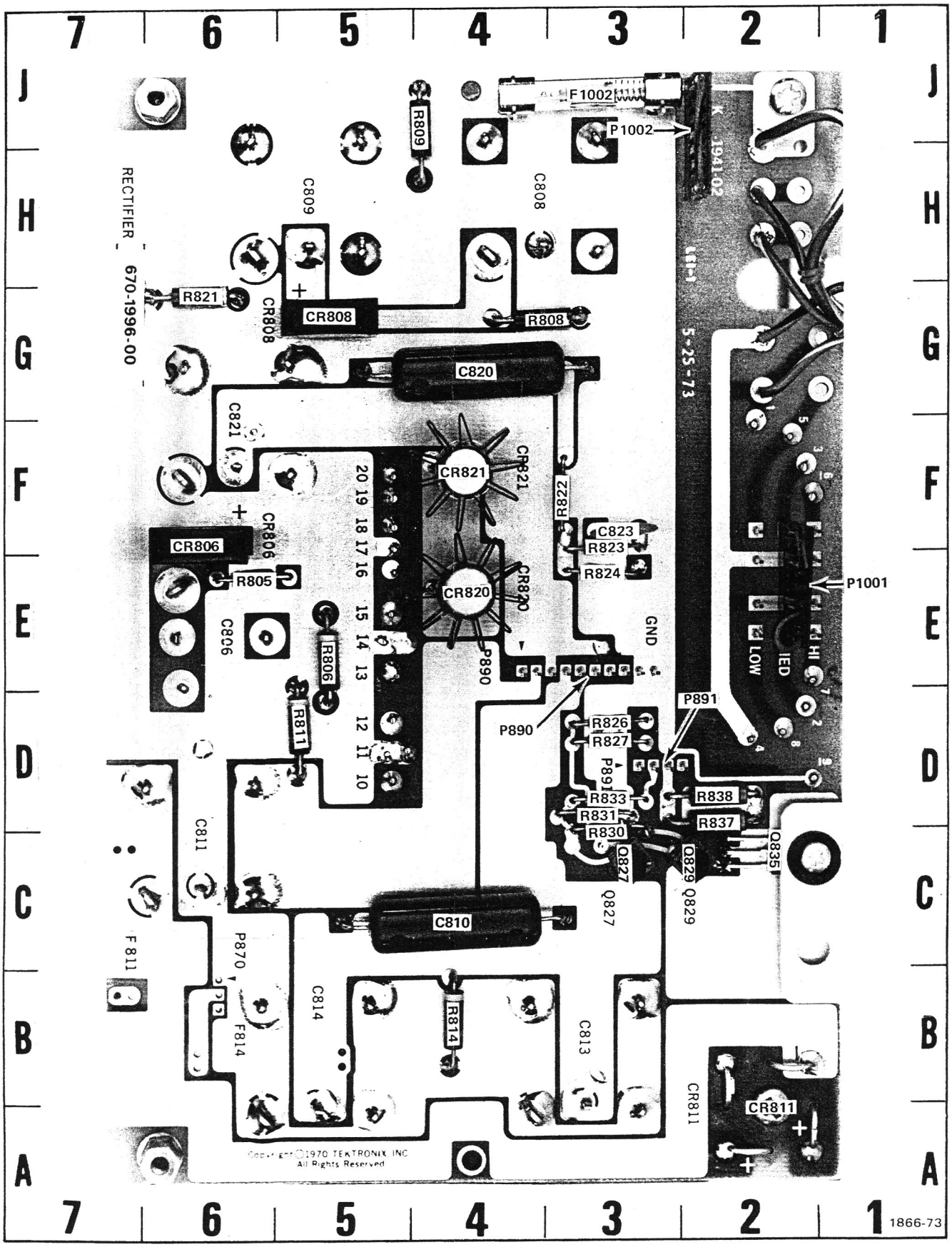


Figure 7-12. A10-Rectifier circuit board assembly.

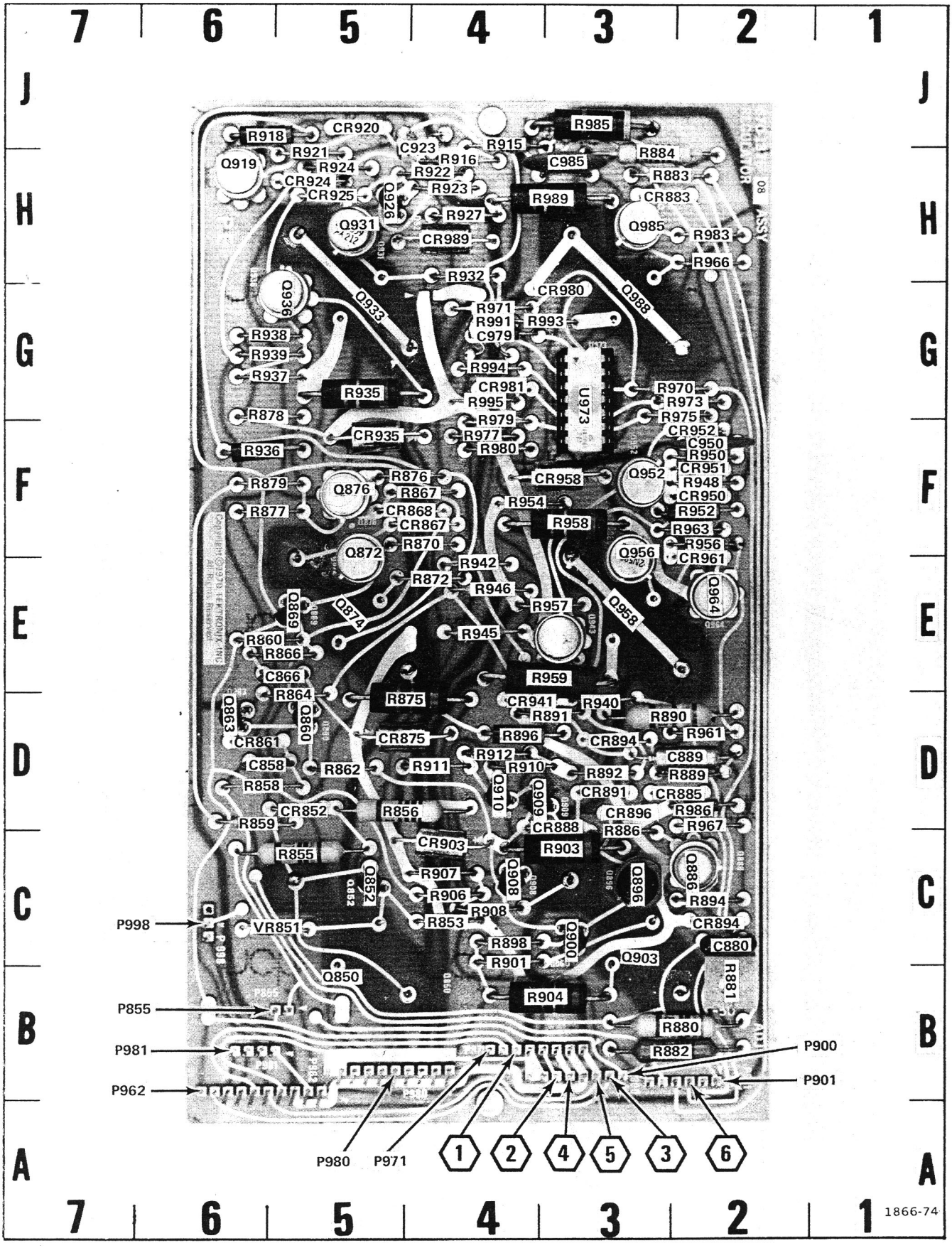


Figure 7-13. A11-Regulator circuit board assembly.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Oscilloscope system	Deflection factor, 5 mV to 2 V/div; input impedance, 1 megohm; frequency response, dc to 25 MHz. Probe: 1X attenuation probe compatible with vertical input.	Tektronix OS-245(P)/U, AM-6565/U, TD-1085/U Oscilloscope System. Use a Tektronix P6011 1X Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE MEASUREMENTS

Voltage measurements on this diagram were made under the following conditions:

No plug-in units are installed.
Set INTENSITY and GRAT ILLUM to mid-range.
Set the VERT MODE switch to ADD; set TRIG SOURCE switch to VERT MODE.
Voltmeter common is connected to chassis ground.

WAVEFORMS

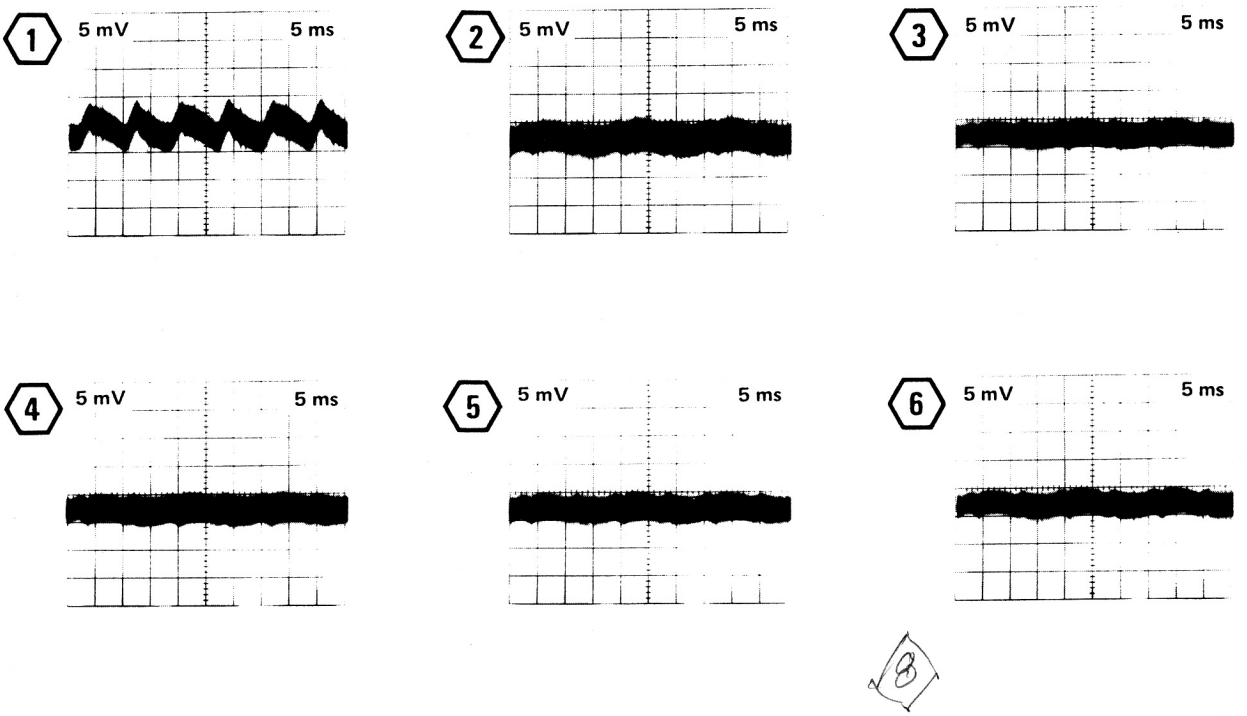
Waveforms shown on this diagram were obtained under the following conditions:

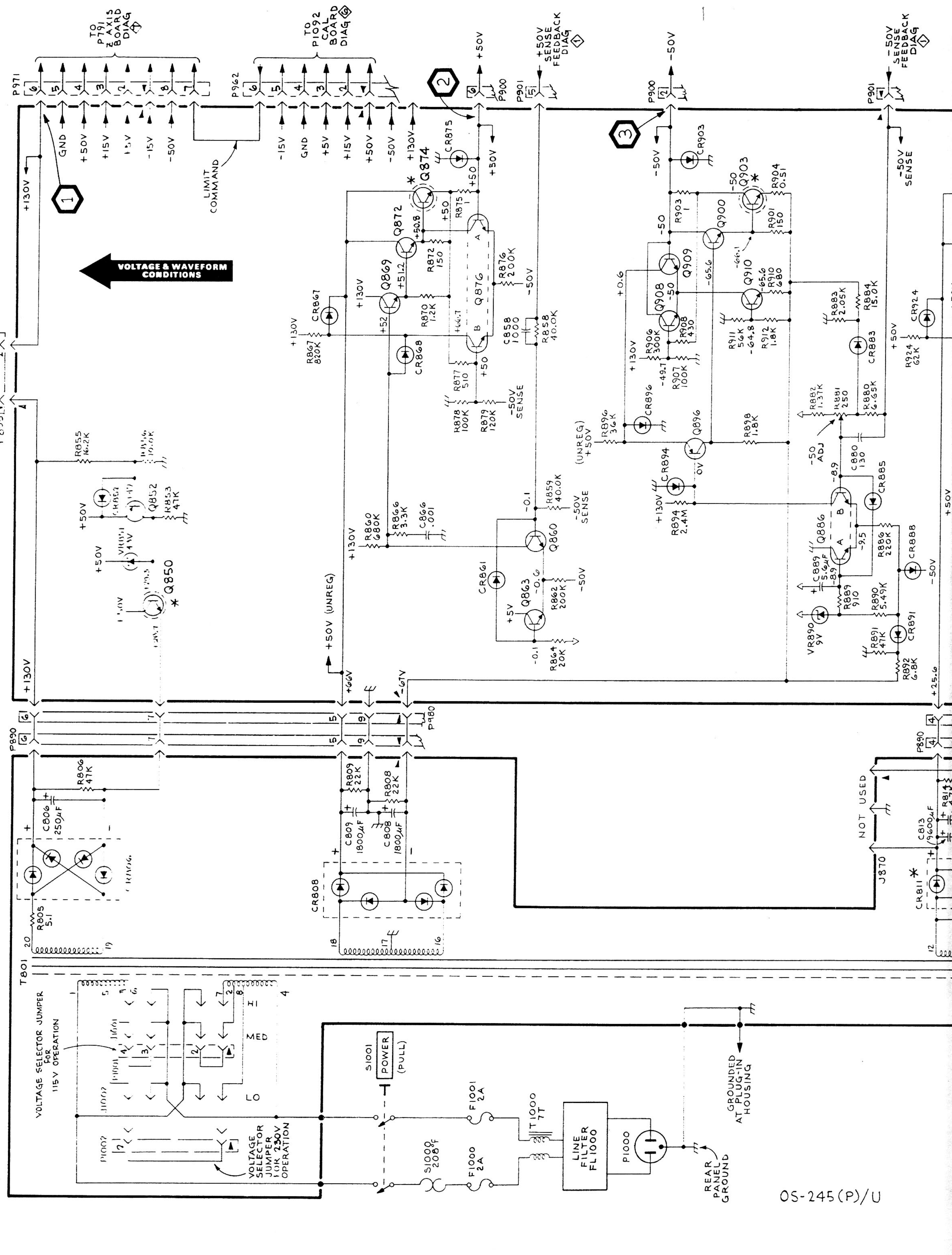
OSCILLOSCOPE UNDER TEST. Front-panel controls are set the same as for voltage measurements. No plug-in units are installed.

