TEKTRONIX®

# 7A19 AMPLIFIER

## INSTRUCTION MANUAL

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

Serial Number ____________

070-2129-00

First Printing MAY 1976

# TABLE OF CONTENTS

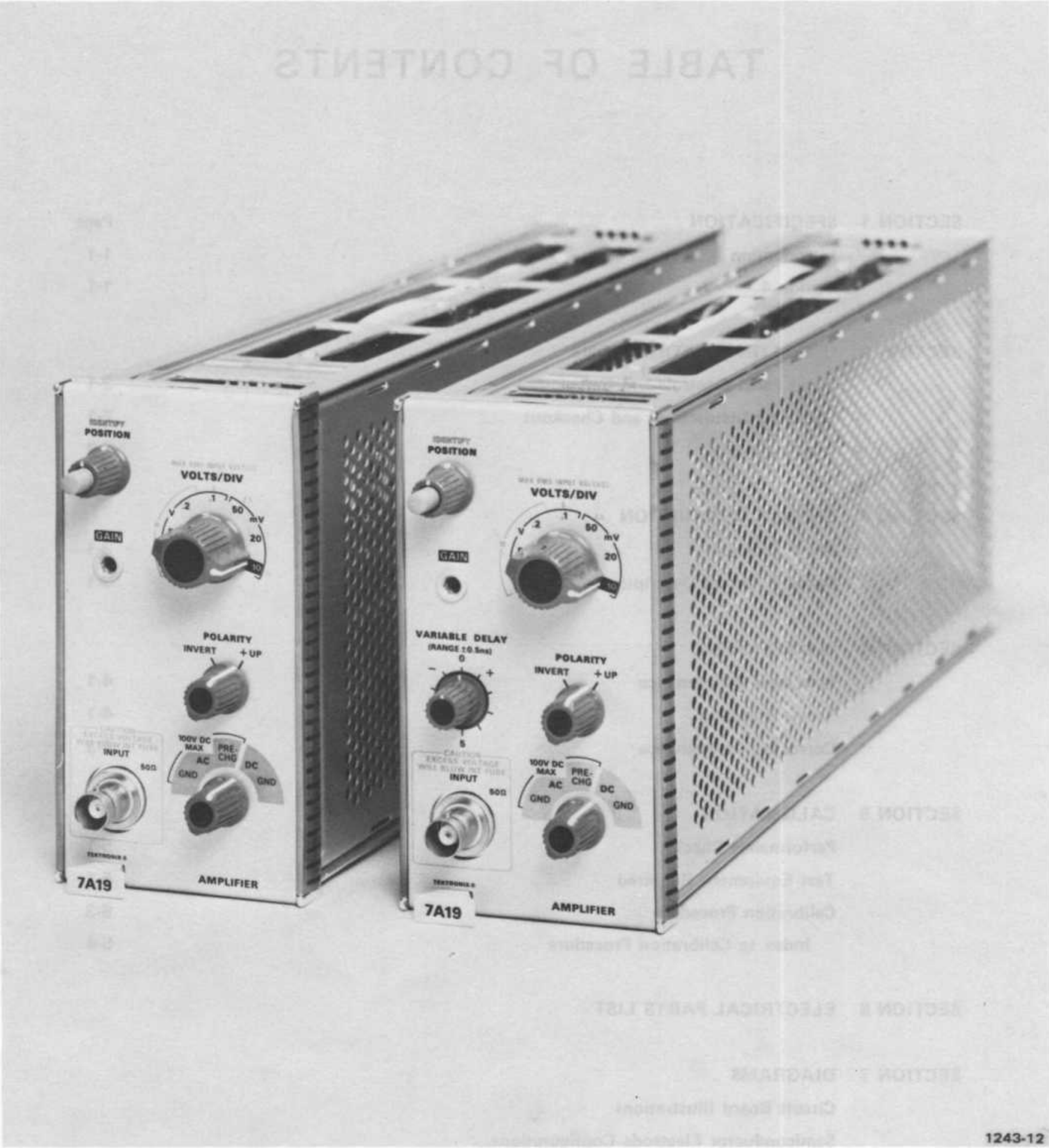



Fig. 1-1. 7A19 Amplifier plug-in (Left) and 7A19 with Variable delay option (Right).

# SPECIFICATION

## Introduction

The 7A19 Amplifier plug-in unit is a wide band amplifier designed for use with TEKTRONIX 7000-Series oscilloscopes. Readout encoding circuitry is provided in the 7A19 to allow probe coding, deflection factor readout, and IDENTIFY functions. The 7A19 can be operated in any compartment of the 7000-Series oscilloscopes, but is primarily intended for use in the vertical plug-in compartments.

The following electrical characteristics are valid over the stated environmental range for instruments calibrated at an ambient temperature of +20°C to +30°C, and after a five minute warmup unless otherwise noted.

## Option 4

An optional VARIABLE DELAY may be ordered with the 7A19 to provide a signal delay of up to ±500 ps.

**TABLE 1-1**

**ELECTRICAL**

| Characteristic | Performance Requirement | Supplemental Information |
|---|---|---|
| Deflection Factor | | |
| Calibrated Range | 10 mV/div to 1 V/div, 7 steps in a 1, 2, 5 sequence | Pre-Charge circuit may be used as a calibrated 100X attenuator |
| Gain Ratio Accuracy | Within 3% with GAIN adjusted at 10 mV/div when driven from 50 ohm source. | Front panel GAIN control allows calibration to mainframe. |
| Frequency Response (8 division reference, mainframe dependent) | | |
| Upper Bandwidth AC or DC coupled 10 mV/div to 1 V/div | With 7400, 65 MHz; With 7500, 100 MHz; With 7700, 175 MHz; With 7900, 500 MHz | |
| Lower Bandwidth AC Coupled | 1 kHz or less | |
| Maximum Input Power DC or AC coupled | 2 watts average or 50 divisions peak deflection. | *CAUTION* *Pre-charge circuit must be used for both charging and discharging AC coupling capacitor to potentials greater than 50 divisions equivalent voltage.* |
| Voltage (AC coupled) | 100 volts (DC + peak AC) not to exceed 2 watts average or 50 divisions peak. | |
| Input Impedance | | |
| Resistance (DC or DC GND) | 50 ohms ±1 ohm | VSWR is typically less than 1.25 @ 500 MHz |
| Reflection Coefficient (Time Domain) | Less than 0.1 peak to peak | |
| Maximum Input Current | Less than 0.2 mA | |

TABLE 1-1 (cont)

| Characteristic | Performance Requirement | Supplemental Information |
|---|---|---|
| IDENTIFY | | Deflects trace approximately 0.3 division |
| Trace Positioning | | At least ±8 divisions |
| Display Noise (Tangentially Measured) | | Less than 0.1 division |
| DC Drift | | |
| Drift with ambient temperature (line voltage constant) | 100 $\mu$V/C° or less | |
| Variable Delay (Option 4) | | |
| Range | Variable from −0.5 ns to +0.5 ns | |
| Accuracy | To 1 ns within ±0.05 ns of dial setting | |
| Input Polarity | | Front panel switch selects +UP or INVERT |

TABLE 1-2

ENVIRONMENTAL CHARACTERISTICS

Refer to the specifications for the associated oscilloscope.

TABLE 1-3

PHYSICAL

| | |
|---|---|
| Size | Fits all 7000-Series plug-in compartments |
| Weight | 7A19: .9 kilograms or 2.1 lbs.<br>7A19 (option 1): 1.3 kilograms or 2.9 lbs. |

# OPERATING INSTRUCTIONS

## General

To effectively use the 7A19, the operation and capabilities of the instrument must be known. This section describes front-panel control functions, general information on signal input connections, and other subjects that pertain to various measurement applications.

## Installation

The 7A19 is calibrated and ready for use as received. It can be installed in any compartment of TEKTRONIX 7000-Series Oscilloscopes, but is intended for principal use in vertical plug-in compartments. To install, align the upper and lower rails of the 7A19 with the oscilloscope tracks and insert it. The front panel will be flush with the front of the oscilloscope and the latch at the bottom left corner will be in place against the front panel when the 7A19 is fully inserted.

To remove the 7A19, pull on the latch (inscribed with the unit identification "7A19") and the 7A19 will unlatch. Continue pulling to slide the 7A19 out of the oscilloscope.

## FRONT PANEL CONTROLS AND CONNECTORS

| | |
|---|---|
| VOLTS/DIV | Selects calibrated deflection factors from 10 mV/Div to 1 V/Div; 7 steps in a 1-2-5 sequence. |
| POSITION | Controls the position of the trace. |
| IDENTIFY | Deflects the trace about 0.3 division for trace identification. In instruments with readout, also replaces readout with the word "IDENTIFY". |
| GAIN Adjustment | Screwdriver adjustment permits calibration of deflection factor. |
| POLARITY | Provides a means of inverting the display. |
| | +UP: A positive-going signal at the INPUT connector deflects the CRT display upward. |
| | INVERT: A positive-going signal at the INPUT connector deflects the CRT display downward. |
| Input Coupling Switch | Selects signal input coupling mode. |
| | AC: The AC component of the signal is coupled to the amplifier input while the DC component is blocked. |
| | AC GND: Grounds the amplifier input while maintaining the same AC load for the input signal. |
| | PRE-CHG: Provides a charge path for the AC coupling capacitor to pre-charge the input circuit before switching the Input coupling switch to AC. |
| | DC: Both AC and DC components of the signal are coupled to the amplifier input. |
| | DC GND: Grounds the amplifier input while maintaining the same DC load for the input signal. |
| INPUT Connector | Provides a means for connecting a signal. |
| VARIABLE DELAY (Option 4) | Delays the signal up to ±500 picoseconds by using a calibrated 10 turn dial. |

## OPERATING INSTRUCTIONS and CHECKOUT

### Probes

Probes recommended for use with the 7A19 are the P6056 (10X) or P6057 (100X). Both probes are compatible to 50 ohm systems, and will allow optimum frequency response. These probes also contain trace IDENTIFY and readout encoding functions.

If the P6201 Probe is used, a one megohm input impedance may be achieved. Consult your local TEKTRONIX Field Engineer or Representative for further information.

## Vertical Gain Check and Adjustment

To check the gain of the 7A19, set the VOLTS/DIV switch to 10 mV and connect 20 mV, 1 kHz signal from the oscilloscope Calibrator to the INPUT connector. The vertical deflection should be exactly two divisions. If not, adjust the front panel GAIN control for exactly two vertical divisions.

## Input Coupling

The input coupling switch allows a choice of input coupling methods. The type of display desired and the applied signal will determine the coupling to use.

The DC coupling position can be used for most applications. For AC signals with frequencies below about 1 kHz, and square waves whose low-frequency components are important to the display, it is necessary to use DC coupling to obtain a satisfactory presentation.

DC GND position disconnects the signal source from the amplifier and connects it to a resistive 50 ohm termination, thus providing the same type of load to the signal source. The input to the amplifier is also provided with a ground reference.

In the AC coupling position, the DC component of the signal is blocked by a capacitor in the input circuit. The AC coupling position provides the best display of signals with a DC component much larger than the AC component.

The PRE-CHG feature should be used when there is a possibility of having a residual charge on the input capacitor of the opposite polarity to the intended input, and when the algebraic sum of the charges may be greater than the maximum input limitations of the amplifier. To use this feature, first set the coupling switch to PRE-CHG, then connect the signal source to the INPUT and wait about two seconds for the coupling capacitor to charge, set the coupling switch to AC.

Another useful feature of the PRE-CHG position is that it can be used as a calibrated 100X attenuator having an input impedance of five kilohms in series with two microfarads. This extends the Low Frequency response to less than 20 Hz. Input power should be limited to 1/8 watt in this mode.

The AC GND position disconnects the signal source from the amplifier and connects it to a capacitive coupled 50 ohm termination, thus providing the same type of load to the signal source. The input to the amplifier is also provided with a ground reference.

## VOLTS/DIV Switch

The amount of deflection produced by a signal is determined by the signal amplitude, the attenuation factor of the probe, the setting of the VOLTS/DIV switch, and the setting of the Input Coupling switch. Calibrated deflection factors represented by the VOLTS/DIV switch apply only when the probe attenuation is X1 and when the Input Coupling switch is not in the PRE-CHG position (the PRE-CHG position has an attenuation of 100X).

## POLARITY Switch

The POLARITY switch provides a means of inverting the displayed signal. With the POLARITY switch set to +UP, a positive-going signal at the INPUT produces an upward deflection of the CRT display. With the POLARITY switch set to INVERT, a positive-going signal will produce a downward deflection of the CRT display.

## Trace Identification and Readout Functions

When the IDENTIFY button is pressed, the trace is deflected upward about 0.3 division to identify the 7A19 trace. This feature is particularly useful when multiple traces are displayed on the CRT. In mainframes with readout, it also replaces the deflection factor readout with the word "IDENTIFY".

The 7A19 is equipped with probe encoding circuitry that, when used with a coded probe, corrects the deflection factor readout.

## VARIABLE DELAY (Option 4)

The optional VARIABLE DELAY line provides a means for delaying the signal applied to the INPUT for up to ±500 ps.

# APPLICATIONS

## General

The following information describes the procedures and techniques for making measurements with a 7A19 and the associated TEKTRONIX oscilloscope and time-base. These applications are not described in detail, since each application must be adapted to the requirements of the individual measurements. This instrument can also be used for many applications which are not described in this manual. Contact your local TEKTRONIX Field Office or representative for assistance in making specific measurements.

## Peak-to-Peak Voltage Measurements (AC)

To make peak-to-peak voltage measurements, use the following procedure:

1. Apply the signal to the INPUT connector.

2. Set the Coupling switch to AC.

*NOTE*

*For low-frequency signals below about 1 kHz, use the DC position to prevent attenuation of the signal.*

3. Set the VOLTS/DIV switch to display about five vertical divisions of the waveform.

4. Set the time-base Triggering controls for a stable display. Set the time base to a sweep rate which displays several cycles of the waveform.

5. Turn the 7A19 POSITION control so the lower portion of the waveform coincides with one of the graticule lines below the center horizontal line, and the top of the waveform is within the viewing area. With the time base Position control, move the display so one of the upper peaks lies near the center vertical line (see Fig. 2-1).

6. Measure the divisions of vertical deflection peak to peak.

*NOTE*

*This technique can also be used to make measurements between two points on the waveform, rather than peak to peak.*

7. Multiply the distance measured in step 6 by the VOLTS/DIV switch setting. Include the attenuation factor of the probe, if used.

EXAMPLE: Assume that the peak to peak vertical deflection is 4.5 divisions using a 10X attenuator probe, and the VOLTS/DIV switch is set to 1 V.

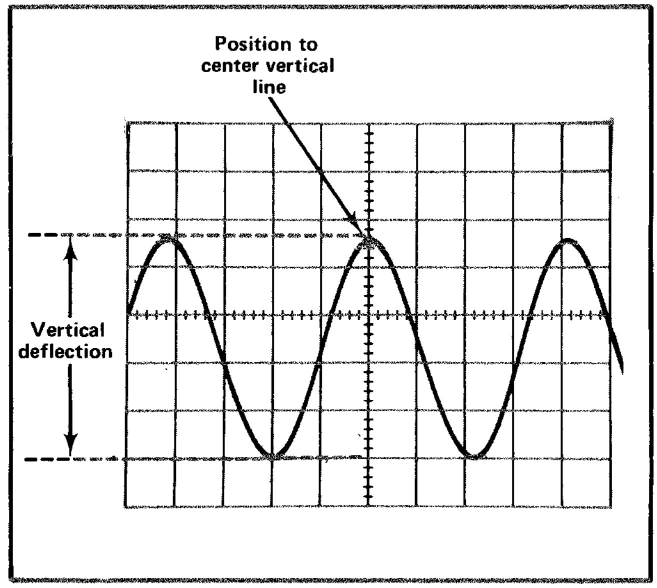



**Fig. 2-1. Measuring the peak to peak voltage of a waveform.**

$$\text{Volts} = \begin{array}{c}\text{vertical}\\ \text{deflection}\\ \text{(divisions)}\end{array} \times \begin{array}{c}\text{VOLTS/DIV}\\ \text{setting}\end{array} \times \begin{array}{c}\text{probe}\\ \text{attenuator}\\ \text{factor}\end{array}$$

Substituting the given values:

Volts Peak to Peak = 4.5 X 1 X 10

The peak-to-peak voltage is 45 volts.

When using a coded probe and an oscilloscope equipped with readout, simply multiply the distance measured in step 6 by the deflection factor displayed on the CRT.

## Instantaneous Voltage Measurements (DC)

To measure the DC level at a given point on a waveform, proceed as follows:

1. Connect the signal to the INPUT connector.

2. Set the VOLTS/DIV switch to display about five divisions.

3. Set the Coupling switch to GND, and position the trace to the bottom graticule line or other reference line. If the voltage is negative with respect to ground, position the

trace to the top graticule line. Do not move the POSITION control after this reference line has been established.

4. Set the Coupling switch to DC. The ground reference line can be checked at any time by switching to the GND position.

*NOTE*

*To measure a voltage level with respect to another voltage rather than ground, make the following changes to Step 4. Set the Coupling switch to DC and apply the reference voltage to the INPUT connector. Then position the trace to the reference line and disconnect the reference voltage.*

5. Set the time-base Triggering controls for a stable display. Set the Time Base sweep rate for an optimum display of the waveform.

6. Measure the distance in divisions between the reference line and the point on the waveform at which the DC level is to be measured. For example, in Fig. 2-2 the measurement is between the reference line and point A.

7. Establish the polarity of the waveform. With the POLARITY switch in the NORM position, any point above the reference line is positive.

8. Multiply the distance measured in step 6 by the VOLTS/DIV switch setting. Include the attenuation factor of the probe, if used.

EXAMPLE: Assume the vertical distance measured is 3.6 divisions (see Fig. 2-2) and the waveform is above the reference line, using a 10X probe with a VOLTS/DIV switch setting of 0.5 V.

Using the formula:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Instan- | | vertical | | | | VOLTS/ | | probe |
| taneous | = | distance | X | polarity | X | DIV | X | attenuation |
| voltage | | (divisions) | | | | setting | | factor |

Substituting the given values:

Instantaneous Voltage = 3.6 X 1 X 0.5 V X 10

The instantaneous voltage is 18 volts.

## Matching transit times using two 7A19's, one having VARIABLE DELAY (Option 4)

In some applications it is necessary to view the time relationship of two signals, one with respect to the other.

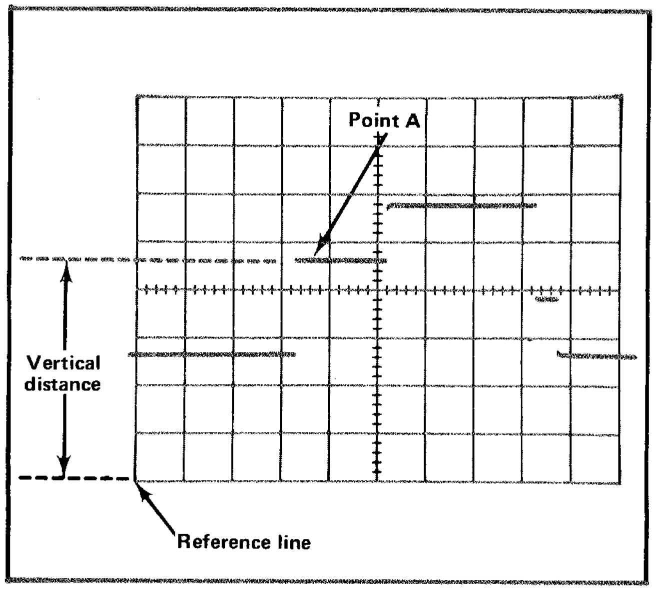



**Fig. 2-2. Measuring instantaneous voltage with respect to same reference.**

With high speed signals, the transit times of the probes and amplifiers can distort the true time relationship of the two signals. By using the VARIABLE DELAY (Option 4), the transit times between two units can be matched to within 50 ps, thus giving a true time relationship of the signals being viewed.

For matching transit times of two 7A19 with probes, proceed as follows:

1. Install the 7A19 without the VARIABLE DELAY option in the left vertical plug-in compartment.

2. Install the 7A19 with VARIABLE DELAY option in the right vertical plug-in compartment.

3. Connect the probes to a common signal source of greater than 100 kHz and adjust the time-base unit for the fastest sweep available.

4. Set the Trigger Source switch to left Vert, and Vertical Mode to Alternate.

5. Set both 7A19's to the same deflection factor settings.

6. Center both displays vertically.

7. Adjust VARIABLE DELAY so that the two displays are superimposed. The transit times of both units are now matched.

# CIRCUIT DESCRIPTION

## Introduction

This section of the manual contains a description of the circuitry used in the 7A19 amplifier. The description begins with a discussion of the instrument using the block diagram shown in the Diagrams section. Then, each circuit is described in detail using block diagrams to show the interconnections between stages in each major circuit and the relationship of the front panel controls to the individual stages.

A complete schematic of the circuits are given in the Diagrams section. Refer to this schematic throughout the following circuit description for electrical values and relationship.

## BLOCK DIAGRAM

The following discussion is provided to aid in understanding the overall concept of the 7A19 before the individual circuits are discussed in detail. Only the basic interconnections between the blocks are shown on the block diagram (see Diagrams section). Each block represents a major circuit in the instrument.

Signals to be displayed on the CRT are applied to the INPUT connector. The signal passes through the Input Coupling Switch, where the appropriate coupling is selected, to the Attenuators. The VOLTS/DIV switch selects the correct amount of attenuation.

Transit time for the 7A19 is standardized by the Fixed Delay Line. An optional Variable Delay Line can be ordered that allows the transit time of the plug-in to be varied up to 1 ns.

Signals from the Delay Line are connected to the Signal Line. The Signal Line represents a 50 Ω line that is connected to Signal Amplifier, Trigger Amplifier, Limiter, and is terminated in the Signal Line Terminater. Input impedance is effectively adjusted, therefore, by the Input Current control.

Overvoltage protection is provided by the Limiter circuitry and the fuse located in the Input Coupler.

The Signal Amplifier and Trigger Amplifier circuits are identical. They provide positioning and gain switching for the 10 mV and 20 mV ranges. GAIN calibration and temperature compensation is provided by the Gain Current Amplifier.