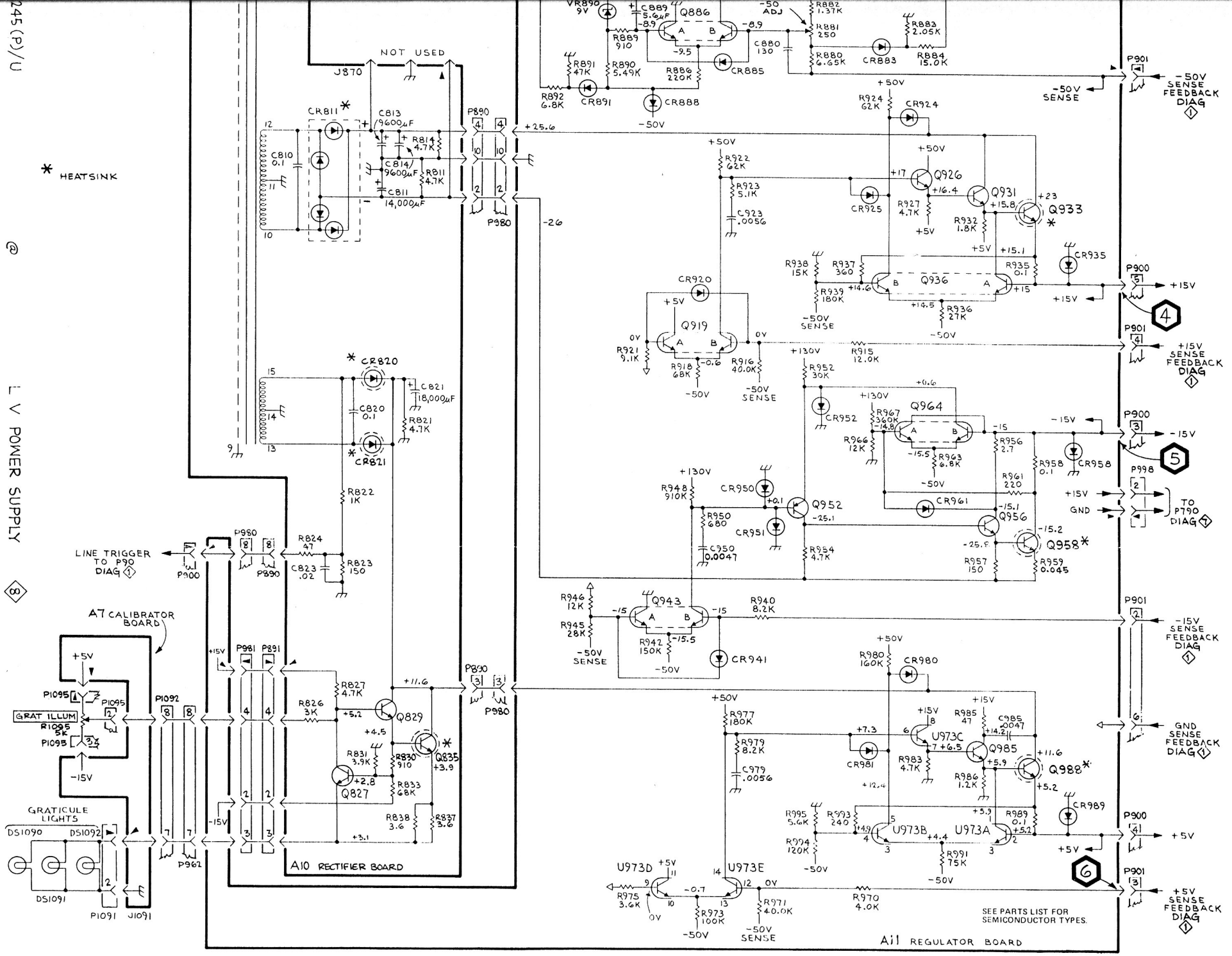
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 1X Probe to the vertical input.

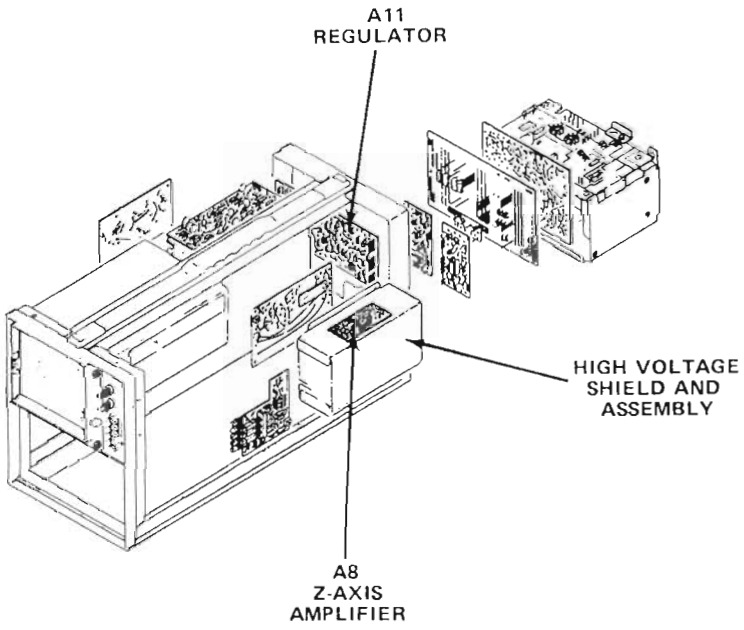
NOTE

Voltages and waveforms are not absolute and may vary between instruments.




VOLTAGE & WAVEFORM CONDITIONS
TO P791 Z AXIS BOARD DIAG
TO P1092 CAL BOARD DIAG
+50V SENSE FEEDBACK DIAG
-50V SENSE FEEDBACK DIAG
LIMIT COMMAND
+50V (UNREG)
NOT USED
VOLTAGE SELECTOR JUMPER FOR 115V OPERATION
VOLTAGE SELECTOR JUMPER FOR 230V OPERATION
POWER (PULL)
LINE FILTER FL1000
GROUNDED AT PLUG-IN HOUSING
REAR PANEL GROUND
OS-245(P)/U


* HEATSINK
NOT USED
J870
CR811 *
C813 9600μF
C814 9600μF
C811 14,000μF
C810 0.1
R814 4.7K
R811 4.7K
P890
P980
+25.6
-26
CR820 *
C821 18,000μF
C820 0.1
R821 4.7K
CR821 *
R822 1K
R824 47
C823 .02
R823 150
LINE TRIGGER TO P90 DIAG ①
P900
P980
P890
A7 CALIBRATOR BOARD
+5V
-15V
+15V
P981
P891
P1095
GRAT ILLUM
R1095 5K
P1092
GRATICULE LIGHTS
DS1090
DS1092
DS1091
P1091
J1091
P962
R827 4.7K
R826 3K
Q829
+11.6
+5.2
+4.5
R831 3.9K
R830 910
Q835 *
+3.9
Q827
+2.8
R833 68K
R838 3.6
R837 3.6
+3.1
A10 RECTIFIER BOARD
VR890 9V
C889 5.6μF
Q886
-8.9
-9.5
R889 910
R890 5.49K
R886 220K
CR885
R891 47K
R892 6.8K
CR891
CR888
-50V
-50 ADJ
R882 1.37K
R881 250
C880 130
R880 6.65K
CR883
R883 2.05K
R884 15.0K
P901
-50V SENSE FEEDBACK DIAG ①
-50V SENSE
+50V
R924 62K
CR924
R922 62K
R923 5.1K
C923 .0056
Q926
+17
+16.4
Q931
+15.8
+23
Q933 *
CR925
R927 4.7K
R932 1.8K
+5V
+15.1
CR935
R938 15K
R937 360
R939 180K
Q936
+14.6
+14.5
R936 27K
R935 0.1
+15
+15V
P900
CR920
Q919
0V
R921 9.1K
R918 68K
-0.6
R916 40.0K
-50V SENSE
R915 12.0K
+130V
R952 30K
CR952
+0.6
Q964
R967 360K
-14.8
R966 12K
-15.5
R963 6.8K
R956 2.7
R958 0.1
CR958
-15V
P998
TO P790 DIAG ①
GND
R961 220
CR961
-15.1
Q956
-15.2
Q958 *
-25.8
R957 150
R959 0.045
CR950
R948 910K
+0.1
Q952
-25.1
R950 680
CR951
C950 0.0047
R954 4.7K
R946 12K
R945 28K
Q943
R940 8.2K
R942 150K
CR941
R980 160K
CR980
R977 180K
R979 8.2K
C979 .0056
+7.3
CR981
U973C
+6.5
R985 47
C985 .0047
+14.2
Q985
+11.6
Q988 *
+5.9
+5.2
+12.4
R983 4.7K
R986 1.2K
R995 5.6K
R993 240
R994 120K
U973B
U973A
+4.4
+5.3
R989 0.1
CR989
R991 75K
U973D
U973E
R975 3.6K
R973 100K
R971 4.0K
R970 4.0K
-0.7
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
A11 REGULATOR BOARD
-15V SENSE FEEDBACK DIAG ①
GND SENSE FEEDBACK DIAG ①
+5V SENSE FEEDBACK DIAG ①
4
5
6


A11
REGULATOR
HIGH VOLTAGE
SHIELD AND
ASSEMBLY
A8
Z-AXIS
AMPLIFIER

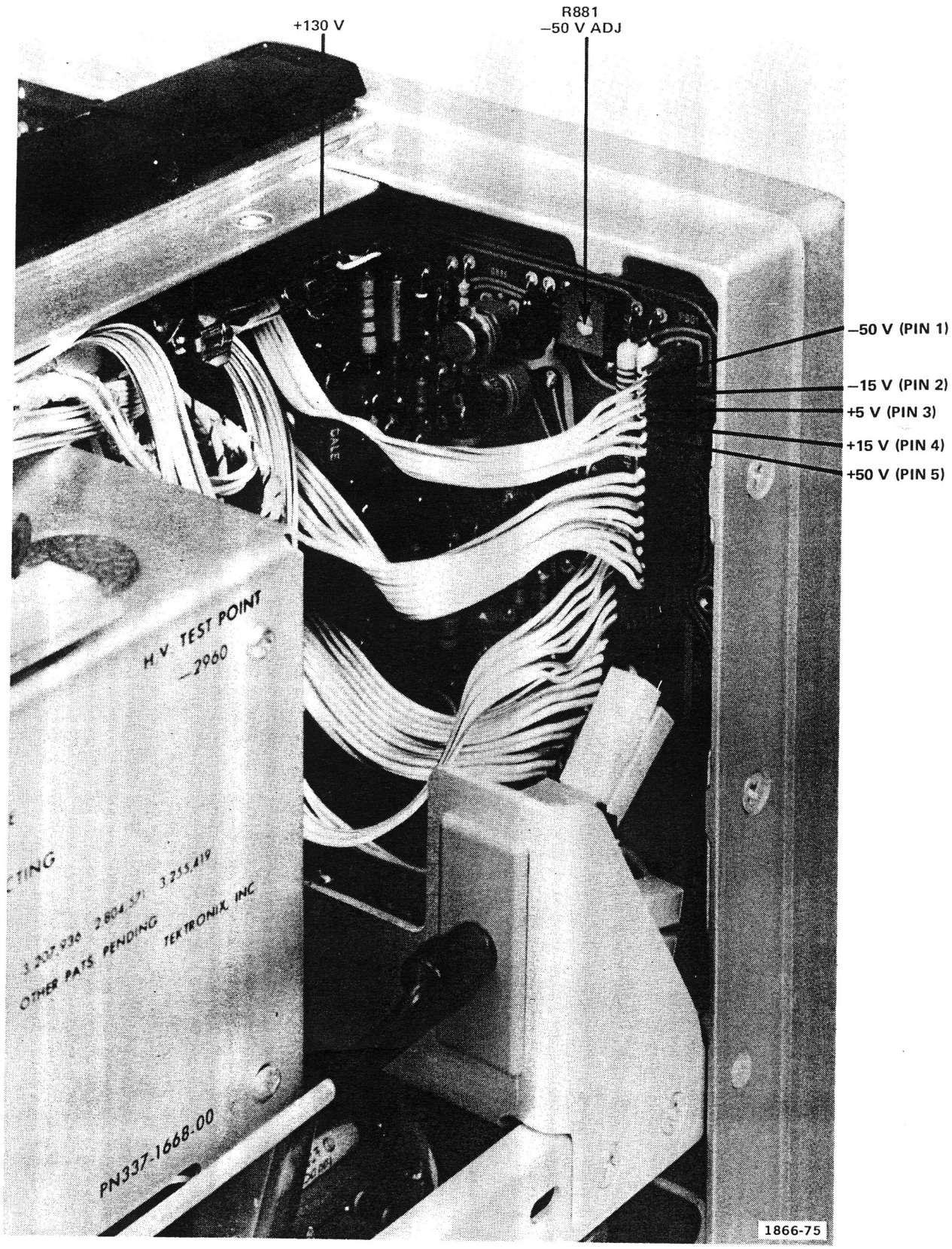


Figure 7-14. Locations of power supply test points and –50-volt adjustment.

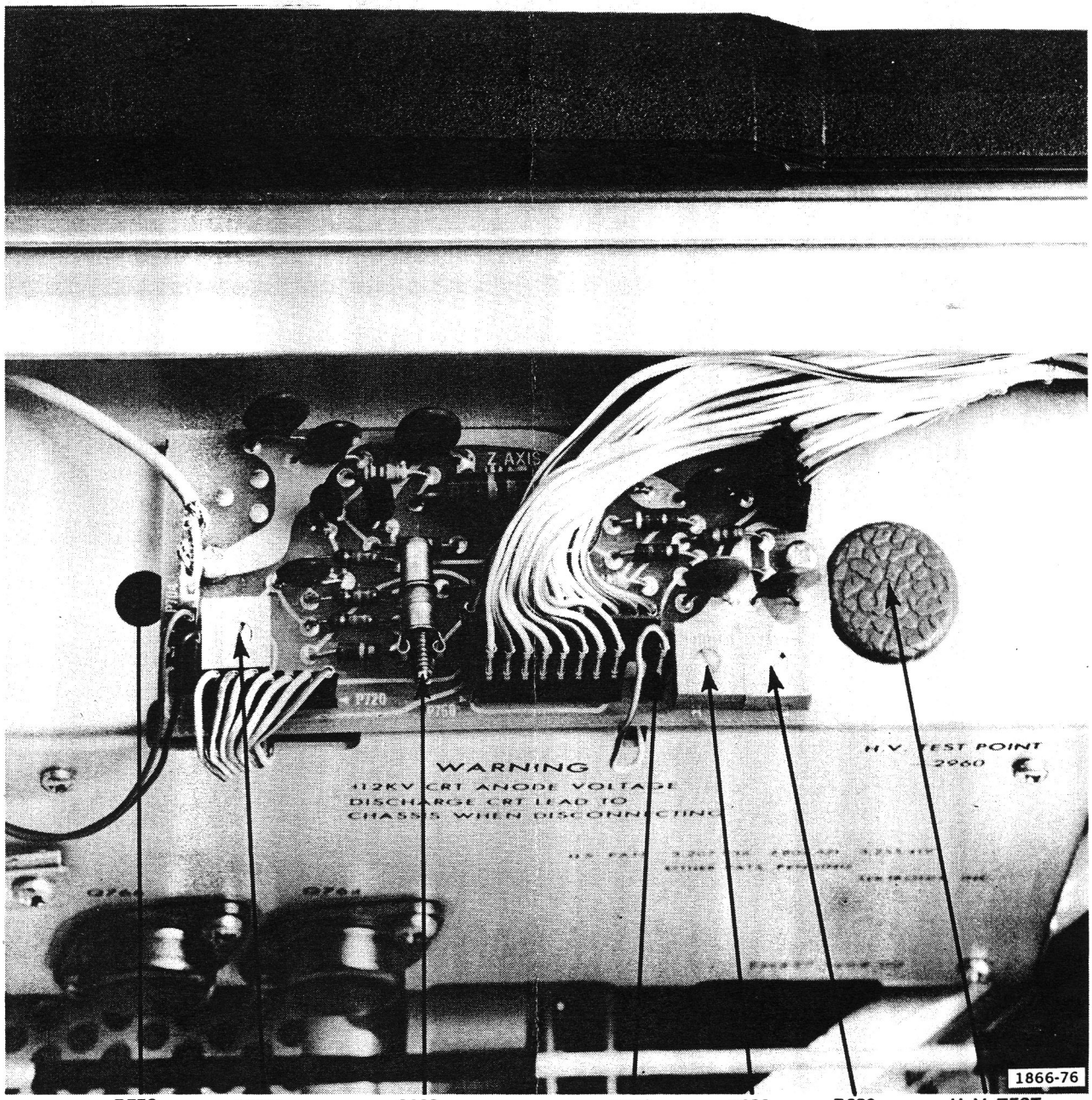


Figure 7-15. Locations of test points and adjustments on Z-Axis Amplifier board and High-Voltage Assembly.

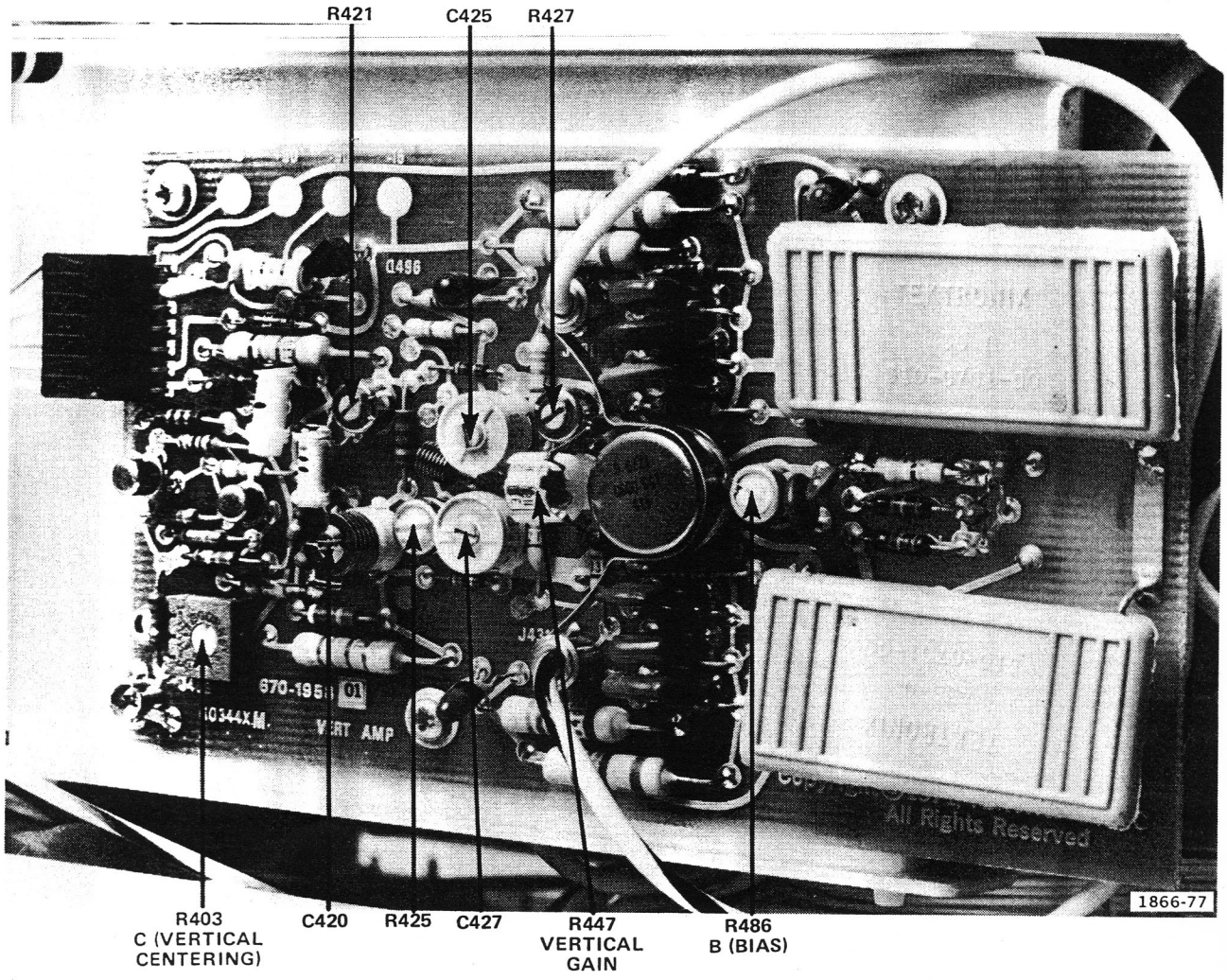


Figure 7-16. Locations of adjustments on Vertical Amplifier board.

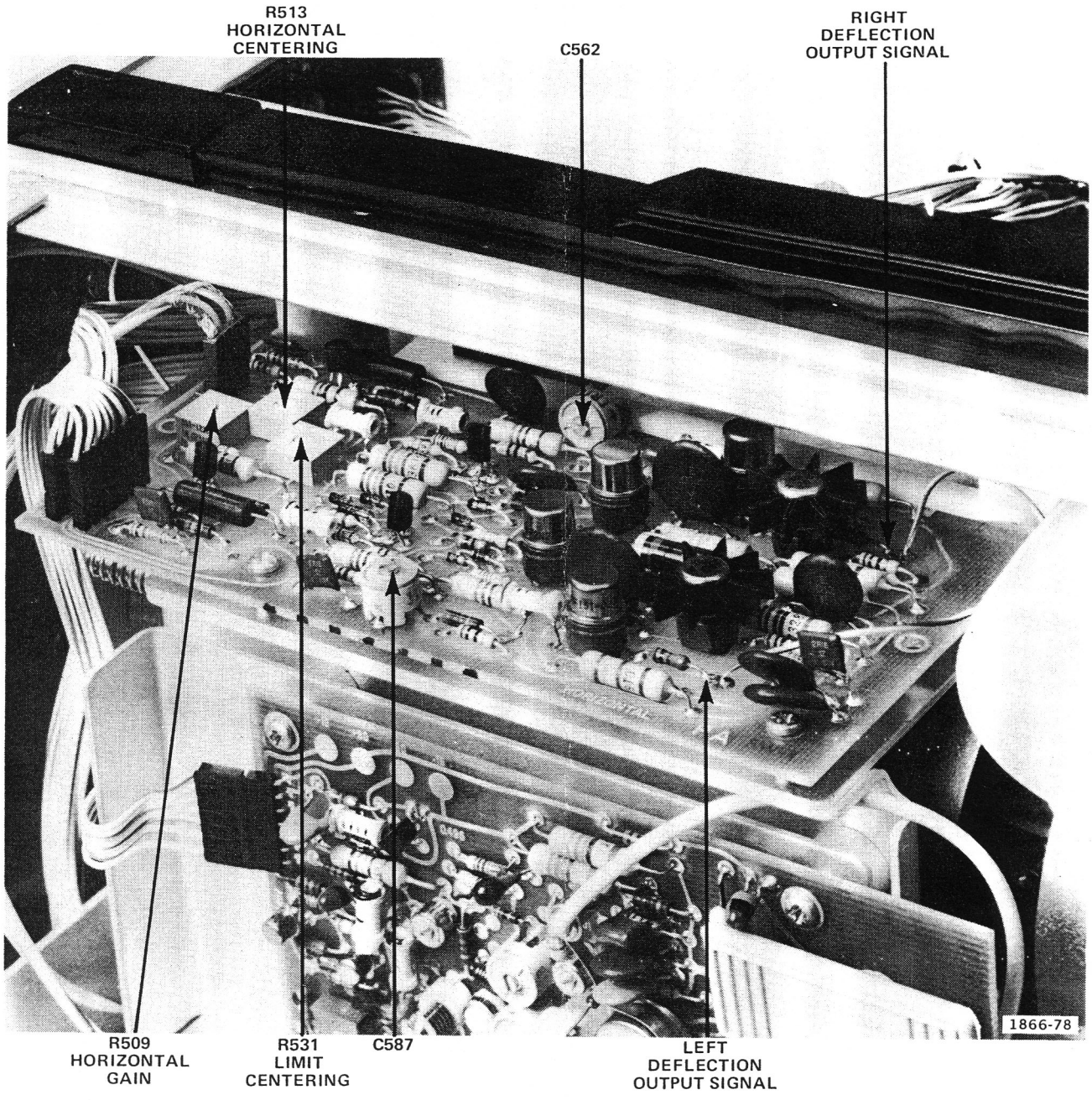
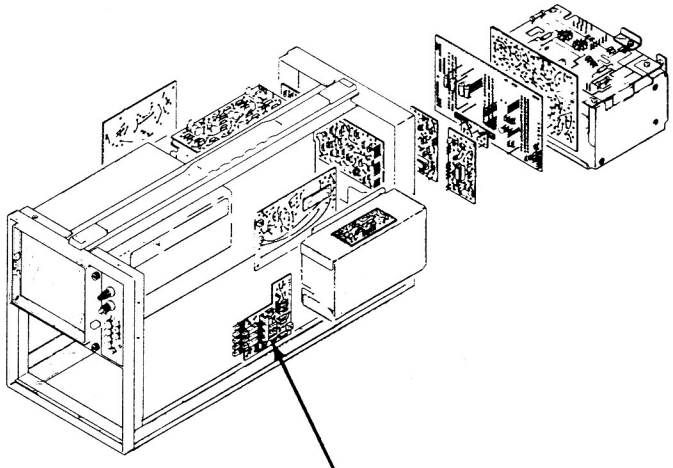


Figure 7-17. Locations of adjustments and signal points on Horizontal Amplifier board.



A7
CALIBRATOR AND
MODE SWITCHES

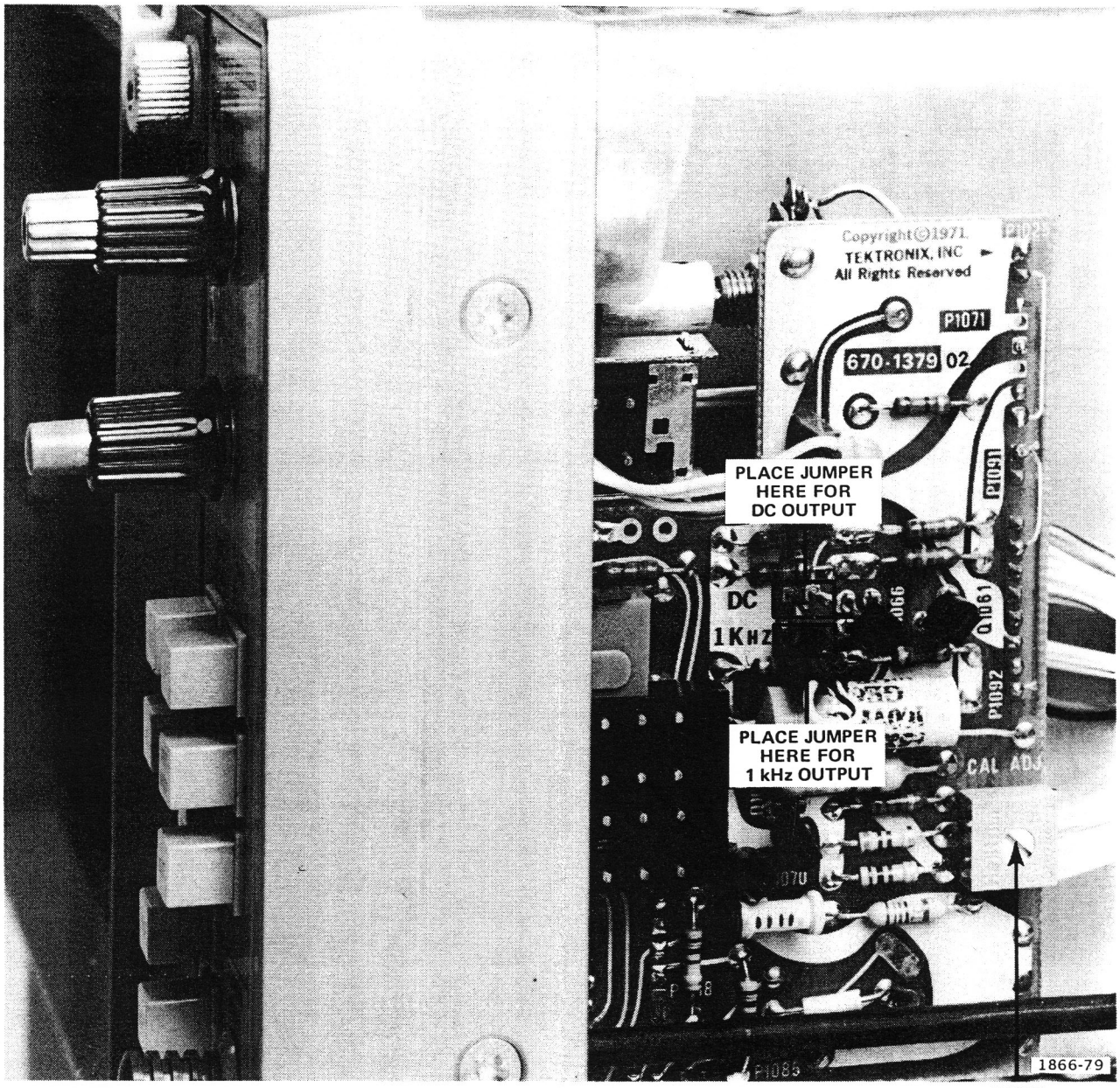
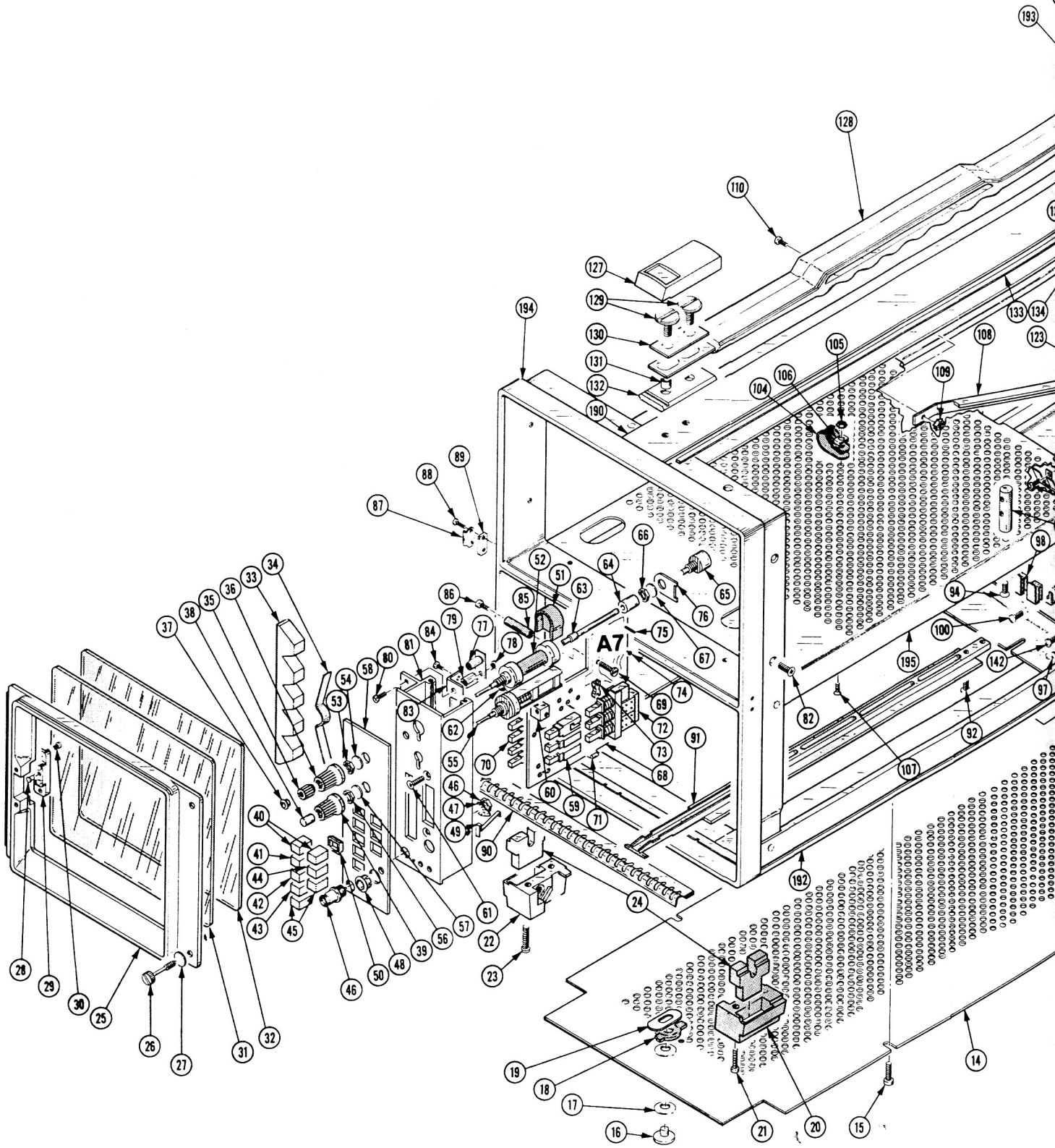
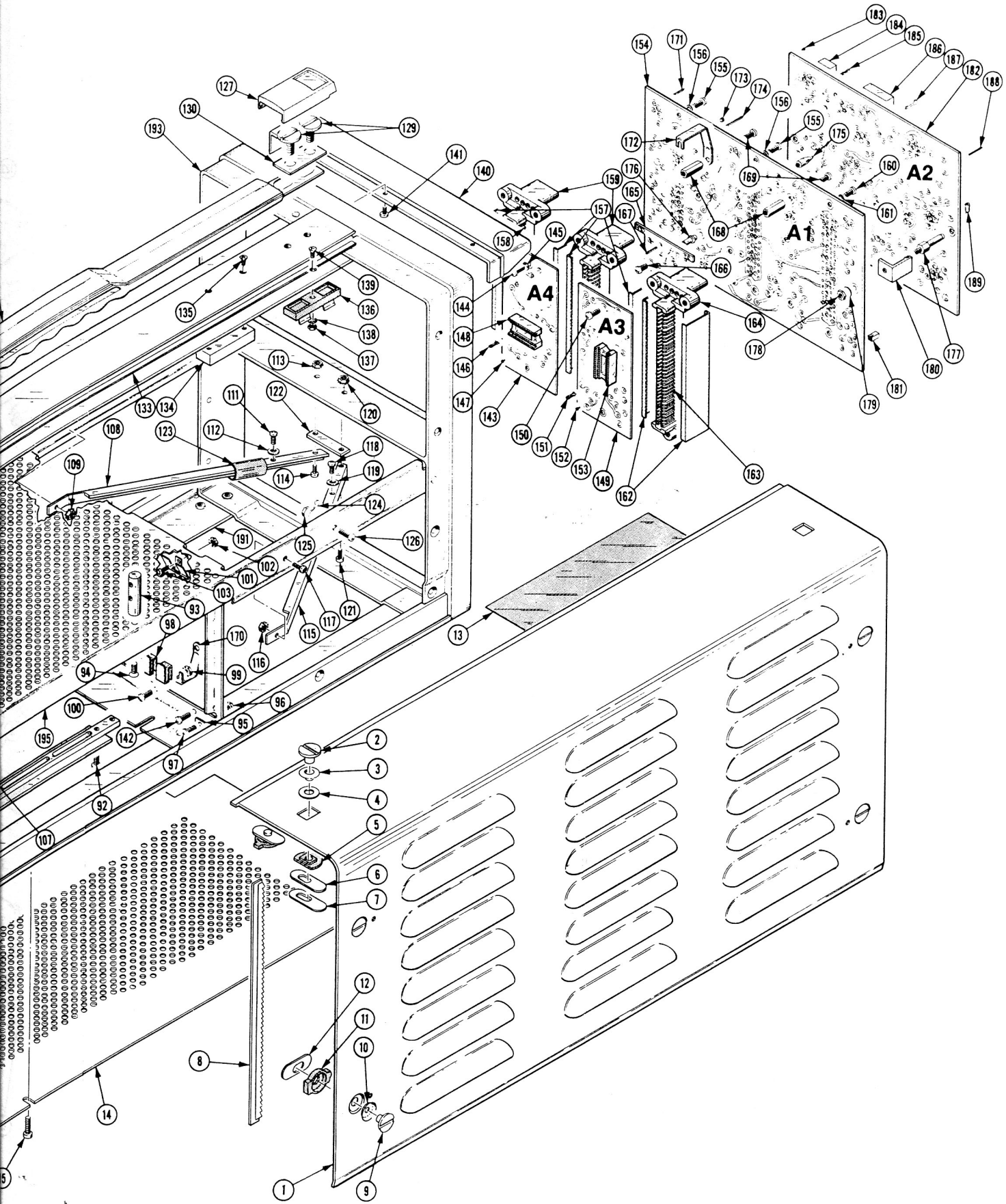