The Signal Amplifier and Trigger Amplifier is connected to the Polarity circuit where the oscilloscope is provided with +UP or inverted signal and trigger outputs. Outputs are connected to the oscilloscope via the interface connectors.

## DETAILED CIRCUIT DESCRIPTION

### Input Coupling

Input signals connected to the INPUT connector can be AC-coupled, DC-coupled, or internally disconnected. S5 is a cam-type switch; a contact-closure chart showing the operation is given on the schematic in the Diagrams section. When the Input Coupling Switch is in the DC position, the input signal is coupled directly to the Attenuator. The DC GND position disconnects the input signal from the Attenuators and connects it to ground through two 100 Ω resistors in parallel. Paralleling the 100 Ω resistors reduces the inductance associated with the resistors so that the combination will remain 50 Ω for all frequencies within the limits of this plug-in. Connected in a similar manner and for the same reasons are the input fuses F6 and F7. In the AC position, the input signal passes through capacitor C5. The capacitor prevents the DC component of the signal from passing to the Attenuator. AC GND position disconnects the input signal from the Attenuators and connects it to ground through C5 and the two 100 Ω resistors. This represents the same load to the signal source. The PRE-CHG position limits the instantaneous current caused by connecting a large signal to the INPUT connector by inserting a resistor in series with C5. Since this resistor is 4.95 kΩ and the input to the Attenuator is 50 Ω, the PRE-CHG position will act as a X100 attenuator.

### Attenuator

The effective overall deflection factor of the 7A19 is determined by the setting of the VOLTS/DIV switch, S135 and the Step Attenuator, A10. Gain switching for the 10 mV and 20 mV positions occur in the Signal and Trigger Amplifiers. The signal in the 10 mV and 20 mV position is passed through the Step Attenuator, unattenuated. Precision microwave attenuators, located in the Step Attenuator, are switched in at all other VOLTS/DIV positions.

### Delay Lines

Unless Variable Delay Option 4 is requested, all 7A19's are equipped with a Fixed Delay Line consisting of a precision length of 50 Ω cable. The Fixed Delay Line is inserted in series with the Signal Line so that the transit times of all 7A19 plug-in's can be closely regulated. The optional Variable Delay Line, when requested, replaces the Fixed Delay Line.

## Signal Line Terminator

The Signal Line Terminator consists of a current sensing operational amplifier connected to the Signal Line. This operational amplifier senses changes in currents at the Signal Line and compensates by adding or subtracting currents. The Input Current control sets the quiescent current at the Signal Line. This is the major controlling factor for input impedance. Changes of input current due to positioning or polarity switching are also compensated by this circuit. R121 and C121 compensate for the addition of this circuit to the Signal Line.

## Limiter

CR124, CR125 provide overload protection. An overload condition at the signal INPUT connector will cause one or both diodes to forward bias. If this condition continues, the current flowing through the diodes will soon cause the fuses F6, F7 to burn out. Diodes CR124, CR125 are connected to the Signal Line through an impedance matching "T" network, L124, L125, and C123.

## Signal Amplifier and Trigger Amplifier

The Signal Amplifier and Trigger Amplifier circuitry are identical. The description for the Signal Amplifier applies equally to the Trigger Amplifier.

The Signal Amplifier consists mainly of a TEKTRONIX-made hybrid integrated circuit (U40) and its related circuitry. A representation of U40 is shown in the schematic diagrams section. The Signal Line is connected to the Signal Amplifier input through a "T" network consisting of C20, L21, and L22. The "T" coils, L21 and L22 are adjusted for minimum aberrations at high frequencies. The paraphase input of U40 converts the single ended input to a differential signal. Frequency compensation, signal balancing, gain, and temperature compensation are all accomplished in the emitters of the paraphase amplifier. Frequency compensation is achieved through the use of the series of resistors, capacitors, and an inductor connected to pins 5 and 11. R38 signal balance control balances our the resultant currents in the amplifier.

## Gain Current Source

Temp Comp control, R76, sets the voltage at the emitter of Q76. The current through R74 is set by the current generator Q73 and Gain control R73. As the thermal resistor R74 changes with temperature so will the voltage at the collector of Q73; therefore, compensating for temperature changes within the plug-in.

Positioning is achieved by varying the DC level at the input of the paraphase amplifier (pin 4, U40). Q56A and Q56B is a DC amplifier having an inverting input and non-inverting input. Gain of this amplifier is selected by the VOLTS/DIV switch. With the VOLTS/DIV switch in the 10 mV position, the gain of Q56 is set by R66. In the 20 mV position the gain of Q56 is doubled. The POSITION control (R68) applies a DC signal to either the inverting or non-inverting input. This is selected so that a clockwise rotation of the POSITION control will always produce an upward deflection of the displayed trace. The output of the position amplifier is applied to the Signal and Trigger Amplifier through an inverting buffer Q50. This signal is also applied to the Signal Line Terminator which compensates for the current changes that occur as a result of the positioning circuitry.

## Polarity Circuit

The output from the Signal and Trigger Amplifiers is connected through the Polarity switch to the interface connector. The Polarity switch, in the INVERT position, not only inverts the Signal and Trigger outputs but it inverts the polarity signal so that a clockwise rotation of the POLARITY control always produces an upward deflection. See the description for the Position Circuit for details.

## Connectors

All connections made to the mainframe by the 7A19 are shown on the schematic located in the Diagrams section of this manual. Also shown are the power supply decoupling components.

## Readout

The 7A19 incorporates standard vertical readout encoding circuitry. Refer to any 7000-Series Oscilloscope with readout for more information.

# MAINTENANCE

## Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance, and troubleshooting of the 7A19.

Further maintenance information relating to general maintenance can be found in the instruction manuals for the 7000-Series oscilloscopes.

## PREVENTIVE MAINTENANCE

### General

Preventive maintenance, consisting of cleaning, visual inspection, etc., performed on a regular basis, will improve the reliability of this instrument. Periodic checks of the semiconductor devices used in the unit are not recommended as a preventive maintenance measure. See semiconductor-checking information given under Troubleshooting.

### Cleaning

**Front Panel.** Loose dust may be removed with a soft cloth or a dry brush. Water and mild detergent may be used; however, abrasive cleaners should not be used.

**Interior.** Cleaning the interior of the unit should precede calibration, since the cleaning process could alter the settings of the calibration adjustments. Use low-velocity compressed air to blow off the accumulated dust. Hardened dirt can be removed with a soft, dry brush, cotton-tipped swab, or cloth dampened with a mild detergent and water solution.

### Lubrication

Use a cleaning-type lubricant on shaft bushings in connecting plug contacts, and switch contacts. Lubricate switch detents with a heavier grease. A lubrication kit containing the necessary lubricating materials and instructions is available through any TEKTRONIX Field Office. Order by TEKTRONIX Part No. 003-0342-01. Local purchase is recommended whenever possible.

## TROUBLESHOOTING

### General

The following is provided to augment information contained in other sections of this manual when troubleshooting the 7A19. The schematic diagrams, circuit description, and calibration sections should be used to full advantage. The circuit description section gives detailed information on circuit behavior and output requirements.

### Troubleshooting Aids

**Diagrams.** Circuit diagrams are given on foldout pages in Section 7. The circuit number and electrical value of each component in this instrument are shown on the diagrams. Important voltages and semiconductor lead configurations are also shown.

**Circuit Board.** The circuit board used in the 7A19 is outlined on the schematic diagrams, and a photograph of the board is shown on the back of the schematic diagrams. Each board-mounted electrical component is identified on the photograph by its circuit number.

**Component and Wiring Color Code.** Colored stripes or dots on resistors and capacitors signify electrical values, tolerances, etc., according to the EIA standard color code. Components not color coded usually have the value printed on the body.

The insulated wires used for interconnection in the 7A19 are color coded to facilitate tracing a wire from one point to another in the unit.

### Troubleshooting Equipment

The following equipment is useful for troubleshooting the 7A19.

1. Semiconductor Tester—Some means of testing the transistors and diodes, used in this instrument is helpful. A transistor-curve tracer such as the TEKTRONIX Type 576 will give the most complete information.

2. DC Voltmeter and Ohmmeter—A voltmeter for checking voltages within the circuit and an ohmmeter for checking resistors and diodes is required.

3. Test Oscilloscope—A test oscilloscope is required to view waveforms at different points in the circuit. A TEKTRONIX 7000-Series Oscilloscope equipped with a readout system, 7D13 Digital Multimeter unit, 7B-Series Time-Base unit, and a 7A-Series Amplifier unit with a 10X probe will meet the needs of both items 2 and 3.

4. Plug-in Extender—A fixture that permits operation of the unit outside of the plug-in compartment for better accessibility during troubleshooting. Order TEKTRONIX Part No. 067-0616-00.

## Troubleshooting Procedure

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding with extensive troubleshooting.

1. Check Control Settings. An incorrect setting of the 7A19 controls can indicate a trouble that does not exist. If there is any question about the correct function or operation of a control or front-panel connector, see Section 2.

2. Check Associated Equipment. Before proceeding with troubleshooting of the 7A19 check that the equipment used with this instrument is operating correctly. If possible, substitute an amplifier unit known to be operating correctly into the indicator unit and see if the problem persists. Check that the input signals are properly connected and that the interconnecting cables are not defective.

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

4. Check Instrument Performance. Check the calibration of the unit, or the affected circuit by performing Performance Checks of Section 5. The apparent trouble may only be a result of mis-adjustment and may be corrected by calibration.

5. Check Voltages. Often the defective component or stage can be located by checking for the correct voltage in the circuit. Typical voltages are given on the diagrams; however, these are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the instructions in the Diagrams section.

6. Check Individual Components. The following methods are provided for checking the individual components in the 7A19. Components which are soldered in place are best checked by disconnecting one end to isolate the measurement from the effects of surrounding circuitry.

A. TRANSISTORS AND INTEGRATED CIRCUITS. The best check of transistor operation is actual performance under operating conditions. If a semiconductor is suspected of being defective, it can best be checked by substituting a component known to be good; however, be sure that circuit conditions are not such that a replacement might also be damaged. If substitute transistors are not available, use a dynamic tester (such as TEKTRONIX Type 576). Static-type testers may be used, but since they do not check operation under simulated operating conditions, some defects may go unnoticed. The schematic shows base pin and socket arrangements of semiconductor devices. Be sure the power is off before attempating to remove or replace any semiconductor component.

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using integrated circuits. Use care when checking voltages and waveforms around the integrated circuits so that adjacent leads are not shorted together.

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

**CAUTION**

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

C. RESISTORS. Check resistors with an ohmmeter. Resistor tolerance is given in the Electrical Parts List. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

D. CAPACITORS. A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter on the highest scale. Use an ohmmeter which will not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter, or by checking whether the capacitor passes AC signals.

7. Repair and Readout the Circuit. Special techniques required to replace components in this unit are given under Component Replacement. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced. Recalibration of the affected circuit may be necessary.

## CORRECTIVE MAINTENANCE

### General

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

### Obtaining Replacement Parts

**Standard Parts.** All electrical and mechanical part replacements for the 7A19 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 parts list for value, tolerance, rating and description.