Figure 7-18. Locations of jumper positions and adjustment on Calibrator and Mode Switches board.

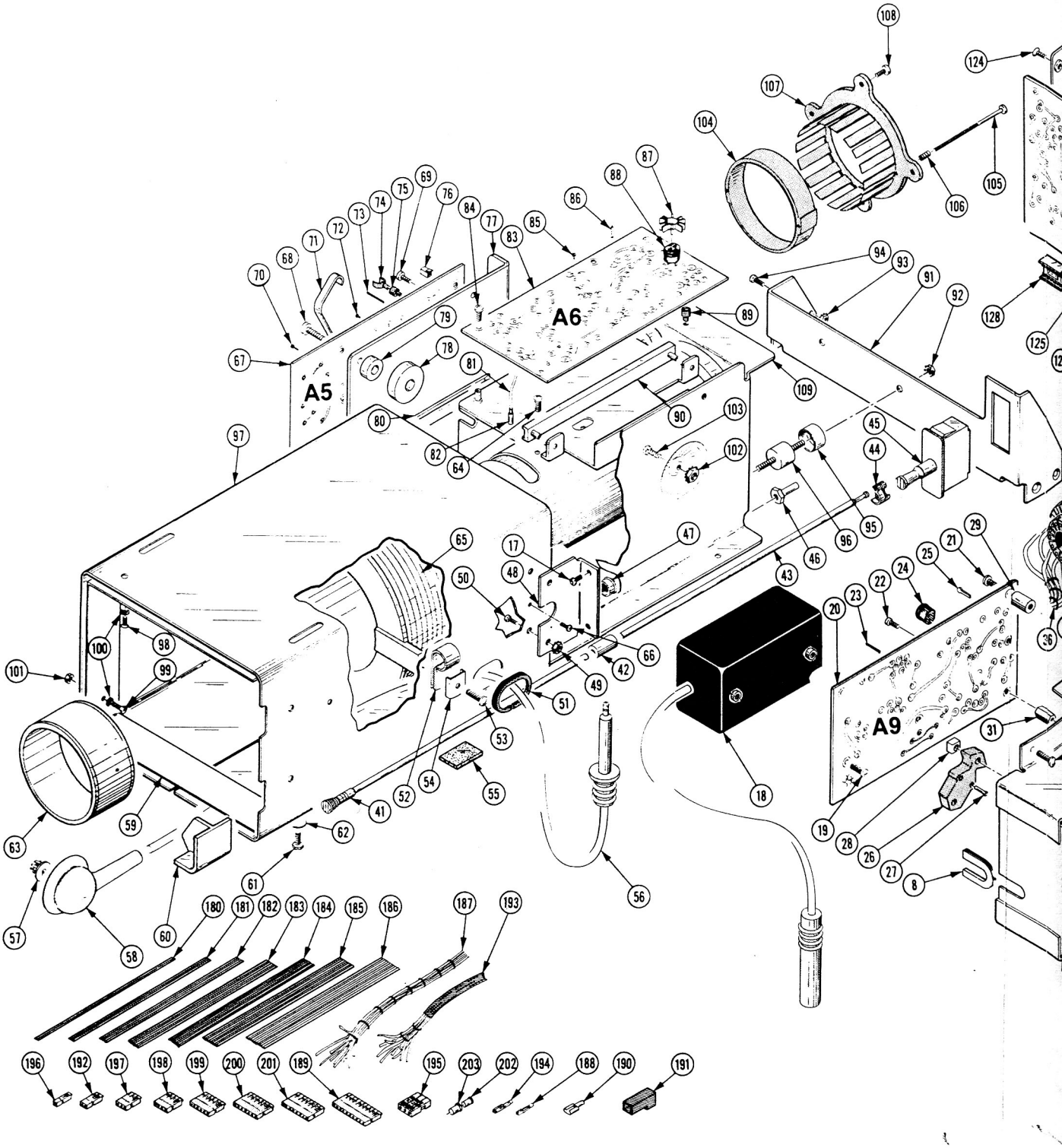

A7

@

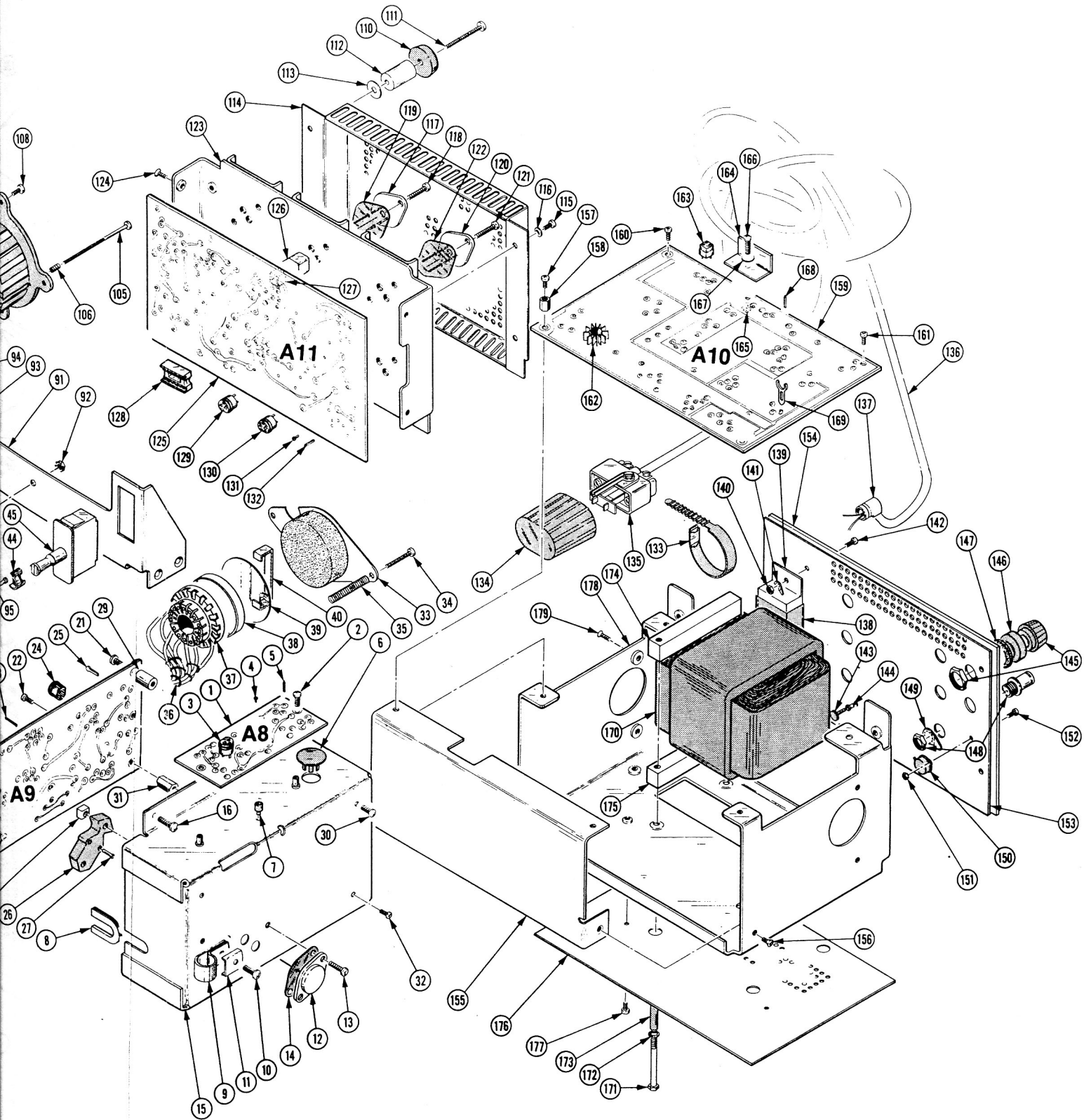


OS-245(P)/U

FIG. 2 CHASSIS



OS-245(P)/U


A11
A10
A8
A9

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
0000C	GETTIG ENGINEERING AND MANUFACTURING CO.		SPRINGMILL, PA 16875
00779	AMP, INC.	P. O. BOX 3608	HARRISBURG, PA 17105
02660	BUNKER RAMO CORP., AMPHENOL CONNECTOR DIV.	2801 S. 25TH AVE.	BROADVIEW, IL 60153
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06229	ELECTROVERT, INC.	86 HARTFORD AVE.	MOUNT VERNON, NY 10553
06982	MOORE, HOWARD J., CO.	105 E. 16TH ST.	NEW YORK, NY 10003
07700	TECHNICAL WIRE AND PRODUCTS, INC.	129 DERMODY ST.	CRANFORD, NJ 07016
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
09422	PLASTIC STAMPING CORP.	2216 W. ARMITAGE AVE.	CHICAGO, IL 60647
12136	PHILADELPHIA HANDLE CO., INC.	1643 HADDON AVE.	CAMDEN, NJ 08103
12327	FREEWAY CORP.	9301 ALLEN DR.	CLEVELAND, OH 44125
16428	BELDEN CORP.	P. O. BOX 1101	RICHMOND, IN 47374
18488	CONNOR SPRING AND MFG. CO., DIVISION OF SLOSS AND BRITTAIN	1101 MONTEREY PASS RD.	MONTEREY PARK, CA 91754
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23499	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	455 N. QUINCE ST.	ESCONDIDO, CA 92025
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
26365	GRIES REPRODUCER CO., DIV. OF COATS AND CLARK INC.	125 BEECHWOOD AVE.	NEW ROCHELLE, NY 10802
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
46384	PENN ENGINEERING AND MFG. CORP.	OLD EASTON HIGHWAY	DOYLESTOWN, PA 18901
61463	UNIROYAL, INC.	OXFORD MGT.&RES. CTR.BENSON RD.	MIDDLEBURY, CT 06749
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71218	BUD RADIO, INC.	4605 E. 355TH ST.	WILLOUGHBY, OH 44094
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
71785	TRW ELECTRONIC COMPONENTS, CINCH CONNECTOR OPERATIONS	1501 MORSE AVE.	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74921	ITEN FIBRE CO., THE	4001 BENEFIT AVE.	ASHTABULA, OH 44004
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
83058	CARR CO., THE, UNITED-CARR DIV. OF TRW, INC.	31 AMES ST.	CAMBRIDGE, MA 02142
83309	ELECTRICAL SPECIALITY CO., SUBSIDIARY OF BELDEN CORP.	213 E. HARRIS AVE.	SOUTH SAN FRANCISCO, CA 9408
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83501	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	CENTRAL ST.	BROOKFIELD, MA 01506
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
91260	CONNER SPRING AND MFG. CO.	1729 JUNCTION AVE.	SAN JOSE, CA 95112
91737	ITT GREMAR, INC.	922 S. LYON ST.	SANTA ANA, CA 92705
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
96904	NATVAR CORP.	211 RANDOLPH AVE.	WOODBRIDGE, NJ 07095
97539	APM-HEXSEAL CORP.	44 HONECK ST.	ENGLEWOOD, NJ 07631
98003	NIELSEN HARDWARE CORP.	770 WETHERSFIELD AVE.	HARTFORD, CT 06101

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	390-0291-00			2		COVER,SCOPE:SIDE	80009	390-0291-00
	----- -----			-		. EACH SIDE COVER INCLUDES:		
-2	214-0400-00			2		. PIN,STR,HEADED:	80009	214-0400-00
-3	358-0218-00			2		. BUSHING,PLASTIC:	80009	358-0218-00
-4	210-1152-00			2		. WASHER,FLAT:0.281 ID X 0.625 OD,NEOPRENE	80009	210-1152-00
-5	387-0871-00			2		. STOP,CLP,RIM CL:	80009	387-0871-00
-6	387-0804-00			2		. CLAMP,RIM CLENC:0.030 SPRING STEEL	91260	B-2012
-7	220-0486-00			2		. NUT,SHEET SPR:LATCH SECURE	18488	OBD
-8	348-0274-00			2		. SHLD GSKT,ELEC:	80009	348-0274-00
-9	214-0603-01			4		. PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-10	214-0604-00			1		. WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-11	386-0227-01			4		. STOP,CLP,RIM CL:	80009	386-0227-01
-12	386-1151-00			4		. PLATE,LATCH LKG:	80009	386-1151-00
-13	255-0319-00			2		. PLSTC SHEET:3 X 9 INCH,W/ADH ONE SIDE,CLEAR	80009	255-0319-00
-14	390-0288-00			1		COVER,SCOPE:BOTTOM	80009	290-0288-00
						(ATTACHING PARTS)		
-15	211-0503-00			4		SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. SCOPE BOTTOM INCLUDES:		
-16	214-0603-01			2		. PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-17	214-0604-00			2		. WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-18	386-0227-01			2		. STOP,CLP,RIM CL:	80009	386-0227-01
-19	386-1151-00			2		. PLATE,LATCH LKG:SPRING STEEL	80009	386-1151-00
-20	348-0074-00			2		SPT PIVOT,FLIP:RIGHT FRONT AND LEFT REAR	80009	348-0074-00
						(ATTACHING PARTS FOR EACH)		
-21	211-0532-00			2		SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
						- - - * - - -		
-22	348-0073-00			2		SPT PIVOT,FLIP:LEFT FRONT AND RIGHT REAR	80009	348-0073-00
						(ATTACHING PARTS FOR EACH)		
-23	211-0532-00			2		SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
						- - - * - - -		
-24	377-0119-00			4		PAD,CUSHIONING:	80009	377-0119-00
-25	200-1209-04			1		RTNR,IMPLOSION:	80009	200-1209-04
						(ATTACHING PARTS)		
-26	211-0634-00			2		THUMBSCREW:	80009	211-0634-00
-27	210-0894-00			2		WASHER,NONMETAL:0.19 ID X 0.438" OD,PLSTC	09422	OBD
						- - - * - - -		
-28	210-0713-01			3		EYELET,METALLIC:	80009	210-0713-01
-29	204-0476-00			1		BODY,TERMINAL:	80009	204-0476-00
						(ATTACHING PARTS)		
-30	213-0055-00			2		SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-31	378-0696-00			1		FILTER,LT,CRT:	80009	378-0696-00
-32	337-1439-00			1		SHLD,IMPLOSION:BEIGE	80009	337-1439-00
-33	378-0624-00			1		DIFFUSER,LIGHT:	80009	378-0624-00
-34	214-1253-00			1		SPR HSG,SC LAMP:0.012 SST	80009	214-1253-00
-35	366-1391-00			1		KNOB:GRAY	80009	366-1391-00
	213-0140-00			1		. SETSCREW:2-56 X 0.94 INCH,HEX SOC STL	70276	OBD
-36	366-1077-00			1		KNOB:GRAY	80009	366-1077-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-37	358-0216-00			1		BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-38	366-1059-00			1		PUSH BUTTON:GRAY	80009	366-1059-00
-39	366-1215-00			1		KNOB:GRAY	80009	366-1215-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-40	366-1402-02			2		PUSH BUTTON:LEFT	80009	366-1402-02
-41	366-1402-03			1		PUSH BUTTON:ALT	80009	366-1402-03
-42	366-1402-04			1		PUSH BUTTON:ADD	80009	366-1402-04
-43	366-1257-01			1		PUSH BUTTON:GRAY--CH1	80009	366-1257-01
-44	366-1402-07			1		PUSH BUTTON:VERT MODE	80009	366-1402-07
-45	366-1402-06			2		PUSH BUTTON:RIGHT	80009	366-1402-06
-46	131-0955-00			1		CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR200-1
-47	210-0255-00			1		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
-48	358-0378-00			1		BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-49	131-1266-00			1		CONTACT,ELEC:GROUND SPRING	80009	131-1266-00
-50	426-0681-00			8		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-51	200-0608-00			1		COVER,VAR RES.:PLASTIC	80009	200-0608-00
-52	----- -----			1		RESISTOR,VAR:(SEE R102/R1045 EPL)		
						(ATTACHING PARTS)		
-53	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-54	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-55	----- -----			1		RESISTOR,VAR:(SEE R1095/S1030 EPL)		
						(ATTACHING PARTS)		
-56	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-57	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-58	333-1603-01			1		PANEL,FRONT:	80009	333-1603-01
-59	384-1136-00			3		EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-60	220-0455-00			2		NUT,BLOCK:0.281"SQ,THREE 4-40 THRU THDS	80009	220-0455-00
						(ATTACHING PARTS FOR EACH)		
-61	211-0101-00			1		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
-62	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-63	384-1112-01			1		EXTENSION SHAFT:1.910 INCH L,EPOXY GLASS	80009	384-1112-01
-64	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 INCH,HEX SOC STL	70276	OBD
-65	----- -----			1		RESISTOR,VAR:(SEE R1025 EPL)		
						(ATTACHING PARTS)		
-66	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-67	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-68	----- -----			1		CKT BOARD ASSY:CAL AND VERT MODE(SEE A7 EPL)		
						(ATTACHING PARTS)		
-69	211-0040-00			1		SCREW,MACHINE:4-40 X 0.25",BDCH PLSTC	26365	OBD
						- - - * - - -		
	----- -----			-		. CIRCUIT BOARD ASSEMBLY INCLUDES:		
-70	260-1378-00			1		. SWITCH,PUSH:VERT MODE	71590	2KBC140000-608
-71	131-0566-00			1		. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	0000C	L-2007-1
-72	260-1379-00			1		. SWITCH,PUSH:TRIG SOURCE	71590	2KBC120000-595
-73	361-0411-00			12		. SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-74	136-0252-04			12		. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-75	131-0608-00			28		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-76	386-2285-00			1		. PLATE,RES MTG:	80009	386-2285-00
-77	136-0455-00			1		LAMP HOLDER:	80009	136-0455-00
						(ATTACHING PARTS)		
-78	211-0501-00			2		SCREW,MACHINE:6-32 X 0.125 INCH,PNH STL	83385	OBD
						- - - * - - -		
-79	385-0079-00			2		SPACER,POST:	80009	385-0079-00
						(ATTACHING PARTS FOR EACH)		
-80	211-0541-00			1		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-81	386-2311-00			1		SUBPANEL,FRONT:	80009	386-2311-00
						(ATTACHING PARTS)		
-82	211-0559-00			4		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-83	407-0915-00			1		BRACKET,ANGLE:	80009	407-0915-00
						(ATTACHING PARTS)		
-84	211-0541-00			2		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-85	361-0137-00			1		POST,ELEC-MECH:1.345 INCH,W/4-40 THREAD	80009	361-0137-00
						(ATTACHING PARTS)		
-86	211-0040-00			1		SCREW,MACHINE:4-40 X 0.25",BDCH PLSTC	26365	OBD
						- - - * - - -		
-87	105-0390-00			2		CATCH,CLAMPING:FOR FRONT COVER	98003	S8-83314-2CE
						(ATTACHING PARTS FOR EACH)		
-88	213-0119-00			2		SCR,TPG,THD FOR:4-24 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-89	361-0480-00			2		SPACER,CATCH:	80009	361-0480-00
-90	348-0278-00			2		SHLD GSKT,ELEC:	80009	348-0278-00
-91	351-0295-00			3		GUIDE,SLIDE:	80009	351-0295-00
						(ATTACHING PARTS)		
-92	213-0088-00			1		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-93	385-0113-00			1		INSULATOR,STDF:	80009	385-0113-00
						(ATTACHING PARTS)		
-94	211-0538-00			1		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-95	131-1018-00			4		CONTACT,ELEC:PLUG-IN GROUND	80009	131-1018-00
						(ATTACHING PARTS FOR EACH)		
-96	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-97	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-98	131-0930-00			2		CONTACT,ELEC:PLUG-IN GROUND	80009	131-0930-00
						(ATTACHING PARTS FOR EACH)		
-99	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-100	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-101	131-0799-00			2		CONTACT,ELEC:	80009	131-0799-00
						(ATTACHING PARTS FOR EACH)		
-102	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-103	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-104	343-0006-00			1		CLAMP,LOOP:0.50 INCH DIAMETER,PLSTC	95987	1-2-6B
						(ATTACHING PARTS)		
-105	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-106	210-0863-00			1		WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
-107	211-0538-00			1		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-108	386-2277-00			1		SPRT,PL-IN HSG:	80009	386-2277-00
						(ATTACHING PARTS)		
-109	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-110	211-0510-00			1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-111	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-112	210-0803-00			1		WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-113	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-114	211-0551-00			1		SCREW MACHINE:6-32 X 0.562 INCH,PNH STL	83385	OBD
						- - - * - - -		
-115	386-2276-00			1		SPRT,PL-IN HSG:	80009	386-2276-00
						(ATTACHING PARTS)		
-116	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-117	211-0510-00			1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-118	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-119	210-0803-00			1		WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-120	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-121	211-0551-00			1		SCREW MACHINE:6-32 X 0.562 INCH,PNH STL	83385	OBD
						- - - * - - -		
-122	361-0473-00			1		SPACER,PLATE:PLUG-IN HOUSING SUPPORT	80009	361-0473-00
-123	162-0021-00			1		INSL SLVG,ELEC:0.5 ID X 0.525 OD VINYL	96904	OBD
-124	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-125	210-0407-00			1		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-126	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-127	200-0728-02			2		COVER,HDL END:MOLDED BLACK PLASTIC	80009	200-0728-02
-128	367-0108-01			1		HANDLE,CARRYING:	12136	OBD
						(ATTACHING PARTS)		
-129	211-0532-00			4		SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-130	386-1624-00			2		PL,RET.,HANDLE:	80009	386-1624-00
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-131	358-0485-00			4	BUSHING,SLEEVE:0.196ID X 0.287OD X 0.13" L	80009	358-0485-00
-132	386-1283-03			2	PLATE,HDL MTG:PLASTIC	80009	386-1283-03
-133	348-0340-00			2	SHLD GSKT,ELEK:0.125 X 0.125 X 1.5 FT L,FOAM	07700	85-10168
-134	361-0487-00			1	SPACER,RESIL MT:	80009	361-0487-00
					(ATTACHING PARTS)		
-135	213-0040-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PLASTIC	26365	OBD
					- - - * - - -		
-136	352-0031-00			1	FUSEHOLDER:3AG FUSE	75915	357001
					(ATTACHING PARTS)		
-137	210-0407-00			1	NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-138	210-0006-00			1	WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
-139	211-0538-00			1	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-140	337-1685-00			1	SHIELD,ELEC:TRANSISTOR	80009	337-1685-00
					(ATTACHING PARTS)		
-141	213-0236-00			3	SCREW,TPG,TF:6-32 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
	672-0043-00			1	CKT BOARD ASSY:MAIN INTERFACE	80009	672-0043-00
					(ATTACHING PARTS)		
-142	213-0034-00			9	SCR,TPG,THD CTG:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CIRCUIT BOARD ASSEMBLY INCLUDES:		
-143	----- -----			1	. CKT BOARD ASSY:VERT INTERFACE(SEE A4 EPL)		
					(ATTACHING PARTS)		
-144	211-0008-00			2	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-145	210-0906-00			1	. WASHER,NONMETAL:FIBER,0.125 ID X 0.203"OD	86445	OBD
					- - - * - - -		
	----- -----			-	. . CIRCUIT BOARD ASSEMBLY INCLUDES:		
-146	136-0263-03			18	. . CONTACT,ELEC:FOR 0.025 INCH SQUARE PIN	00779	86250-2
-147	136-0252-04			15	. . CONTACT,ELEC:0.188 INCH LONG	22526	75060
-148	136-0260-01			1	. . SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-149	----- -----			1	. CKT BOARD ASSY:TRIGGER SELECTOR(SEE A3 EPL)		
					(ATTACHING PARTS)		
-150	211-0008-00			2	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. . CIRCUIT BOARD ASSEMBLY INCLUDES:		
-151	136-0263-03			16	. . CONTACT,ELEC:FOR 0.025 INCH SQUARE PIN	00779	86250-2
-152	136-0252-04			9	. . CONTACT,ELEC:0.188 INCH LONG	22526	75060
-153	136-0260-01			1	. . SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-154	----- -----			1	. CKT BOARD ASSY:MAIN INTERFACE(SEE A1 EPL)		
	131-0767-02			2	. . CONNECTOR,RCPT,:76 CONTACT	80009	131-0767-02
					(ATTACHING PARTS FOR EACH)		
-155	213-0232-00			2	. . SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	83385	OBD
-156	210-0906-00			2	. . WASHER,NONMETAL:FIBER,0.125 ID X 0.203"OD	86445	OBD
					- - - * - - -		
	----- -----			-	. . . EACH CONNECTOR INCLUDES:		
-157	200-0950-00			2	. . . COVER,ELEC CONN:PLASTIC	80009	200-0950-00
-158	131-0726-00			38	. . . CONTACT,ELEC:STRAIGHT	80009	131-0726-00
	131-0727-00			38	. . . CONTACT,ELEC:OFFSET	80009	131-0727-00
-159	204-0365-00			1	. . . BODY,CONNECTOR:PLUG-IN CIRCUIT BOARD	80009	204-0365-00
	131-0767-00			1	. . CONNECTOR,RCPT,:76 CONTACT	80009	131-0767-00
					(ATTACHING PARTS)		
-160	213-0232-00			2	. . SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	83385	OBD
-161	210-0906-00			2	. . WASHER,NONMETAL:FIBER,0.125 ID X 0.203"OD	86445	OBD
					- - - * - - -		
	----- -----			-	. . . CONNECTOR INCLUDES:		
-162	200-0950-00			2	. . . COVER,ELEC CONN:PLASTIC	80009	200-0950-00
-163	131-0726-00			38	. . . CONTACT,ELEC:STRAIGHT	80009	131-0726-00
	131-0727-00			38	. . . CONTACT,ELEC:OFFSET	80009	131-0727-00
-164	204-0365-02			1	. . . BODY,CONNECTOR:PLUG-IN CIRCUIT BOARD	80009	204-0365-02
-165	670-1374-00			1	. . CKT BOARD ASSY:VERTICAL INTERCONNECT	80009	670-1374-00
					(ATTACHING PARTS)		
-166	211-0008-00			2	. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		