*NOTE*

*When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect 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 adversely affect instrument performance.*

**Special Parts.** In addition to the standard electronic components, some special parts are used in the 7A19. These parts are manufactured or selected by Tektronix, Inc., in accordance with our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local TEKTRONIX Field Office or representative.

**Ordering Parts.** When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument Type.

2. Instrument Serial Number.

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

4. TEKTRONIX Part Number.

### Soldering Techniques

**WARNING**

*Disconnect the instrument from the power source before soldering.*

**Circuit Boards.** The components mounted on the circuit boards in the 7A19 can be replaced using normal circuit board soldering techniques. Keep the following points in mind when soldering on the circuit board:

1. Use a pencil-type soldering iron with a wattage rating from 15 to 50 watts.

2. Apply heat from the soldering iron to the junction between the component and the circuit board.

3. Heat-shunt the lead to the component by means of a pair of long-nose pliers.

4. Avoid excessive heating of the junction with the circuit board, as this could separate the circuit board wiring from the base material.

5. Use electronic grade 60-40 tin lead solder.

6. Clip off any excess lead length extending beyond the circuit board. Clean off any residual flux with a flux-removing solvent.

**Metal Terminals.** When soldering metal terminals (potentiometers, etc.) use 60-40 tin lead solder and a 15 to 50 watt soldering iron. Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-removing solvent.

### Component Replacement

**WARNING**

*Disconnect the equipment from the power source before replacing components.*

**Semiconductor Replacement.** Transistors and integrated circuits (IC's) should not be replaced unless actually defective if removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the calibration of this instrument. When semiconductors are replaced, check the performance of the part of the instrument which may be affected.

Replacement semiconductors should be of the original type or a direct replacement. Lead configuration of the semiconductors used in this instrument are shown on the schematic diagrams. If the replacement semiconductor is not of the original type, check the manufacturer's basing diagram for proper basing.

**TEKTRONIX Integrated Circuits.** If it should become necessary to replace the TEKTRONIX integrated circuits U40 and U100 use the following procedures:

1. Remove the common heat sink (No. 64 in Fig. 1 EXPLODED of the Mechanical Parts List section).

2. Unsolder the two ground straps from either side of the integrated circuit case and unplug the integrated circuit.

3. To install, align the tab of the integrated circuit with the dot, marked on the circuit board. Then, making sure pins are aligned with their sockets, gently push into the socket.

*NOTE*

*The leads of the integrated circuit are cut at the factory to prevent the integrated circuit from resting directly on the circuit board. Defeating this purpose may allow the pin sockets to short against the integrated circuit case. Solder the ground leads to the case and replace the heat sink.*

**Inductor Replacement (L21, L22, L81, L82, L124, L125).** Inductors are replaced as a pair along with their associated capacitor (e.g., L21, L22, and C20). The inductors are formed by the leads of the capacitor, see Fig. 4-1. To replace a pair of inductors, proceed as follows:

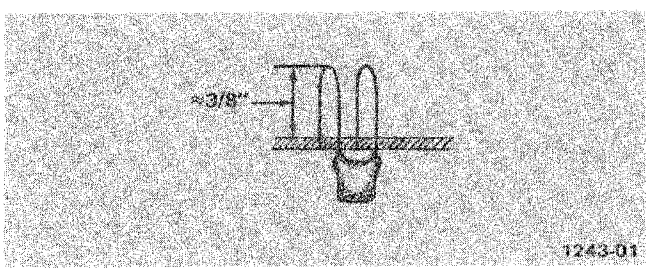



**Fig. 4-1. Inductor ("T" coil) replacement.**

1. Remove the inductors and associated capacitor by using a low wattage soldering iron and a vacuum type desoldering device.

2. Insert the replacement capacitor on the circuit board and bend the leads to form a loop approximately 3/8 inch high.

3. Solder the capacitor and inductors to the circuit board.

Replacement of any of the inductors will affect the high frequency characteristics of the 7A19 and re-calibration will be necessary.

## REPACKAGING FOR SHIPMENT

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

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

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to the following table for carton test strength requirements.

2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.

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

4. Seal carton with shipping tape or industrial stapler.

**SHIPPING CARTON TEST STRENGTH**

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

# CALIBRATION

## Introduction

To assure instrument accuracy, check the calibration of the 7A19 every 1000 hours of operation or every six months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section.

## TEKTRONIX Field Service

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

## Performance Check

The performance of this instrument can be checked by performing only the √ CHECK steps. Performing the steps marked with a √ indicates that the instrument is checked against the tolerances listed as a Performance Requirement (see Specification section).

Limits and tolerances given in other check steps are calibration guides and should not be interpreted as instrument specifications. Operator front-panel adjustments are adjusted as part of the Performance Check procedure.

## Calibration

To verify proper calibration of the 7A19 and to prevent unnecessary re-calibration of the entire instrument, perform the Adjust- portion of a step only if the tolerance given in the Check- part of the step is not met.

For best overall instrument performance when performing a complete calibration procedure, make each adjustment to the exact setting even if the Check- is within allowable tolerance.

# TEST EQUIPMENT REQUIRED

## General

The following test equipment and accessories, or its equivalent, is required for complete calibration of the 7A19. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, the specifications of any test equipment used must meet or exceed the listed specifications. All test equipment is assumed to be correctly calibrated and operating within the listed specifications. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

## Special Calibration Fixtures

Special TEKTRONIX calibration fixtures are used in this procedure only where they facilitate instrument calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number through your local TEKTRONIX Field Office or representative.

## Calibration Equipment Alternatives

All of the listed test equipment is required to completely check and adjust this instrument. The Calibration procedure is based on the first item of equipment given as an example of applicable equipment. When other equipment is substituted, control settings or calibration setup 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 in the Test Equipment list is not available, first check the Specifications column carefully to see if any other equipment is available which might suffice. Then check the Usage column to see what this item of test equipment is used for. If used for a check or adjustment which is of little or no importance to your measurement requirements, the item and corresponding step(s) can be deleted.

## Test Equipment

| Description | Minimum Specifications | Usage | Examples of Applicable Test Equipment |
|---|---|---|---|
| 1. Calibration Oscilloscope | TEKTRONIX 7000-Series 500 MHz bandwidth required for complete procedure. | Used throughout the procedures to provide display. | a. TEKTRONIX 7904 oscilloscope. |
| 2. Time Base Plug-In Unit | TEKTRONIX 7B-Series time base unit. 0.5 ns sweep rate required for complete procedure. | Used throughout procedure to provide sweep. | a. TEKTRONIX 7B92A Time Base unit. |
| 3. Vertical Plug-In Unit | TEKTRONIX 7A-Series vertical plug-in unit. Dual trace with 500 $\mu$V per division sensitivity required. | Used for Common Mode Check/Adjust (step 3) and Input Resistance Adjust. | a. TEKTRONIX 7A22 Dual Trace Vertical Amplifier. |
| 4. Standard Amplitude Calibrator | Amplitude accuracy within 0.25%; range, 60 mV to 2 V into 50 $\Omega$; frequency, 1 kHz. | Used for GAIN Check/Adjust only (step 6). | a. Tektronix PG 506 Calibration Generator.[1] |
| 5. Constant Amplitude Signal Generator | Reference frequency, less than 10 MHz; amplitude accuracy, within 1% of reference frequency; frequency range, to 500 MHz; amplitude range, 80 mV to 8 V into 50 $\Omega$. | Used for Frequency Response Check (step 9). | a. SG 504 Leveled Sine Wave Generator.[1]<br>b. Wavetek 1002 Sweep/Signal Generator.<br>c. General Radio 1362 UHF oscillator with 1263-C Amplitude Regulating supply. |
| 6. Time Domain Reflectometer | System rise time, 350 ps ±35 ps; pulse amplitude, 200 mV. Sensitivity, to 100 m$\rho$. | Used for Reflection Coefficient Check only (step 10). | a. TEKTRONIX 7S12 TDR/SAMPLER plug-in unit with S-1 sampling head and S-52 Pulse Generator head. (This system is to be used with the Calibration Oscilloscope.) |
| 7. Differental Sampling System | System rise time, at least 350 ps; pulse amplitude, 200 mV; Input, differential; sensitivity, 50 mV/div. | Used for Rise Time and Aberration Check / Adjust only (step 8). | a. Use the Time Domain Reflectometer system with the addition of a 7S11 vertical sampling plug-in and a S-1 sampling head. |
| ACCESSORIES<br>8. Cable | Impedance, 50 ohms; length, 42 inches; connectors, BNC. | Used throughout procedures for signal connections. | a. TEKTRONIX Part No. 012-0057-01. |
| 9. GR Cable | Impedance, 50 ohms ±5%; length, 10 inches; connectors, GR. | Used for signal connections during reflection coefficient and HF aberrations. | a. TEKTRONIX Part No. 017-0513-00. |

[1] Requires TM 500 - Series Power Module

Test Equipment (cont)

| Description | Minimum Specifications | Usage | Examples of Applicable Test Equipment |
|---|---|---|---|
| 10. GR Cable | Impedance, 50 ohms ±5%; length, 20 inches; connectors, GR. | Used during reflection coefficient check for signal connection. | a. TEKTRONIX Part No. 017-0515-00. |
| 11. Adapter | BNC male to GR. | Used throughout procedures. | a. TEKTRONIX Part No. 017-0064-00. |
| [illegible] | [illegible] | [illegible] | [illegible] |

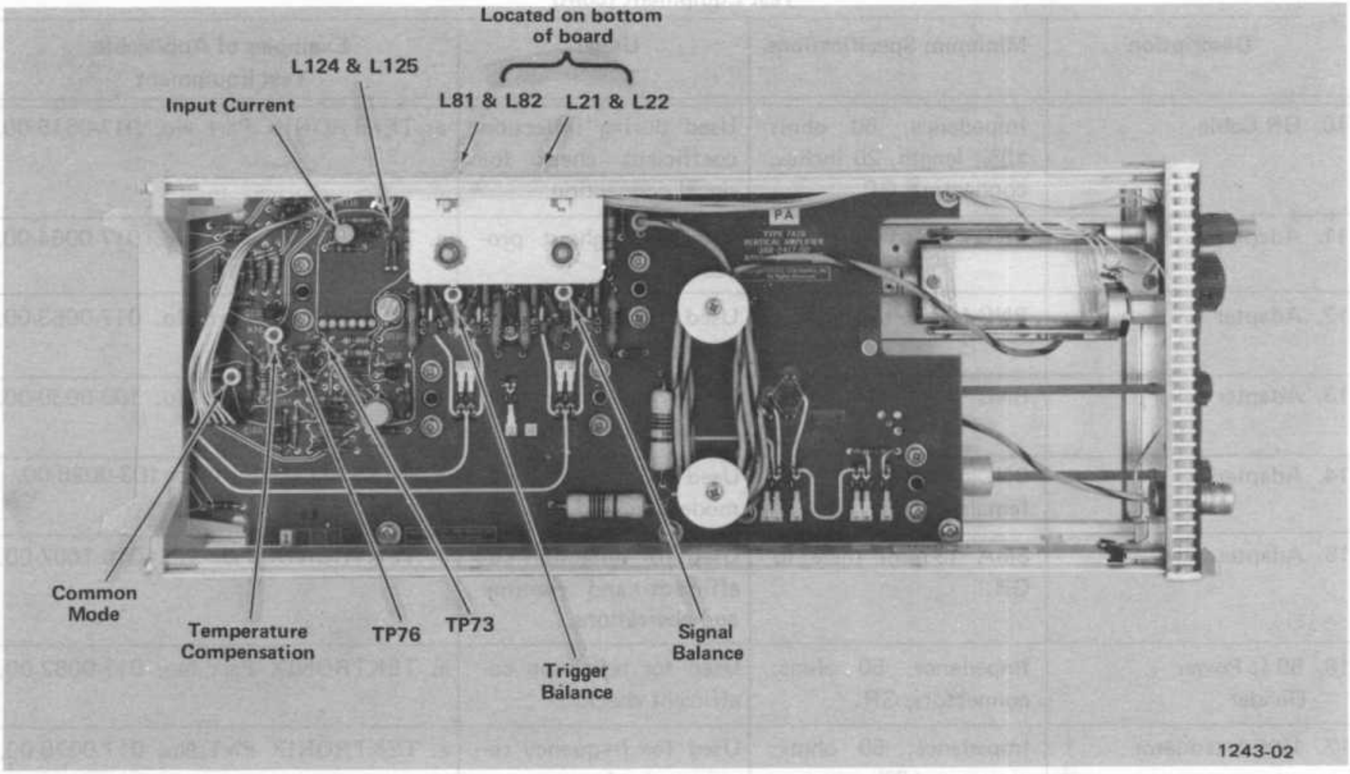



Fig. 5-1. Location of Adjustments (7A19 shown).