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-	----- -----			-	. . . CIRCUIT BOARD ASSEMBLY INCLUDES:		
-167	131-0787-00			8	. . . CONTACT,ELEC:0.64 INCH LONG	22526	47359
-168	129-0308-00			4	. . POST,ELEC-MECH:HEX.,0.25 X 0.465 INCH LONG	80009	129-0308-00
					(ATTACHING PARTS FOR EACH)		
-169	211-0008-00			2	. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-170	131-0805-00			2	. . LINK,TERM.CONNE:J-SHAPE,0.90X0.82 X 0.312"	80009	131-0805-00
-171	131-0608-00			34	. . CONTACT,ELEC:0.365 INCH LONG	22526	47357
-172	131-0804-00			1	. . LINK,TERM.CONNE:J-SHAPE	80009	131-0804-00
-173	136-0252-01			2	. . CONTACT,ELEC:0.178 INCH LONG	00779	1-332095-2
-174	131-0591-00			35	. . CONTACT,ELEC:0.835 INCH LONG	22526	47352
	131-0592-00			23	. . CONTACT,ELEC:0.885 INCH LONG	22526	47353
-175	386-1558-00			2	. . SPACER,CKT BD:PLASTIC	80009	386-1558-00
-176	351-0213-00			2	. . GUIDE-POST,LOCK:0.285 INCH LONG	80009	351-0213-00
-177	214-1568-00			2	. . PIN,GUIDE:	80009	214-1568-00
					(ATTACHING PARTS FOR EACH)		
-178	210-0406-00			1	. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-179	210-0054-00			1	. . WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
					- - - * - - -		
-180	344-0147-00			2	. . CLIP,SPR,TNSN:CIRCUIT BOARD MOUNTING	80009	344-0147-00
-181	131-1003-00			2	. . CONNECTOR BODY,:CKT BD MT,3 PRONG	80009	131-1003-00
-182	----- -----			1	. CKT BOARD ASSY:LOGIC(SEE A2 EPL)		
-183	136-0252-04			21	. . CONTACT,ELEC:0.188 INCH LONG	22526	75060
-184	136-0269-00			4	. . SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-185	136-0263-03			35	. . CONTACT,ELEC:FOR 0.025 INCH SQUARE PIN	00779	86250-2
-186	136-0260-01			1	. . SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-187	214-0579-00			3	. . TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-188	131-0608-00			10	. . CONTACT,ELEC:0.365 INCH LONG	22526	47357
-189	131-0566-00			1	. . LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	0000C	L-2007-1
-190	426-0933-00			1	FRAME SECT,CAB:TOP CENTER	80009	426-0933-00
-191	426-0858-00			1	FRAME SECT,CAB.:LOWER LEFT	80009	426-0858-00
-192	426-0857-00			1	FRAME SECT,CAB.:LOWER RIGHT	80009	426-0857-00
-193	426-0741-08			1	FRAME SECT,CAB:REAR	80009	426-0741-08
-194	426-0741-07			1	FRAME SECT,CAB:FRONT	80009	426-0741-07
-195	380-0291-00			1	HOUSING,PLUG-IN:	80009	380-0291-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 . Name & Description	Mfr Code	Mfr Part Number
2-1	----- -----			1	CKT BOARD ASSY:Z-AXIS AMPLIFIER(SEE A8 EPL)		
					(ATTACHING PARTS)		
-2	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CIRCUIT BOARD ASSEMBLY INCLUDES:		
-3	136-0183-00			1	. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-4	136-0252-04			12	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-5	131-0608-00			30	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-6	134-0067-00			1	BUTTON,PLUG:GRAY PLASTIC	80009	134-0067-00
-7	131-0008-00			1	CONN,PLUG,ELEC:	02660	91MC4M
-8	348-0085-00			2	GROMMET,PLASTIC:U-SHAPED	80009	348-0085-00
-9	343-0008-00			1	CLAMP,LOOP:0.375 INCH DIA,PLASTIC	95987	3-46R
					(ATTACHING PARTS)		
-10	211-0510-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-11	210-0863-00			1	WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
					- - - * - - -		
-12	----- -----			2	TRANSISTOR:(SEE Q764,Q766 EPL)		
					(ATTACHING PARTS FOR EACH)		
-13	211-0510-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-14	386-0978-00			2	INSULATOR,PLATE:0.002 INCH MICA,FOR TO-3	80009	386-0978-00
-15	337-1668-00			1	SHIELD,ELEC:HIGH VOLTAGE	80009	337-1668-00
					(ATTACHING PARTS)		
-16	211-0504-00			3	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-17	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-18	----- -----			1	MULTIPLIER,HV:(SEE U741 EPL)		
					(ATTACHING PARTS)		
-19	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-20	----- -----			1	CKT BOARD ASSY:HIGH VOLTAGE(SEE A9 EPL)		
					(ATTACHING PARTS)		
-21	211-0040-00			2	SCREW,MACHINE:4-40 X 0.25",BDCH PLSTC	26365	OBD
-22	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CIRCUIT BOARD ASSEMBLY INCLUDES:		
-23	131-0608-00			8	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
	131-0589-00			8	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-24	136-0183-00			3	. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-25	214-0579-00			1	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-26	136-0361-00			2	. SOCKET,PLUG-IN:	80009	136-0361-00
-27	136-0384-00			4	. CONTACT,ELEC:FOR 0.04 DIAMETER PIN	00779	52120
-28	131-0847-00			4	. TERMINAL STUD:6-32 X 0.435 INCH LONG	80009	131-0847-00
-29	129-0143-00			2	INSULATOR,STDF:0.312 OD X 0.406" L,NYLON	80009	129-0143-00
					(ATTACHING PARTS FOR EACH)		
-30	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-31	129-0098-00			1	POST,ELEC-MECH:0.250 HEX.X0.406 INCH L,BRS	80009	129-0098-00
					(ATTACHING PARTS)		
-32	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-33	386-2274-00			1	MOUNT,RESILIENT:CRT	80009	386-2274-00
					(ATTACHING PARTS)		
-34	211-0516-00			2	SCREW,MACHINE:6-32 X 0.875 INCH,PNH STL	83385	OBD
					- - - * - - -		
-35	214-1304-00			2	SPRING,HLCPS:0.30 OD X 1.25 INCH LONG	80009	214-1304-00
-36	136-0505-00			1	SKT,PL-IN ELEK:CRT	80009	136-0505-00
-37	136-0304-02			1	. SOCKET,PLUG-IN:CRT,14 PIN SOCKET,W/PINS	80009	136-0304-02
-38	200-0917-01			1	. COV,ELECTRON TU:2.052 OD X 0.291" THK,PLSTC	80009	200-0917-01
-39	367-0117-00			1	. PULL,SOC,PL-IN:	80009	367-0117-00
-40	343-0235-00			1	. CLAMP,SOCKET:	80009	343-0235-00
-41	384-1081-00			1	EXTENSION SHAFT:W/KNOB	80009	384-1081-00
-42	376-0053-00			1	CPLG,SHAFT,RGD:0.128 ID X 0.312 OD	80009	376-0053-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	213-0048-00			2	. SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-43	384-1152-00			1	EXTENSION SHAFT:	80009	384-1152-00
-44	376-0127-00			1	COUPLER,SHAFT:PLASTIC	80009	376-0127-00
-45	260-1222-00			1	SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
-46	361-0109-00			2	NUT,SLEEVE:0.641 INCH LONG,0.375 HEX	80009	361-0109-00
-47	348-0056-00			2	GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-48	407-1077-00			1	BRKT,CRT SHIELD:	80009	407-1077-00
					(ATTACHING PARTS)		
-49	210-0457-00			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-50	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-51	252-0562-00			FT	PLASTIC CHANNEL:0.100 X 0.120,POLYETHYLENE	06229	OBD
-52	343-0013-00			1	CLAMP,LOOP:0.375 INCH DIA	95987	3-8-6B
					(ATTACHING PARTS)		
-53	211-0012-00			1	SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-54	210-0863-00			1	WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
					- - - * - - -		
-55	348-0070-01			1	PAD,CUSHIONING:0.69 INCH,RUBBER	80009	348-0070-01
-56	131-1093-00			1	LEAD,ELECTRICAL:ANODE	80009	131-1093-00
-57	131-0026-00			1	BUTTON,PLUG:	83058	118738
-58	200-0541-00			1	FR,FLTR ELEM,AI:4.562 H X 5.625 INCH WIDE	80009	200-0541-00
-59	348-0324-00			1	PAD,CUSHIONING:	80009	348-0324-00
-60	386-1952-01			4	SUPPORT,CRT:	80009	386-1952-01
					(ATTACHING PARTS FOR EACH)		
-61	211-0603-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,HEX HD STL	83385	OBD
-62	210-0803-00			1	WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
					- - - * - - -		
-63	----- -----			1	COIL,TUBE DEFL:(SEE L1098 EPL)		
					(ATTACHING PARTS)		
-64	213-0138-00			2	SCR,TPG,THD FOR:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-65	----- -----			1	DELAY LINE,ELEC:(SEE L1099 EPL)		
					(ATTACHING PARTS)		
-66	211-0008-00			3	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-67	----- -----			1	CKT BOARD ASSY:VERTICAL AMPL(SEE A5 EPL)		
					(ATTACHING PARTS)		
-68	211-0014-00			2	SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-69	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-70	136-0252-01			19	. CONTACT,ELEC:0.178 INCH LONG	00779	1-332095-2
-71	131-1303-00			1	. CONTACT,ELEC:IC GROUND	80009	131-1303-00
-72	136-0252-04			9	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-73	131-0589-00			7	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-74	352-0100-00			1	. HOLDER,RESISTOR:0.128 DIA,PLASTIC	80009	352-0100-00
-75	361-0008-00			1	. SPACER,SLEEVE:0.11 ID X 0.25 OD X 0.28"H	80009	361-0008-00
-76	131-1003-00			3	. CONNECTOR BODY,:CKT BD MT,3 PRONG	80009	131-1003-00
-77	214-1652-00			1	. HEAT SINK,ELEC:	80009	214-1652-00
-78	214-1757-00			1	. HEAT SINK,ELEC:1.0 DIA X 0.27 THICK	80009	214-1757-00
-79	361-0477-00			2	SPACER,SLEEVE:0.238 ID X 0.25 INCH LONG	80009	361-0477-00
-80	351-0087-00			1	GUIDE,CKT CARD:4.75 INCH LONG,PLASTIC	80009	351-0087-00
-81	195-0085-00			1	LEAD SET,ELEC:	80009	195-0085-00
-82	131-0865-00			4	. TERMINAL,PIN:	80009	131-0865-00
-83	----- -----			1	. CKT BOARD ASSY:HORIZONTAL AMPL(SEE A6 EPL)		
					(ATTACHING PARTS)		
-84	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-85	136-0252-04			30	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-86	131-0608-00			20	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-87	214-1292-00			2	. HEAT SINK,ELEC:TRANSISTOR	05820	205-AB
-88	136-0183-00			6	. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-89	361-0008-00			1	SPACER,SLEEVE:0.11 ID X 0.25 OD X 0.28"H	80009	361-0008-00
-90	351-0087-00			1	GUIDE,CKT CARD:4.75 INCH LONG,PLASTIC	80009	351-0087-00
-91	407-1120-00			1	BRACKET,CHASSIS:	80009	407-1120-00
					(ATTACHING PARTS)		
-92	210-0458-00			3	NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
-93	210-0457-00			4	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-94	211-0538-00			4	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-95	201-0011-00			3	CUP,SHOCKMOUNT:	80009	201-0011-00
-96	348-0338-00			3	MOUNT,RESILIENT:	61463	301ADE60DUROMETE
-97	337-1676-00			1	SHIELD,CRT:	80009	337-1676-00
					(ATTACHING PARTS)		
-98	211-0541-00			2	SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
-99	211-0502-00			2	SCREW,MACHINE:6-32 X 0.188",FLH STL	83385	OBD
-100	210-1150-00			4	WASHER,FLAT:0.221 ID X 0.359 OD	80009	210-1150-00
-101	220-0552-00			2	NUT,PLAIN,SPLN:6-32 X 0.090 THICK,FLUSH MT	46384	F-632-2
-102	210-0458-00			2	NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
-103	212-0004-00			2	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-104	354-0347-00			1	RING,CLP,CRT RE:	80009	354-0347-00
					(ATTACHING PARTS)		
-105	211-0170-00			2	SCREW,MACHINE:4-40 X 2.75 INCH,PNH STL	83385	OBD
-106	214-1333-00			2	SPRING,HLCPS:0.213 OD X 0.375 INCH LONG	80009	214-1333-00
					- - - * - - -		
-107	343-0205-01			1	RETAINER,CRT:	80009	343-0205-01
					(ATTACHING PARTS)		
-108	211-0507-00			4	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-109	441-1082-00			1	CHASSIS,SCOPE:	80009	441-1082-00
-110	348-0001-00			6	MOUNT,RESILIENT:VERTICAL	71218	F-7264A
					(ATTACHING PARTS FOR EACH)		
-111	211-0529-00			2	SCREW,MACHINE:6-32 X 1.25 INCHES,PNH STL	83385	OBD
					- - - * - - -		
-112	361-0484-00			2	SPACER,SLEEVE:0.172 ID X 0.80 INCH LONG	80009	361-0484-00
-113	210-0847-00			2	WASHER,FLAT:0.164 ID X 0.500 OD,NYLON	86445	OBD
-114	337-1682-00			1	SHIELD,ELEC:REGULATOR	80009	337-1682-00
					(ATTACHING PARTS)		
-115	211-0542-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	OBD
-116	210-1011-00			2	WASHER,NONMETAL:0.13 ID X 0.375 " OD,PLSTC	83309	OBD
					- - - * - - -		
-117	----- -----			4	TRANSISTOR:(SEE Q850,Q933,Q958,Q988 EPL)		
					(ATTACHING PARTS FOR EACH)		
-118	211-0511-00			2	SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
-119	386-0978-00			1	INSULATOR,PLATE:0.002 INCH MICA,FOR TO-3	80009	386-0978-00
-120	----- -----			2	TRANSISTOR:(SEE Q874,Q903 EPL)		
					(ATTACHING PARTS FOR EACH)		
-121	211-0511-00			2	SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
-122	386-0978-00			1	INSULATOR,PLATE:0.002 INCH MICA,FOR TO-3	80009	386-0978-00
-123	441-1079-01			1	CHASSIS,SCOPE:REGULATOR	80009	441-1079-01
					(ATTACHING PARTS)		
-124	211-0538-00			4	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-125	----- -----			1	CKT BOARD ASSY:REGULATOR(SEE A11 EPL)		
-126	136-0361-00			6	. SOCKET,PLUG-IN:	80009	136-0361-00
-127	131-0847-00			12	. TERMINAL STUD:6-32 X 0.435 INCH LONG	80009	131-0847-00
-128	136-0269-00			1	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-129	136-0183-00			6	. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-130	136-0235-00			6	. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-131	136-0252-04			27	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-132	131-0608-00			51	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-133	346-0077-00			1	STRAP,TIEDOWN:	80009	346-0077-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-134	200-0260-00			1	SHLD,CAPACITOR:	80009	200-0260-00
-135	131-1335-00			1	CONN,PLUG,ELEC:POWER CORD	97539	UF131-M
-136	161-0033-09			1	CABLE ASSY,PWR:3 WIRE,92 INCH LONG	16428	KH8035
-137	358-0323-00			1	BSHG,STRAIN RLF:90 DEG,0.515 DIA HOLE	28520	SR15-1
-138	253-0140-00			1	TAPE:1.0 INCH WIDE,W/ADH BACK,CLEAR MYLAR	80009	253-0140-00
-139	----- -----			1	FIL,RAD,INTFRF:(SEE FL1000 EPL)		
					(ATTACHING PARTS)		
-140	210-0551-00			1	NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-141	210-0201-00			1	TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
-142	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-143	352-0101-00			1	HOLDER,TOROID:0.128 DIA X 0.665 INCH LONG,PLSTC	80009	352-0101-00
-144	361-0007-00			1	SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
-145	352-0076-00			2	FUSEHOLDER:W/HARDWARE	75915	342012
-146	361-0489-00			2	SPACER,FUSE:	80009	361-0489-00
-147	210-0873-00			2	WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPRN	70485	OBD
-148	131-0955-00			6	CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR200-1
-149	210-0255-00			6	TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
-150	----- -----			1	SWITCH,THRMSTC:(SEE S1000 EPL)		
					(ATTACHING PARTS)		
-151	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-152	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-153	337-1744-00			1	SHIELD,ELEC:REAR PANEL	80009	337-1744-00
-154	386-2233-00			1	PANEL,REAR:	80009	386-2233-00
-155	337-1652-00			1	SHIELD,MOISTURE:POWER SUPPLY	80009	337-1652-00
					(ATTACHING PARTS)		
-156	211-0538-00			2	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-157	211-0504-00			2	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-158	129-0208-00			2	SPACER,POST:0.312" LONG,6-32 ONE END	80009	129-0208-00
-159	----- -----			1	CKT BOARD ASSY:RECTIFIER(SEE A10 EPL)		
					(ATTACHING PARTS)		
-160	211-0507-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-161	211-0511-00			1	SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-162	214-1292-00			2	. HEAT SINK,ELEC:TRANSISTOR	05820	205-AB
-163	136-0220-00			2	. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-164	214-1731-00			1	. HEAT SINK,ELEC:TRANSISTOR	80009	214-1731-00
					(ATTACHING PARTS)		
-165	210-0586-00			1	. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-166	211-0012-00			1	. SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-167	210-0935-00			1	. WASHER,NONMETAL:FIBER,0.14 IDX 0.375"OD	74921	OBD
					- - - * - - -		
-168	131-0608-00			28	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-169	344-0154-00			2	. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-170	----- -----			1	TRANSFORMER,PWR:(SEE T801 EPL)		
					(ATTACHING PARTS)		
-171	212-0582-00			4	SCREW,MACHINE:10-32 X 3.5 INCH,HEX HD STL	83385	OBD
-172	210-0812-00			4	WASHER,NONMETAL:#10,FIBER	06982	OBD
-173	166-0457-00			4	INSUL SLVG,ELEC:0.19 ID X 1.875"LONG MYLAR	80009	166-0457-00
-174	361-0403-00			2	SPACER,XFMR:	80009	361-0403-00
-175	361-0526-00			2	SPACER,XFMR:	80009	361-0526-00
					- - - * - - -		
-176	337-1654-00			1	SHIELD,ELEC:POWER SUPPLY	80009	337-1654-00
					(ATTACHING PARTS)		
-177	211-0504-00			3	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-178	441-1078-00			1	CHASSIS,SCOPE:POWER SUPPLY	80009	441-1078-00
					(ATTACHING PARTS)		
-179	212-0040-00			6	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-180	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	23499	TEK-175-0825-00
-181	175-0826-00			FT	WIRE,ELECTRICAL:3 WIRE RIBBON	08261	TEK-175-0826-00
-182	175-0827-00			FT	WIRE,ELECTRICAL:4 WIRE RIBBON	08261	TEK-175-0827-00
-183	175-0829-00			FT	WIRE,ELECTRICAL:6 WIRE RIBBON	83501	TEK-175-0829-00
-184	175-0830-00			FT	WIRE,ELECTRICAL:7 WIRE RIBBON	08261	TEK-175-0830-00
-185	175-0831-00			FT	WIRE,ELECTRICAL:8 WIRE RIBBON	08261	TEK-175-0831-00
	175-0857-00			FT	WIRE,ELECTRICAL:8 WIRE RIBBON	23499	TEK-175-0857-00
-186	175-0855-00			FT	WIRE,ELECTRICAL:10 WIRE RIBBON	23499	TEK-175-0855-00
-187	179-1817-00			1	WIRING HARNESS:50 OHM COAX	80009	179-1817-00
-188	131-0707-00			5	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-0708-00			5	CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
-189	352-0168-00			1	. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
	179-1637-00			1	WIRING HARNESS,:POWER	80009	179-1637-00
-190	131-0861-00			4	. CONTACT,ELEC:QUICK DISCONNECT	00779	42617-2
-191	200-1075-00			4	. COVER,ELEC CONN:PLASTIC	00779	1-480435-0
-192	352-0169-01			1	. CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01
-193	175-1263-00			1	CABLE,SP,ELEC:17 INCH LONG,W/SHIELD	80009	175-1263-00
-194	131-0621-00			3	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-195	352-0199-00			1	. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	131-0707-00			179	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-0708-00			6	CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
	131-0621-00			2	CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-196	352-0171-00			2	CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00
	352-0169-00			2	CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	352-0169-01			2	CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01
	352-0169-04			2	CONN BODY,PL,EL:2 WIRE YELLOW	80009	352-0169-04
-197	352-0161-00			1	CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0161-00
	352-0161-02			1	CONN BODY,PL,EL:3 WIRE RED	80009	352-0161-02
-198	352-0162-00			2	CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
	352-0162-01			1	CONN BODY,PL,EL:4 WIRE BROWN	80009	352-0162-01
	352-0162-05			1	CONN BODY,PL,EL:4 WIRE GREEN	80009	352-0162-05
-199	352-0164-01			2	CONN BODY,PL,EL:6 WIRE BROWN	80009	352-0164-01
-200	352-0165-00			4	CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0165-00
-201	352-0166-00			4	CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00
	352-0166-01			3	CONN BODY,PL,EL:8 WIRE BROWN	80009	352-0166-01
	352-0166-02			3	CONN BODY,PL,EL:8 WIRE RED	80009	352-0166-02
	352-0166-03			2	CONN BODY,PL,EL:8 WIRE ORANGE	80009	352-0166-03
	352-0168-00			2	CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-202	210-0775-00			8	EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-203	210-0774-00			8	EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00

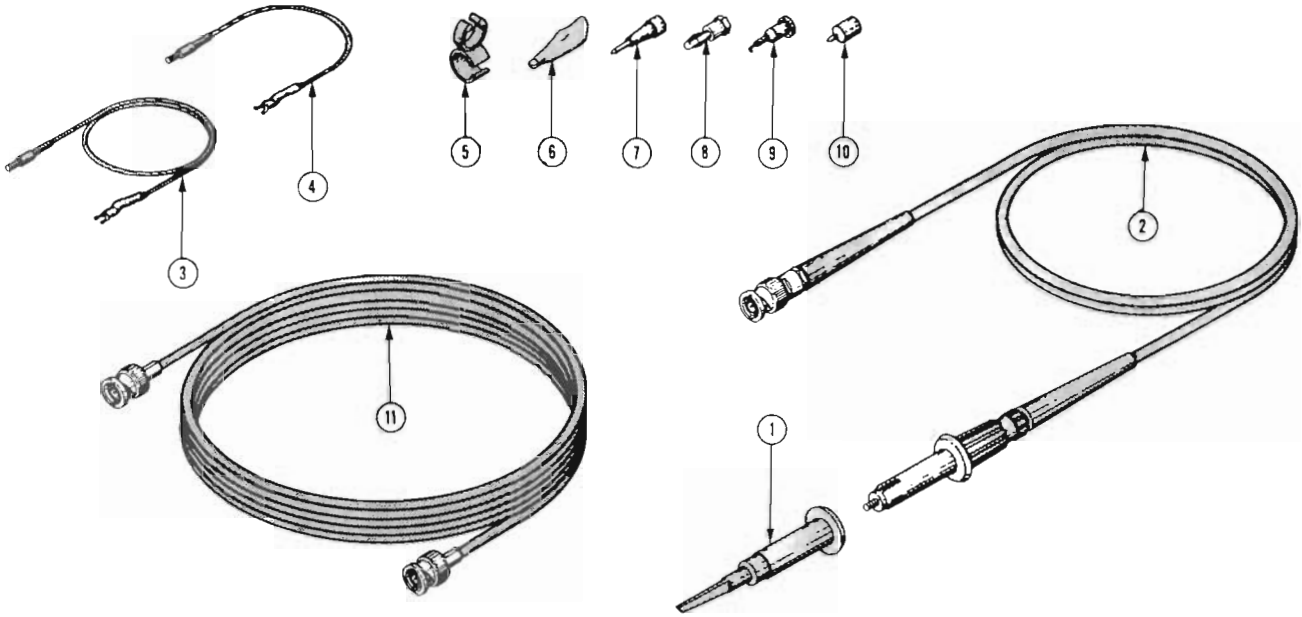


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	016-0553-00			1	COV ASSY,SCOPE:W/PROBE AND ACCESSORIES	80009	016-0553-00
	010-0127-00			2	. LEAD,TEST:	80009	010-0127-00
	----- -----			-	. . EACH PROBE INCLUDES:		
-1	013-0071-00			1	. . TIP,PROBE:RETRACTABLE HOOK	80009	013-0071-00
-2	010-0128-00			1	. . PROBE,VOLTAGE:42.0 INCH LONG,10X	80009	010-0128-00
-3	175-0125-01			1	. . LEAD,ELECTRICAL:PROBE GND,12 INCHES LONG	80009	175-0125-01
-4	175-0124-01			1	. . LEAD,ELECTRICAL:PROBE GND,5 INCHES LONG	80009	175-0124-01
-5	352-0090-00			1	. . HOLDER,TEST PRO:0.45 ID X 0.600 OD	80009	352-0090-00
-6	344-0046-00			2	. . CLIP,ELECTRICAL:ALLIGATOR TYPE,W/COVER	80009	344-0046-00
-7	206-0060-00			1	. . TIP,PROBE:STRAIGHT TIP,ASSY	80009	206-0060-00
-8	134-0013-00			1	. . PLUG,TIP:	74970	108-753-17
-9	206-0105-00			1	. . TIP,PROBE:HOOK ASSEMBLY	80009	206-0105-00
-10	206-0015-00			1	. . TIP,PROBE:	80009	206-0015-00
-11	012-0366-00			2	. CABLE,INTCON:8 FEET LONG,W/BNC EACH END	80009	012-0366-00

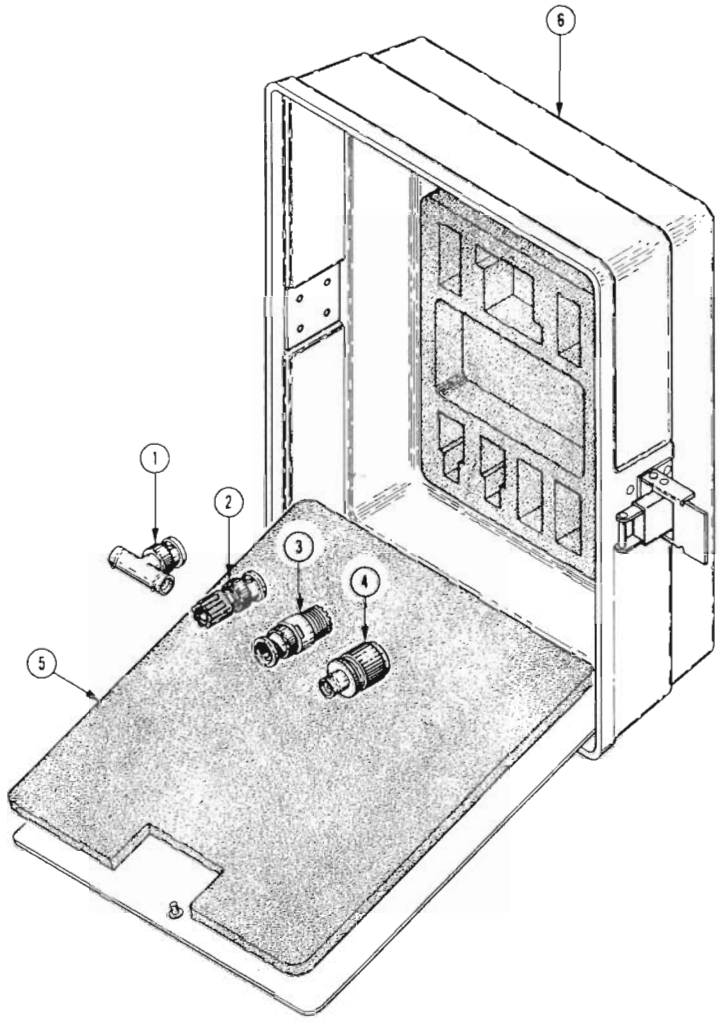


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
-1	103-0030-00			2	. ADAPTER,CONN:BNC TO BNC	91737	UG274BUDURAPLATE
-2	103-0033-00			2	. ADAPTER,CONN:BNC TO BINDING POST	24931	28PB100-2
-3	103-0032-00			2	. ADAPTER,CONN:BNC MALE TO UHF FEMALE	24931	29-JP116-1
-4	103-0015-00			2	. ADAPTER,CONN:BNC TO UHF	24931	29JP100-3
-5	348-0320-00			1	. PAD,CUSHIONING:TOP	80009	348-0320-00
-6	200-1360-01			1	. COVER,SCOPE FR:W/TRAY	80009	200-1360-01
	070-1866-00			1	MANUAL,TECH:INSTRUCTION	80009	070-1866-00

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.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

7603
R7603

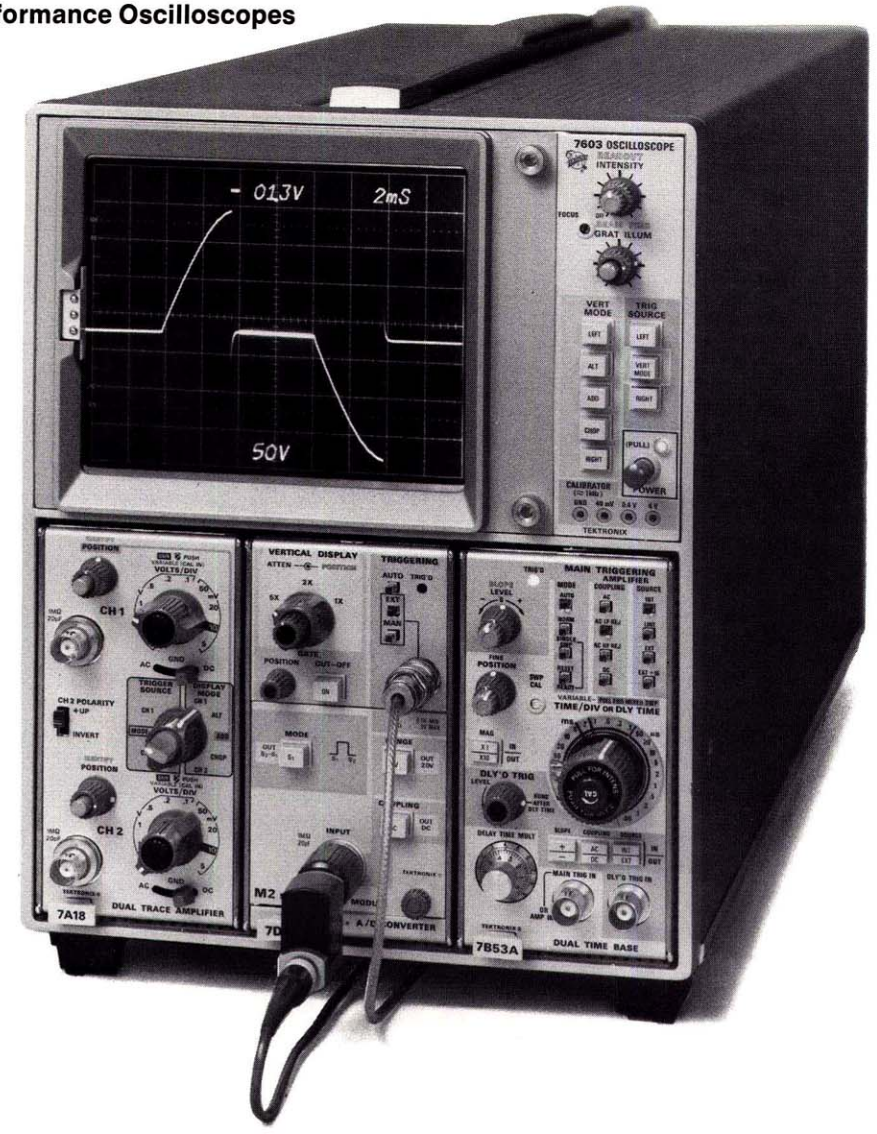
7000-Series 100-MHz Wide Performance Oscilloscopes

Dc-to-100 MHz Bandwidth

6½ in Crt

Crt Readout

5¼ in Rackmount



The TEKTRONIX 7603 and R7603 Oscilloscopes represent the best price/performance ratio available in the 100-MHz plug-in oscilloscope market today.