4. Connect the oscilloscope to a suitable power source.

5. Turn the oscilloscope on and allow 20 minutes warmup before proceeding.

*NOTE*

*This instrument should be calibrated at an ambient temperature of +20°C to +30°C for best overall accuracy. The performance of the instrument can be checked at any temperature within the 0°C to +50°C range.*

## Preliminary Control Settings

Set the calibration oscilloscope and 7A19 as follows:

**Calibration Oscilloscope**

| | |
|---|---|
| Intensity | Midrange |
| Focus | Adjust for a well-defined display |
| Control Illum | As desired |
| Grat Illum | As desired |
| Vertical Mode | Left |
| Trigger Source | Left Vert |

**7A19**

| | |
|---|---|
| POSITION | Center trace |
| POLARITY | +UP |
| VOLTS/DIV | 10 mV |
| Input Coupling | GND |

## Index to Calibration Procedure

1. Trigger Balance Check/Adjust
2. Balance Check/Adjust
3. Common Mode Check/Adjust
4. Input Current Adjust
5. Temperature Compensation Adjust
√6. GAIN Check/Adjust
√7. Input Resistance Adjust, Input Current Check
8. Aberration Check/Adjust
√9. Frequency Response Check
√10. Reflection Coefficient Check

### 1. Trigger Balance Check/Adjust

a. Interchange the + signal line (A-11) with the + trigger line (A-13) in the plug-in extender.

b. Interchange the – signal line (B-11) with the – trigger line (B-13) in the plug-in extender.

c. Check—for less than 0.5 division vertical trace shift while switching the POLARITY switch between +UP and INVERT.

d. Adjust—the Trigger Bal control for minimum vertical trace shift as the POLARITY switch is alternated between +UP and INVERT.

e. Reconnect the signal and trigger lines to their proper connectors in the plug-in extender.

### 2. Balance Check/Adjust

a. Check—for less than 0.5 division vertical trace shift while switching the POLARITY switch between +UP and INVERT.

b. Adjust—the Bal control for minimum vertical trace shift as the POLARITY switch is alternated between +UP and INVERT.

c. Set the POLARITY switch to +UP.

### 3. Common Mode Check/Adjust

a. Disconnect the signal lines from the plug-in extender (A11 and B11 BNC cables) and short the signal lines together using a BNC "T" adapter. Connect the "T" adapter to the Vertical plug-in unit via the BNC female to BNC female adapter and the 42 inch BNC cable.

b. Set the calibration oscilloscope Vertical Mode to Right. Set the vertical plug-in unit to obtain 50 mV/division DC sensitivity.

c. Check—that the oscilloscope display is 0 volts ±50 mV.

d. Adjust—the Common Mode Bal control for 0 volts ±50 mV.

e. Disconnect all test equipment and reconnect the signal lines to the plug-in extender. Return the calibration oscilloscope Vertical Mode to Left.

### 4. Input Current Adjust

a. Adjust—the Input Current control for minimum vertical trace shift (±1 division) while switching the Input Coupling switch between DC and GND.

b. Return the Input Coupling switch to DC.

### 5. Temperature Compensation Adjust

a. Connect a 1 kHz, 0.2 volt square-wave signal from the oscilloscope Calibrator to the 7A19 INPUT using a 42 inch BNC cable.

b. Set the 7A19 VOLTS/DIV switch to 50 mV.

c. Connect a shorting strap across the silicon resistor, R74 (TP73 and TP76 are connected to either side of R74 to provide a convenient means for connecting the shorting strap).

d. Adjust—the Temperature Compensation control by turning clockwise until the waveform just begins to increase.

e. Remove the shorting strap and return the VOLTS/DIV switch to 10 mV.

f. Disconnect all test equipment.

### √6. GAIN Check/Adjust

a. Connect the Standard Amplitude Calibrator output to the INPUT connector with a 42 inch BNC cable.

b. Set the Standard Amplitude Calibrator for a 60-millivolt square-wave output and set the Input Coupling switch to DC.

c. Check—CRT display for a vertical deflection of six divisions ±0.18 division.

d. Adjust—Front panel GAIN control for exactly six divisions vertical deflection.

CHECK DEFLECTION FACTOR ACCURACY

e. Check—Using the VOLTS/DIV switch and Standard Amplitude Calibrator settings given in Table 5-1, check that vertical deflection is within 3% for each position of the VOLTS/DIV switch.

f. Disconnect all test equipment and return the VOLTS/DIV switch to 10 mV.

**TABLE 5-1**

**Vertical Deflection Accuracy**

| VOLTS/DIV Switch Setting | Standard Amplitude Calibrator Output | Vertical Deflection In Divisions | Maximum Error for ±3% Accuracy (Divisions) |
|---|---|---|---|
| 10 mV | 50 mV | 5 | Set in step 6 |
| 20 mV | 0.10 V | 5 | ±0.15 |
| 50 mV | 0.5 V | 5 | ±0.15 |
| .1 V | 0.5 V | 5 | ±0.15 |
| .2 V | 1.0 V | 5 | ±0.15 |
| .5 V | 2.5 V | 5 | ±0.15 |
| 1 V | 5 V | 5 | ±0.15 |

## √7. Input Resistance Adjust, Input Current Check

a. Set 7A19 VOLTS/DIV switch to 10 mV.

b. Connect test circuit as shown in Fig. 5-2.

c. Set calibration oscilloscope Vertical Mode to Right. Set the vertical plug-in unit to AC and obtain a sensitivity of 500 $\mu$V/div.

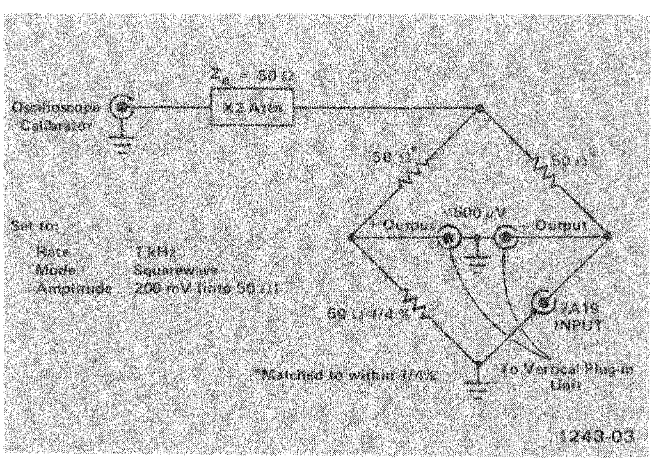



**Fig. 5-2. Test circuit for adjusting input Resistance.**

d. Adjust—Input Current control for a signal amplitude of one (1) division or less.

e. Disconnect the test circuit and set the calibration oscilloscope Vertical Mode to Left.

f. Check—for a vertical trace shift of 1 division or less while switching the Input Coupling switch between DC and GND. If not within 1 division, repeat steps 7b and 7c.

g. Return Input Coupling switch to DC.

## 8. Aberration Check/Adjust

a. Remove Rigid plug-in extender, Vertical plug-in unit, and Time Base unit from the Calibration Oscilloscope.

b. Install the 7S11 with the S1 head into the Left Vertical compartment. Install the 7S12 with the S1 and S52 heads into the Right Vertical and A Horizontal compartments.

c. Connect the Signal Pickoff fixture to the 7A19. Connect the Flexiable Extender to the Signal Pickoff, and plug the Flexiable Extender into the remaining oscilloscope horizontal compartment (to provide power to the 7A19).

d. Connect the Signal Pickoff + and — vertical lines (A11 to S1 head in 7S12, and B11 to S1 head in 7S11) to the Sampling system inputs using GR to TEKTRONIX adapters. Be sure the + and — trigger lines (A13 and B13) are connected to the Signal Pickoff internal 50 Ω termination.

e. Set the 7A19 VOLTS/DIV switch to 50 mV, and check POLARITY switch for + UP position.

f. Connect the sampling pulse generator output to the 7A19 INPUT by using a SMA to GR adapter, a 20 inch GR cable, and a GR to male BNC adapter.

g. Set the test oscilloscope (7904) to RIGHT and A HORIZ. Set the 7S12 controls as follows:

| | |
|---|---|
| Variable (cal in) | 50 mV |
| DC Offset | midrange |
| Locate/Scan | out |
| Rep | pushbutton in |
| Time/Div | X .1 5 ns |
| High Resolution | pushbutton out |

h. Rotate the TIME - DISTANCE knob until brightened portion of the waveform appears over the leading edge of waveform. (The intensity may have to be re-adjusted to discern the brightened waveform).

i. Change the 7904 VERTICAL MODE switch to LEFT.

j. Push in the LOCATE pushbutton on the 7S12.

k. Push in the INVERT pushbutton on the 7S11, and set VARIABLE (CAL IN) to the 50 mV position. Set the DOT RESPONSE to NORMAL.

l. Position the waveform to mid-screen with the DC OFFSET control.

m. Set the 7904 VERTICAL MODE switch to CHOP.

n. Using the 7S11 and 7S12 DC OFFSET controls, position both waveforms so they overlap.

o. Use the 7S11 DELAY control and position the leading edge of the waveform so they coincide.

p. Change the 7904 VERTICAL MODE switch to ADD.