The crt is large, 8 x 10 div (1.22 cm/div), and features an internal graticule with variable illumination and 15 kV accelerating potential. An optional maximum brightness crt with a smaller 8 x 10 cm display and 18 kV potential gives you greater visual brightness and higher photographic writing speed.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit; see Vertical System Specifications Chart.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — Repetition rate is approx 1 MHz.

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channels — One right-hand plug-in compartment; compatible with all 7000-Series Plug-ins.

Fastest Calibrated Sweep Rate — 5 ns/div.

X-Y Mode — The phase shift between vertical and horizontal channels is within 2° from dc to 35 kHz. Bandwidth is dc to at least 2 MHz.

CRT AND DISPLAY FEATURES

Standard — Internal 8 x 10-div (1.22 cm/div) graticule with variable illumination. Accelerating potential is 15 kV with P31 phosphor.

Option 01, without Crt Readout — No crt readout.

Option 04, Max Brightness Crt — Internal 8 x 10 cm graticule with variable illumination. Accelerating potential is 18 kV with P31 phosphor standard.

Option 06, Spectrum Analyzer Graticule.

Optional Phosphors (Specify) — P7, P11, or P7/SA. (Phosphor/Spectrum Analyzer graticule combination.)

Minimum Photographic Writing Speed — Using Polaroid film without film fogging. Can be increased by using the TEKTRONIX Writing Speed Enhancer.

Crt	Writing Speed div/μs				Camera	Lens
	Type 107/47		Type 410			
	P31	P11	P31	P11		
Standard 8 x 10 div (1.22 cm/div)	100	150	200	300	C-50	f/1.9 1:0.7
Option 04 8 x 10 div (1 cm/div)	200	300	400	600		

External Z-Axis Input — 2 V p-p for full intensity range from dc to 2 MHz; intensity range diminishes to 20% of full range at 10 MHz. A positive signal blanks the trace. Max input voltage is 10 V (dc + peak ac) and p-p ac.

Autofocus — Reduces the need for additional manual focusing with changes in intensity after focus control has been adjusted.

Beam Finder — Limits display within graticule area.

OUTPUTS/INPUTS

+SAWTOOTH — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output R is 950 Ω. Output voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω.

+Gate — Positive pulse of the same duration and coincident with sweep. Output R is 950 Ω. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Rise time is 20 ns or less into 50 Ω. Source is selectable from Main, Delay, or Auxiliary Gate.

Sig Out — Selected by TRIGGER SOURCE switch. Output voltage is 0.5 V/div (±10%) into 1 MΩ, 25 mV/div (±10%) into 50 Ω. Output R is 950 Ω. Bandwidth depends upon vertical plug-in; see Vertical System Specifications Chart.

External Single-sweep Reset — Ground closure, rear panel BNC provides input to reset sweep.

Single-sweep Ready Indicator — Rear panel BNC provides 5 V for single-sweep ready condition.

Option 07, without Signal Outputs/Inputs — No outputs/inputs.

CAMERA POWER OUTPUT

Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

CALIBRATOR

Voltage Output — Rectangular waveshape, positive-going from ground (dc voltage available when selected by internal jumper). Ranges are 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15°C to +35°C); within 2% (0°C to +50°C). Repetition rate is approx 1 kHz.

Current Output — 40-mA rectangular waveshape (dc current available when selected by internal jumper) with optional current-loop accessory (012-0259-00) connected between 4 V and gnd pin jacks.

POWER REQUIREMENTS

Line Voltage Ranges — 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick-change jumpers.

Line Frequency — 50 Hz to 400 Hz (7603); 50 Hz to 60 Hz (R7603).

Option 5, Line Frequency Change (50-400 Hz) — Converts the R7603 to 50-400 Hz operation (not required for 7603).

Max Power Consumption — 180 W, 2.0 A at 115 V line, 60 Hz. Cooling is provided by a fan for the R7603.

Included Accessories — (For 7603 and R7603) 20 in cable (two-pin-to-BNC) (175-1178-00); crt filter (Blue 337-1700-01, Clear 337-1700-04). The R7603 includes rackmounting hardware.

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

The R7603 requires only 5¼ in of rack height in a standard 19 in rack. It is fan cooled and comes complete with slide-out chassis tracks.

ORDERING INFORMATION

(Plug-ins not Included)

7603 Oscilloscope $1850

R7603 Oscilloscope $2050

7603 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $100
Option 06	with Internal Spectrum Analyzer Graticule	No charge
Option 07	without Sig Out/In	Sub $50
Option 08	Protective Panel Cover	Add $100

R7603 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $100
Option 05	Line Freq Change (50-400 Hz) (not required for 7603)	Add $125
Option 06	with Internal Spectrum Analyzer Graticule	No charge
Option 07	without Sig Out/In	Sub $50

7603 CONVERSION KITS

040-0654-02	Crt Readout	$550
040-0662-00	Emi Modification	$165
040-0629-01	Sig Out/In	$120
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30
040-0718-00	X-Y Horiz Comp	$150

R7603 CONVERSION KITS

040-0674-02	Crt Readout	$550
040-0679-00	Emi Modification	$165
040-0633-00	Sig Out/In	$85
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30
040-0718-00	X-Y Horiz Comp	$150

PHOSPHOR OPTIONS (7603/R7603)

Option 76	P7 Phosphor	No charge
Option 77	P7 Phosphor with Internal Spectrum Analyzer Graticule	No charge
Option 78	P11 Phosphor	No charge

7000-Series Ruggedized Oscilloscope System | 7603N11S

Ruggedized for Extreme Environments

Meets or Exceeds MIL-O-24311 (EC) (AN/USM-281C Specifications)

Large Bright Display—6½ in Crt (15 kV)

5 ns/div Delaying Sweep

0.5 mV Vertical Sensitivity

Three-plug-in Flexibility

Versatile Trigger-source Selection

Pushbutton Switching

Illuminated No-Parallax Graticule

Color-keyed Panels

Protective Cover with Accessories

The 7603N11S Ruggedized Oscilloscope System meets the rigid environmental and electrical specifications required by MIL-O-24311 (EC) and appears on U.S. Navy QPL-24311. The system consists of a three-plug-in mainframe, two single-trace amplifiers, a dual time base, and a front-panel cover with probes and accessories.

Although the military spec requires only 50-MHz performance, this system actually performs to 65 MHz. Other better-than-required specs include operating altitude, sensitivity at reduced bandwidth with X10 gain, "X" sensitivity in X-Y mode, triggering frequency range, delaying and delayed sweep speeds, and crt size.

7603N11S Ruggedized Oscilloscope System

The mainframe and plug-ins are compatible with the TEKTRONIX 7000-Series product line. The system does not have crt readout, and it can't be used with the digital plug-ins.

ENVIRONMENTAL

Temperature — Nonoperating −62°C to +75°C, operating −28°C to +65°C.

Humidity — 0 to 95% rh over entire temperature range, operating or nonoperating.

Altitude — Nonoperating sea level to 50,000 ft, operating sea level to 15,000 ft.

Vibration (Operating) — 5 to 15 Hz at 0.060 in ±0.012 in p-p amplitude, 16 to 25 Hz at 0.040 in ±0.008 in p-p amplitude, 26 to 33 Hz at 0.020 in ±0.004 in p-p amplitude.

Shock (Operating) — 9 consecutive 400-pound hammer blows without failure from 1, 3, and 5 ft in vertical, horizontal, and longitudinal axis as per MIL-S-901 for Grade A, Class 1, Type A for lightweight equipment.

Inclination (Operating) — As per MIL-E-16400.

Drip Proof (Nonoperating) — As per MIL-STD-198.

Salt Spray (Nonoperating) — As per MIL-E-16400.

Electromagnetic Interference — As per MIL-STD-462 performed by MIL-STD-461 for the following tests:

CE-01	30 Hz to 20 kHz	Power lead emission
CE-03	20 kHz to 50 MHz	Power lead emission
CS-01	30 Hz to 50 kHz	Power lead, radiation susceptibility
CS-02	50 kHz to 4C0 MHz	Power lead, radiation susceptibility
CS-06	Spike Test	Power lead, spike susceptibility
RE-01	30 Hz to 30 kHz	Instrument radiation, magnetic
RE-02	14 kHz to 10 GHz	Instrument radiation, electric
RS-01	30 Hz to 30 kHz	Instrument susceptibility, magnetic
RS-03	14 kHz to 10 GHz	Instrument susceptibility, electric

Reliability — Optimum performance and reliable service are provided during continuous or interrupted operation. The MIL-O-24311(EC) MTBF requirement of greater than 600 hours is met as tested under the following conditions: temperature +40°C ±2°C; relative humidity 70% ±5%; vibration 25 Hz at 0.040 in ±0.0008 in p-p amplitude for 10 minutes of each "Power On" hour during each day of the 8 hour manned schedule; power cycled at 4 hour intervals with 10 minutes power off for each 4 hour period of the manned test schedule. An MTBF of greater than 2000 hours was achieved during testing.

VERTICAL SYSTEM
(Includes Two 7A15AN11 Plug-ins)

Channels — Two left-hand plug-in compartments, with a delay line which allows the leading edge of the displayed waveform to be viewed. All 7000-Series Plug-ins are compatible (except those which require crt readout).

Display Modes — LEFT, ALT, ADD, CHOP, RIGHT. Chopped frequency is approx 1 MHz. Added mode displays signals algebraically with a cmrr of 20:1 to 25 MHz.

Bandwidth/Sensitivity — Dc to 65 MHz from 5 mV/div to 10 V/div, accuracy within 2%, variable extends to 25 V/div. Max sensitivity is 0.5 mV at 10 MHz with X10 gain. Ac-coupling lower −3 dB point is less than 2 Hz. Rise time is 5.4 ns with less than 2% aberrations.

Input R and C — 1 MΩ within 2%, less than 27 pF.

Max Input Voltage — 400 V (dc + peak ac).

Dc Stability — Less than 1 div/hr drift at 25°C.

HORIZONTAL SYSTEM
(Includes One 7B53AN11 Plug-in)

Channels — One right-hand plug-in compartment. All 7000-Series Plug-ins are compatible (except those which require crt readout).

Internal Trigger Modes — LEFT VERT, VERT MODE, RIGHT VERT.

X-Y Mode — The phase shift between vertical and horizontal channels is less than 2° from dc to 35 kHz. Bandwidth is at least 2 MHz. Rise time is less than 175 ns. Using the 7B53AN11 time-base external amplifier, 10 mV, 100 mV, and 1 V sensitivities (±10%) are available. Input R and C for 7B53AN11 is 1 MΩ within 2%, 20 pF within 2 pF. Any vertical plug-in, such as the 7A15AN11, may be used in the horizontal compartment, providing a greater number of sensitivities for calibrated X-Y displays.

Sweep Display Modes — Main Sweep, Main Sweep Intensified by Delayed Sweep, Delayed Sweep.

MAIN (DELAYING) SWEEP

Sweep Rate — 0.05 μs/div to 5 s/div in 25 steps (1-2-5 sequence). 5 ns/div fastest calibrated sweep rate, obtained with X10 magnifier. The uncalibrated variable is continuous between steps and to 12.5 s/div.

Sweep Accuracy — Within 3% from 0.05 μs/div to 5 s/div, within 5% at 5 ns/div.

Sweep Modes — Normal, Auto, Single Sweep.

Delay Time — Multiplier range is 0 to 10 times the Time/Div setting. Accuracy is within 1% from 0.5 s/div to 0.5 μs/div, within 2% from 5 s/div to 1 s/div. Incremental linearity is within 0.2% of full scale. Jitter is less than 1 part in 20,000 of X10 Time/Div setting.

Triggering (Source/Sensitivity) — Internal 0.5 cm to 50 MHz. External, 0.25 V to 20 MHz, 0.5 V to 50 MHz. Ext ÷ 10, 2.5 V to 20 MHz, 5 V to 50 MHz. Triggering extends to 100 MHz with reduced sensitivity in both Internal and External Modes. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF.

Triggering Frequency Range — Ac, 30 Hz to 50 MHz; ac lf Rej, 30 kHz to 50 MHz; ac hf Rej, 30 Hz to 50 kHz; dc, dc to 50 MHz. With external level range, slope is ±30 V.

DELAYED SWEEP

Triggering (Source/Sensitivity) — Internal 0.3 div to 10 MHz increasing to 1.5 div at 50 MHz. External, 0.1 V to 10 MHz increasing to 0.5 V at 100 MHz. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF.

Triggering Frequency Range — Ac, 30 Hz to 50 MHz; dc, dc to 50 MHz.

Sweep Rate — 0.05 μs/div to 0.5 s/div in 22 steps (1-2-5 sequence). The delayed sweep runs after delay time or is triggerable after delay time.

Sweep Accuracy — Within 3% from 50 ms/div to 0.5 μs/div, within 4% for all other sweep rates except the magnified X10 sweep rate of 5 ns/div, which is within 6%.

CRT

Accelerating Potential — 15 kV.

Phosphor — P31.

Graticule — Internal 8 x 10 cm with variable illumination. The 6½ in crt permits 2 cm of linear overscan in both axes, making a total viewing area of approx 10 x 12 cm.

Crt Controls — Located on front panel are Focus, Intensity, Graticule Illumination, Beam Finder, and Trace Rotation. Astigmatism is an internal control.

External Z-Axis Input (BNC Connector on Rear Panel) — 2 V p-p for full intensity range from dc to 2 MHz, intensity range diminishes to 20% of full range at 10 MHz. Max input voltage is 10 V (dc + peak ac).

OUTPUTS

Calibrator (BNC Connector on Front Panel) — 1 V within 1%, 1 kHz square wave within 20%.

Horizontal — Main Sweep +5 V, Delayed Sweep +5 V, Main Sweep Gate +2 V, Delayed Sweep Gate +2 V, Delayed Trigger +1 V with pulse width of greater than 50 ns. All amplitudes are minimum and measured when working into at least 100 kΩ and 15 pF.

POWER REQUIREMENTS

Input Voltages — 100, 110, 120, 220, and 240 V ac ± 10% internally selectable with quick-change jumpers with 47.5−440 Hz single phase line frequency. Max power consumption is 125 W.

C281 COVER WITH ACCESSORIES

The cover provides protection during transport and packages the included accessories.

INCLUDED ACCESSORIES
(All Packaged in Cover)

Two P6006 probe packages (010-0127-00); two 8 ft long 50-Ω BNC cables (012-0366-00); two BNC female to uhf male adapters (103-0015-00); two BNC male to uhf female adapters (103-0032-00); two BNC male to binding post adapters (103-0033-00); two BNC T connectors (103-0030-00). One set of technical manuals (not packaged in cover).

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION

7603N11S Oscilloscope System (AN/USM-281C)
Order 7603NMS **$3450**

System Includes — One each 7603N11 Oscilloscope, two each 7A15AN11 Amplifier Plug-ins, one each 7B53AN11 Time Base*, and one each C281 Cover with Accessories.

To Order Separately:

7603N11 Oscilloscope (OS-245(P)/U) **$1775**

7A15AN11 Amplifier Plug-in (AM-6565/U) **$350**

7B53AN11 Time Base* Plug-in (TD-1085/U) **$975**

016-0553-00, C281 Cover W/Accessories **$120**

*Not compatible with 7844.