*NOTE*

*Slight misadjustment of the 7S11 Delay control will degrade the leading edge of the waveform. Re-adjust the Delay control to obtain optimum square corner, with minimum rolloff.*

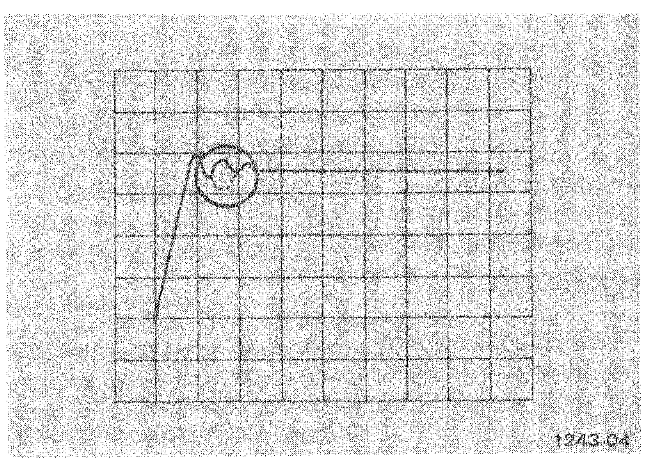



**Fig. 5-3. Dotted line shows effects of bringing a metal screwdriver close to a "T" coil.**

q. Check—that the aberrations are 7% peak to peak or less.

r. Adjust—inductors L21, L22, L81, L82, L124, and L125 for minimum aberrations. These coils are located on both sides of the circuit board, refer to Fig. 5-1 for their locations. Each coil affects a different portion of the step waveform, usually 2 to 10 ns after the initial step. To adjust the aberrations, use the following procedure:

1. Locate the portion of the step waveform that contains the largest aberration.

2. Locate the coil that affects that portion of the step waveform by bringing a metal screwdriver or similar metallic object close to each of the six coils.

3. After determining which coil affects the aberration, shorten or lengthen the coil to reduce the aberration (see illustration Fig. 5-3). Shortening the coil, by squeezing will cause a positive going aberration to decrease while lengthening the coil, by spreading, will cause a negative going aberration to decrease. See Fig. 5-4.

4. Continue with this procedure by choosing the next largest aberration and so on until the total aberration are 7% peak to peak or less.

s. Disconnect and remove all test equipment including sampling system.

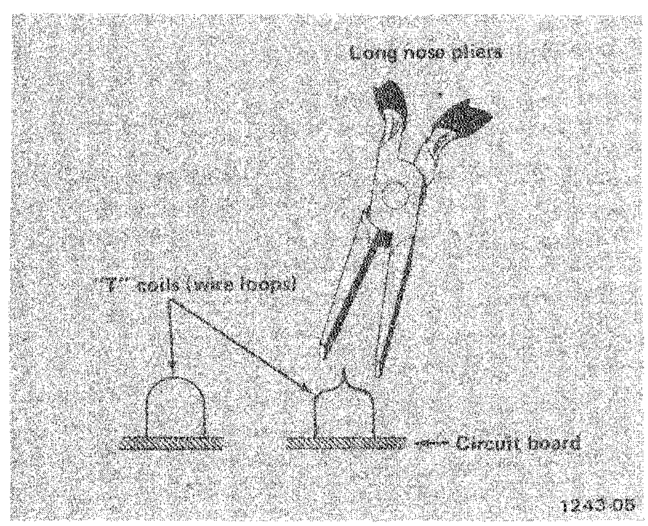



**Fig. 5-4. Illustration showing method of squeezing "T" coils.**

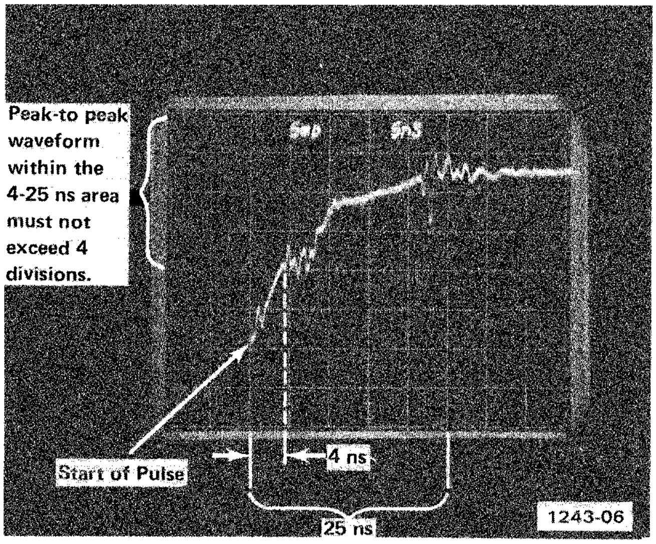



**Fig. 5-5. Waveform showing a 4 division display corresponding to a reflection coefficient of 0.1 or less.**

## √9. Frequency Response Check

a. Remove the plug-in extender and install the 7A19 directly into the Left Vertical compartment. Install the Time Base plug-in unit into the Oscilloscope B Horizontal compartment. Set the calibration oscilloscope Vertical Mode to Left and Horizontal Mode to B.

b. Connect the Constant Amplitude sine-wave generator to the 7A19 using a 10X attenuator and a GR to BNC adapter.

c. Set the constant amplitude generator to its reference frequency and adjust the amplitude for a CRT display of exactly 8 divisions.

d. Increase the generator frequency to 500 MHz and check that the amplitude of the displayed signal is >5.6 divisions peak to peak.

e. Continue checking bandwidth for the entire VOLTS/DIV range using the constant amplitude generator settings and results given in Table 5-2.

**TABLE 5-2**

| VOLTS/DIV Switch Setting | Constant Amplitude Generator (Set at Reference Frequency) | Amplitude Displayed with Generator Set to 500 MHz |
|---|---|---|
| 10 mV | 8 div | 5.6 div |
| 20 mV | 8 div | 5.6 div |
| 50 mV | 8 div | 5.6 div |
| 0.1 V | 8 div | 5.6 div |
| 0.2 V | 8 div | 5.6 div |
| 0.5 V | 8 div | 5.6 div |
| 1 V | 4 div | 2.8 div |

f. Return VOLTS/DIV to 20 mV.

## √10. Reflection Coefficient Check

a. Install the 7S12 with the S1 and S52 heads into the Right Vertical and A Horizontal compartments.

b. Install the 7A19 into the Left Vertical compartment.

c. Connect the 50 Ω Power Divider Tee to the S1 head using a 20 inch GR cable and GR to BNC male adapter.

d. Connect the 50 Ω Power Divider Tee to the Pulse Output of the S52 head using a 10 inch GR cable and GR to 3 mm adapter.

e. Connect the 50 Ω Power Divider Tee to the 7A19 using a 2 ns cable.

f. Set the 7A19 VOLTS/DIV control to 10 mV/div, POLARITY to + UP, and INPUT to DC.

g. Set the test oscilloscope (7904) to RIGHT and A HORIZ. Set the 7S12 controls as follows:

| | |
|---|---|
| Variable (cal in) | 50 mV |
| DC Offset | midrange |
| Locate/Scan | out |
| Rep | pushbutton in |
| Time/Div | X .1 5 ns |
| High Resolution | pushbutton out |
| $m\rho$ | pushbutton in |

h. Position the waveform to midscreen using the DC OFFSET control.

i. Set the intensified zone to fall on the rise portion of the pulse, using the TIME/DISTANCE control.

j. Push LOCATE button.

k. Adjust—Front panel P CAL control for a 4 division peak to peak display.

l. Change the VARIABLE (CAL IN) control to 5.

m. Position the top portion of the waveform to mid-screen, using the DC OFFSET control (see Fig. 5-5).

n. Set SCAN control for no rolloff of front corner of the waveform.

o. Check—the peak to peak waveform for a 4 division display or less, as observed within the 4–25 nsec area (see Fig. 5-5). This corresponds to a reflection coefficient of 0.1 or less. If more than four divisions, repeat steps 7, 8, and 9.

This completes the calibration/check of the 7A19.

# 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 |
|---|---|---|---|
| 01121 | ALLEN-BRADLEY COMPANY | 1201 2ND STREET SOUTH | MILWAUKEE, WI 53204 |
| 03508 | GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT | ELECTRONICS PARK | SYRACUSE, NY 13201 |
| 03888 | KDI PYROFILM CORPORATION | 60 S JEFFERSON ROAD | WHIPPANY, NJ 07981 |
| 12697 | CLAROSTAT MFG. CO., INC. | LOWER WASHINGTON STREET | DOVER, NH 03820 |
| 15454 | RODAN INDUSTRIES, INC. | 2905 BLUE STAR ST. | ANAHEIM, CA 92806 |
| 24931 | SPECIALTY CONNECTOR CO., INC. | 3560 MADISON AVE. | INDIANAPOLIS, IN 46227 |
| 72982 | ERIE TECHNOLOGICAL PRODUCTS, INC. | 644 W. 12TH ST. | ERIE, PA 16512 |
| 73138 | BECKMAN INSTRUMENTS, INC., HELIPOT DIV. | 2500 HARBOR BLVD. | FULLERTON, CA 92634 |
| 75042 | TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION | 401 N. BROAD ST. | PHILADELPHIA, PA 19108 |
| 75915 | LITTELFUSE, INC. | 800 E. NORTHWEST HWY | DES PLAINES, IL 60016 |
| 80009 | TEKTRONIX, INC. | P O BOX 500 | BEAVERTON, OR 97077 |
| 91637 | DALE ELECTRONICS, INC. | P. O. BOX 609 | COLUMBUS, NE 68601 |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A1 | 670-1889-00 | B010100 | B029999 | CKT BOARD ASSY:VERTICAL AMPLIFIER | 80009 | 670-1889-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| A1 | 670-1889-01 | B030000 | B037849 | CKT BOARD ASSY:VERTICAL AMPLIFIER | 80009 | 670-1889-01 |
| | ------ ------ | | | * STANDARD ONLY | | |
| A1 | 670-1889-02 | B037850 | | CKT BOARD ASSY:VERTICAL AMPLIFIER | 80009 | 670-1889-02 |
| | ------ ------ | | | * STANDARD ONLY | | |
| A1 | 670-1889-00 | B010100 | B039999 | CKT BOARD ASSY:VERTICAL AMPLIFIER | 80009 | 670-1889-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| A1 | 670-1889-01 | B040000 | B043049 | CKT BOARD ASSY:VERTICAL AMPLIFIER | 80009 | 670-1889-01 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| A1 | 670-1889-02 | B043050 | | CKT BOARD ASSY:VERTICAL AMPLIFIER | 80009 | 670-1889-02 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| A2 | ------ ------ | XB030000 | | CKT BOARD ASSY:ATTENUATOR | | |
| | ------ ------ | | | (A2, REPLACEABLE UNDER 672-0430-00 ONLY) | | |
| C5 | 283-0278-00 | | | CAP.,FXD,CER DI:2.2UF,20%,100V | 72982 | 8150-M100Z5U225M |
| C20 | 283-0181-00 | B010100 | B037849 | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L21 AND L22 | | |
| | ------ ------ | | | * STANDARD ONLY | | |
| C20 | 283-0158-00 | B037850 | | CAP.,FXD,CER DI:1PF,(NOM VALUE),SEL | 72982 | 8101B057C0K0109B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L21 AND L22 | | |
| | ------ ------ | | | * STANDARD ONLY | | |
| C20 | 283-0181-00 | B010100 | B043049 | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L21 AND L22 | | |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| C20 | 283-0158-00 | B043050 | | CAP.,FXD,CER DI:1PF,(NOM VALUE),SEL | 72982 | 8101B057C0K0109B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L21 AND L22 | | |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| C24 | 283-0069-00 | B010100 | B011449 | CAP.,FXD,CER DI:15PF,20%,50V | 72982 | 811-059C0G0150M |
| | ------ ------ | | | * STANDARD ONLY | | |
| C24 | 283-0069-00 | B011450 | | CAP.,FXD,CER DI:15PF,(NOM VALUE),SEL | 72982 | 811-059C0G0150M |
| | ------ ------ | | | * STANDARD ONLY | | |
| C24 | 283-0069-00 | B010100 | B019999 | CAP.,FXD,CER DI:15PF,20%,50V | 72982 | 811-059C0G0150M |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| C24 | 283-0069-00 | B020000 | | CAP.,FXD,CER DI:15PF,(NOM VALUE),SEL | 72982 | 811-059C0G0150M |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| C26 | 283-0201-00 | | | CAP.,FXD,CER DI:27PF,10%,200V | 72982 | 8101B210X7R0270K |
| C28 | 283-0156-00 | | | CAP.,FXD,CER DI:1000PF,+100-0%,200V | 72982 | 8111A208Z5U0102Z |
| C31 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C35 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C41 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C47 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C58 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C61 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C73 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C80 | 283-0181-00 | B010100 | B037849 | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L81 AND L82. | | |
| | ------ ------ | | | * STANDARD ONLY | | |
| C80 | 283-0158-00 | B037850 | | CAP.,FXD,CER DI:1PF,(NOM VALUE),SEL | 72982 | 8101B057C0K0109B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L81 AND L82. | | |
| | ------ ------ | | | * STANDARD ONLY | | |
| C80 | 283-0181-00 | B010100 | B043049 | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L81 AND L82. | | |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| C80 | 283-0158-00 | B043050 | | CAP.,FXD,CER DI:1PF,(NOM VALUE),SEL | 72982 | 8101B057C0K0109B |
| | ------ ------ | | | * FURNISHED AS A UNIT WITH L81 AND L82. | | |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| C80 | ----- ----- | | | * OPTION 4 ONLY | | |
| C84 | 283-0069-00 | | | CAP.,FXD,CER DI:15PF,20%,50V | 72982 | 811-059C0G0150M |
| C86 | 283-0201-00 | | | CAP.,FXD,CER DI:27PF,10%,200V | 72982 | 8101B210X7R0270K |
| C88 | 283-0156-00 | | | CAP.,FXD,CER DI:1000PF,+100-0%,200V | 72982 | 8111A208Z5U0102Z |
| C91 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C95 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C101 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C107 | 283-0182-00 | | | CAP.,FXD,CER DI:51PF,5%,400V | 72982 | 8110N400C0G510J |
| C121 | 283-0160-00 | B010100 | B037650 | CAP.,FXD,CER DI:1.5PF,10%,50V | 72982 | 8101A058C0K159B |
| C121 | 283-0181-00 | B037651 | B037849 | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| C121 | 283-0185-00 | B037850 | | CAP.,FXD,CER DI:2.5PF,(NOM VALUE),SEL | 72982 | 8101B057C0K0295B |
| | ----- ----- | | | * STANDARD ONLY | | |
| C121 | 283-0185-00 | B043050 | | CAP.,FXD,CER DI:2.5PF,(NOM VALUE),SEL | 72982 | 8101B057C0K0295B |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| C123 | 283-0160-00 | | | CAP.,FXD,CER DI:1.5PF,10%,50V | 72982 | 8101A058C0K159B |
| | ----- ----- | | | (C123, FURNSIHED AS A UNIT WITH L124 AND L125) | | |
| C162 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C167 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C168 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| CR50 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 80009 | 152-0141-02 |
| CR54 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 80009 | 152-0141-02 |
| CR58 | 152-0141-02 | XB039010 | | SEMICOND DEVICE:SILICON,30V,150MA | 80009 | 152-0141-02 |
| CR59 | 152-0141-02 | XB039010 | | SEMICOND DEVICE:SILICON,30V,150MA | 80009 | 152-0141-02 |
| CR124 | 152-0333-00 | | | SEMICOND DEVICE:SILICON,55V,200MA | 80009 | 152-0333-00 |
| CR125 | 152-0333-00 | | | SEMICOND DEVICE:SILICON,55V,200MA | 80009 | 152-0333-00 |
| CR147 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 80009 | 152-0141-02 |
| DL13 | 119-0321-00 | | | DELAY LINE,ELEC: | 80009 | 119-0321-00 |
| | ----- ----- | | | (DL13, OPTION 4 ONLY) | | |
| F6 | 159-0056-00 | B010100 | B029999X | FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW | 75915 | 279-100 |
| | ----- ----- | | | * STANDARD ONLY | | |
| F6 | 159-0056-00 | B010100 | B039999X | FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW | 75915 | 279-100 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| F7 | 159-0056-00 | B010100 | B029999X | FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW | 75915 | 279-100 |
| | ----- ----- | | | * STANDARD ONLY | | |
| F7 | 159-0056-00 | B010100 | B039999X | FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW | 75915 | 279-100 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| F10 | 159-0118-00 | XB030000 | | FUSE,THERMAL:50 OHM | 80009 | 159-0118-00 |
| | ----- ----- | | | * STANDARD ONLY | | |
| F10 | 159-0118-00 | XB040000 | | FUSE,THERMAL:50 OHM | 80009 | 159-0118-00 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| J1 | 131-1171-00 | | | CONNECTOR,RCPT,:BNC,50 OHM | 24931 | 28JR231-1 |
| L21 | 283-0181-00 | | | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| | ----- ----- | | | (L21, FURNISHED AS A UNIT WITH C20, SEE SERVICE | | |
| | ----- ----- | | | MANUAL MAINTENANCE SECTION.) | | |
| L22 | 283-0181-00 | | | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| | ----- ----- | | | (L22, FURNISHED AS A UNIT WITH C20, SEE SERVICE | | |
| | ----- ----- | | | MANUAL MAINTENANCE SECTION.) | | |
| L27 | 108-0129-00 | B010100 | B010879 | COIL,RF:18UH | 80009 | 108-0129-00 |
| L27 | 108-0409-00 | B010880 | | COIL,RF:17.5UH | 80009 | 108-0409-00 |
| L81 | 283-0181-00 | | | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |
| | ----- ----- | | | (L81, FURNISHED AS A UNIT WITH C80.) | | |
| | ----- ----- | | | (L81, SEE SERVICE MANUAL MAINTENANCE SECTION) | | |
| L82 | 283-0181-00 | | | CAP.,FXD,CER DI:1.8PF,10%,100V | 72982 | 8101B121C0K0189B |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| | ----- ----- | | | (L82, FURNISHED AS A UNIT WITH C80.) | | |
| | ----- ----- | | | (L82, SEE SERVICE MANUAL MAINTENANCE SECTION) | | |
| L124 | 283-0160-00 | | | CAP.,FXD,CER DI:1.5PF,10%,50V | 72982 | 8101A058C0K159B |
| | ----- ----- | | | (L124, FURNISHED AS A UNIT WITH C123.) | | |
| | ----- ----- | | | (L124, SEE SERVICE MANUAL MAINTENANCE SECTION) | | |
| L125 | 283-0160-00 | | | CAP.,FXD,CER DI:1.5PF,10%,50V | 72982 | 8101A058C0K159B |
| | ----- ----- | | | (L125, FURNISHED AS A UNIT WITH C123.) | | |
| | ----- ----- | | | (L125, SEE SERVICE MANUAL MAINTENANCE SECTION) | | |
| LR40 | 108-0412-00 | | | COIL,RF:1.7UH(WOUND ON A 180 OHM RES.) | 80009 | 108-0412-00 |
| LR46 | 108-0412-00 | | | COIL,RF:1.7UH(WOUND ON A 180 OHM RES.) | 80009 | 108-0412-00 |
| LR100 | 108-0412-00 | | | COIL,RF:1.7UH(WOUND ON A 180 OHM RES.) | 80009 | 108-0412-00 |
| LR106 | 108-0412-00 | | | COIL,RF:1.7UH(WOUND ON A 180 OHM RES.) | 80009 | 108-0412-00 |
| Q50 | 151-0220-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0220-00 |
| Q56 | 151-0232-00 | | | TRANSISTOR:SILICON,NPN,DUAL | 80009 | 151-0232-00 |
| Q73 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0188-00 |
| Q76 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0188-00 |
| Q130 | 151-0254-00 | B010100 | B037375 | TRANSISTOR:SILICON,NPN | 80009 | 151-0254-00 |
| Q130 | 151-0281-00 | B037376 | | TRANSISTOR:SILICON,NPN | 03508 | X16P4039 |
| Q165 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0188-00 |
| Q168 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0188-00 |
| R4 | 321-0748-06 | | | RES.,FXD,FILM:4.95K OHM,0.25%,0.125W | 91637 | MFF1816C49500C |
| R7 | 317-0202-00 | B010100 | B011789 | RES.,FXD,CMPSN:2K OHM,5%,0.125W | 01121 | BB2025 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R7 | 317-0302-00 | B011790 | B029999 | RES.,FXD,CMPSN:3K OHM,(NOM VALUE),SEL | 01121 | BB3025 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R7 | 317-0472-00 | B030000 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.125W | 01121 | BB4725 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R7 | 317-0202-00 | B010100 | B019999 | RES.,FXD,CMPSN:2K OHM,5%,0.125W | 01121 | BB2025 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| R7 | 317-0302-00 | B020000 | B039999 | RES.,FXD,CMPSN:3K OHM,(NOM VALUE),SEL | 01121 | BB3025 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| R7 | 317-0472-00 | B040000 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.125W | 01121 | BB4725 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| R8 | 324-0097-00 | | | RES.,FXD,FILM:100 OHM,1%,1W | 75042 | CCFT0P1000F |
| R9 | 324-0097-00 | | | RES.,FXD,FILM:100 OHM,1%,1W | 75042 | CCFT0P1000F |
| R10 | 307-1021-00 | XB030000 | | ATTENUATOR:STRIP,50 OHM,HYBRID,2.5X | 80009 | 307-1021-00 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R10 | 307-1021-00 | XB040000 | | ATTENUATOR:STRIP,50 OHM,HYBRID,2.5X | 80009 | 307-1021-00 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| R11 | 307-1023-00 | XB030000 | | ATTENUATOR,FXD:50 OHM,5X | 80009 | 307-1023-00 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R11 | 307-1023-00 | XB040000 | | ATTENUATOR,FXD:50 OHM,5X | 80009 | 307-1023-00 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| R12 | 307-1024-00 | XB030000 | | ATTENUATOR,FXD:50 OHM,10X | 80009 | 307-1024-00 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R12 | 307-1024-00 | XB040000 | | ATTENUATOR,FXD:50 OHM,10X | 80009 | 307-1024-00 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| R24 | 317-0750-00 | B010100 | B011449 | RES.,FXD,CMPSN:75 OHM,5%,0.125W | 01121 | BB7505 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R24 | 317-0750-00 | B011450 | | RES.,FXD,CMPSN:75 OHM,(NOM VALUE),SEL | 01121 | BB7505 |
| | ----- ----- | | | * STANDARD ONLY | | |
| R24 | 317-0750-00 | B010100 | B019999 | RES.,FXD,CMPSN:75 OHM,5%,0.125W | 01121 | BB7505 |
| | ----- ----- | | | * OPTION 4 ONLY | | |
| R24 | 317-0750-00 | B020000 | | RES.,FXD,CMPSN:75 OHM,(NOM VALUE),SEL | 01121 | BB7505 |
| | ----- ----- | | | * OPTION 4 ONLY | | |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| R26 | 317-0361-00 | | | RES.,FXD,CMPSN:360 OHM,5%,0.125W | 01121 | BB3615 |
| R27 | 315-0181-00 | | | RES.,FXD,CMPSN:180 OHM,(NOM VALUE),SEL | 01121 | CB1815 |
| R28 | 315-0621-00 | B010100 | B037650 | RES.,FXD,CMPSN:620 OHM,5%,0.25W | 01121 | CB6215 |
| R28 | 315-0621-00 | B037651 | | RES.,FXD,CMPSN:620 OHM,(NOM VALUE),SEL | 01121 | CB6215 |
| R30 | 321-0097-00 | | | RES.,FXD,FILM:100 OHM,1%,0.125W | 91637 | MFF1816G100R0F |
| R32 | 323-0149-00 | | | RES.,FXD,FILM:348 OHM,1%,0.50W | 75042 | CECT0-3480F |
| R34 | 321-0097-00 | | | RES.,FXD,FILM:100 OHM,1%,0.125W | 91637 | MFF1816G100R0F |
| R36 | 323-0149-00 | | | RES.,FXD,FILM:348 OHM,1%,0.50W | 75042 | CECT0-3480F |
| R38 | 311-0634-00 | | | RES.,VAR,NONWIR:500 OHM,10%,0.50W | 73138 | 82-31-0 |
| R39 | 301-0621-00 | | | RES.,FXD,CMPSN:620 OHM,5%,0.50W | 01121 | EB6215 |
| R42 | 323-0120-00 | | | RES.,FXD,FILM:174 OHM,1%,0.50W | 75042 | CECT0-1740F |
| R44 | 317-0750-00 | | | RES.,FXD,CMPSN:75 OHM,5%,0.125W | 01121 | BB7505 |
| R45 | 325-0027-00 | | | RES.,FXD,FILM:93 OHM,1%,0.05W | 03888 | PME50-C93R00F |
| R48 | 323-0120-00 | | | RES.,FXD,FILM:174 OHM,1%,0.50W | 75042 | CECT0-1740F |
| R49 | 301-0621-00 | | | RES.,FXD,CMPSN:620 OHM,5%,0.50W | 01121 | EB6215 |
| R52 | 315-0202-00 | | | RES.,FXD,CMPSN:2K OHM,5%,0.25W | 01121 | CB2025 |
| R54 | 315-0333-00 | | | RES.,FXD,CMPSN:33K OHM,5%,0.25W | 01121 | CB3335 |
| R56 | 315-0682-00 | | | RES.,FXD,CMPSN:6.8K OHM,5%,0.25W | 01121 | CB6825 |
| R58 | 321-0193-00 | | | RES.,FXD,FILM:1K OHM,1%,0.125W | 91637 | MFF1816G10000F |
| R59 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| R61 | 321-0193-00 | | | RES.,FXD,FILM:1K OHM,1%,0.125W | 91637 | MFF1816G10000F |
| R63 | 321-0372-00 | | | RES.,FXD,FILM:73.2K OHM,1%,0.125W | 91637 | MFF1816G73201F |
| R64 | 321-0223-00 | | | RES.,FXD,FILM:2.05K OHM,1%,0.125W | 91637 | MFF1816G20500F |
| R66 | 321-0372-00 | | | RES.,FXD,FILM:73.2K OHM,1%,0.125W | 91637 | MFF1816G73201F |
| R67 | 315-0275-00 | | | RES.,FXD,CMPSN:2.7M OHM,5%,0.25W | 01121 | CB2755 |
| R68 | 311-1320-00 | | | RES.,VAR,NONWIR:5K OHM,1W,W/SW | 12697 | 381CM-39700 |
| | ------ ----- | | | (R68, FURNISHED AS A UNIT WITH S70) | | |
| R72 | 322-0193-00 | | | RES.,FXD,FILM:1K OHM,1%,0.25W | 75042 | CEBT0-1001F |
| R73 | 311-0172-00 | | | RES.,VAR,NONWIR:2.5K OHM,10% | 12697 | 381-CM25200 |
| R74 | 307-0250-00 | | | RES.,THERMAL:390 OHM,10% | 15454 | DG125390K |
| R76 | 311-0633-00 | | | RES.,VAR,NONWIR:5K OHM,10%,0.50W | 73138 | 82-30-0 |
| R78 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| R79 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| R84 | 317-0750-00 | | | RES.,FXD,CMPSN:75 OHM,5%,0.125W | 01121 | BB7505 |
| R85 | 315-0181-00 | XB038100 | | RES.,FXD,CMPSN:180 OHM,5%,0.25W | 01121 | CB1815 |
| R86 | 315-0361-00 | | | RES.,FXD,CMPSN:360 OHM,5%,0.25W | 01121 | CB3615 |
| R88 | 315-0621-00 | | | RES.,FXD,CMPSN:620 OHM,5%,0.25W | 01121 | CB6215 |
| R90 | 321-0097-00 | | | RES.,FXD,FILM:100 OHM,1%,0.125W | 91637 | MFF1816G100R0F |
| R92 | 323-0149-00 | | | RES.,FXD,FILM:348 OHM,1%,0.50W | 75042 | CECT0-3480F |
| R94 | 321-0097-00 | | | RES.,FXD,FILM:100 OHM,1%,0.125W | 91637 | MFF1816G100R0F |
| R96 | 323-0149-00 | | | RES.,FXD,FILM:348 OHM,1%,0.50W | 75042 | CECT0-3480F |
| R98 | 311-0634-00 | | | RES.,VAR,NONWIR:500 OHM,10%,0.50W | 73138 | 82-31-0 |
| R99 | 301-0621-00 | | | RES.,FXD,CMPSN:620 OHM,5%,0.50W | 01121 | EB6215 |
| R102 | 323-0120-00 | | | RES.,FXD,FILM:174 OHM,1%,0.50W | 75042 | CECT0-1740F |
| R104 | 317-0750-00 | | | RES.,FXD,CMPSN:75 OHM,5%,0.125W | 01121 | BB7505 |
| R105 | 325-0027-00 | | | RES.,FXD,FILM:93 OHM,1%,0.05W | 03888 | PME50-C93R00F |
| R108 | 323-0120-00 | | | RES.,FXD,FILM:174 OHM,1%,0.50W | 75042 | CECT0-1740F |
| R109 | 301-0621-00 | | | RES.,FXD,CMPSN:620 OHM,5%,0.50W | 01121 | EB6215 |
| R110 | 321-0222-00 | | | RES.,FXD,FILM:2K OHM,1%,0.125W | 91637 | MFF1816G20000F |
| R112 | 321-0385-00 | | | RES.,FXD,FILM:100K OHM,1%,0.125W | 91637 | MFF1816G10002F |
| R114 | 315-0242-00 | | | RES.,FXD,CMPSN:2.4K OHM,5%,0.25W | 01121 | CB2425 |
| R116 | 311-1007-00 | | | RES.,VAR,NONWIR:20 OHM,20%,0.50W | 73138 | 82-38-0 |
| R117 | 317-0202-00 | | | RES.,FXD,CMPSN:2K OHM,(NOM VALUE),SEL | 01121 | BB2025 |
| R119 | 321-0067-00 | | | RES.,FXD,FILM:48.7 OHM,1%,0.125W | 91637 | MFF1816G48R70F |
| R121 | 317-0121-00 | B010100 | B037650 | RES.,FXD,CMPSN:120 OHM,5%,0.125W | 01121 | BB1215 |
| R121 | 317-0121-00 | B037651 | | RES.,FXD,CMPSN:120 OHM,(NOM VALUE),SEL | 01121 | BB1215 |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| R132 | 321-0299-00 | | | RES.,FXD,FILM:12.7K OHM,1%,0.125W | 91637 | MFF1816G12701F |
| R133 | 315-0753-00 | | | RES.,FXD,CMPSN:75K OHM,5%,0.25W | 01121 | CB7535 |
| R134 | 315-0753-00 | | | RES.,FXD,CMPSN:75K OHM,5%,0.25W | 01121 | CB7535 |
| R135 | 315-0154-00 | | | RES.,FXD,CMPSN:150K OHM,5%,0.25W | 01121 | CB1545 |
| R137 | 315-0154-00 | | | RES.,FXD,CMPSN:150K OHM,5%,0.25W | 01121 | CB1545 |
| R138 | 321-0344-00 | | | RES.,FXD,FILM:37.4K OHM,1%,0.125W | 91637 | MFF1816G37401F |
| R139 | 315-0753-00 | | | RES.,FXD,CMPSN:75K OHM,5%,0.25W | 01121 | CB7535 |
| R141 | 315-0154-00 | | | RES.,FXD,CMPSN:150K OHM,5%,0.25W | 01121 | CB1545 |
| R142 | 315-0513-00 | | | RES.,FXD,CMPSN:51K OHM,5%,0.25W | 01121 | CB5135 |
| R144 | 315-0753-00 | | | RES.,FXD,CMPSN:75K OHM,5%,0.25W | 01121 | CB7535 |
| R145 | 321-0344-00 | | | RES.,FXD,FILM:37.4K OHM,1%,0.125W | 91637 | MFF1816G37401F |
| R147 | 315-0154-00 | | | RES.,FXD,CMPSN:150K OHM,5%,0.25W | 01121 | CB1545 |
| R148 | 315-0154-00 | | | RES.,FXD,CMPSN:150K OHM,5%,0.25W | 01121 | CB1545 |
| R163 | 311-0634-00 | | | RES.,VAR,NONWIR:500 OHM,10%,0.50W | 73138 | 82-31-0 |
| R164 | 322-0212-00 | | | RES.,FXD,FILM:1.58K OHM,1%,0.25W | 75042 | CEBTO-1581F |
| R166 | 321-0193-00 | | | RES.,FXD,FILM:1K OHM,1%,0.125W | 91637 | MFF1816G10000F |
| R168 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| R171 | 315-0510-00 | | | RES.,FXD,CMPSN:51 OHM,5%,0.25W | 01121 | CB5105 |
| R173 | 315-0510-00 | | | RES.,FXD,CMPSN:51 OHM,5%,0.25W | 01121 | CB5105 |
| R178 | 315-0470-00 | | | RES.,FXD,CMPSN:47 OHM,5%,0.25W | 01121 | CB4705 |
| S5 | 105-0321-00 | B010100 | B029999 | ACTR ASSY,CAM S:INPUT | 80009 | 105-0321-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| S5 | 263-1094-00 | B030000 | | SW CAM ACTR AS:INPUT | 80009 | 263-1094-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| S5 | 105-0321-00 | B010100 | B039999 | ACTR ASSY,CAM S:INPUT | 80009 | 105-0321-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| S5 | 263-1094-00 | B040000 | | SW CAM ACTR AS:INPUT | 80009 | 263-1094-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| S10 | 263-1064-00 | XB030000 | | SW CAM ACTR AS:VOLTS/DIV | 80009 | 263-1064-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| S10 | 263-1064-00 | XB040000 | | SW CAM ACTR AS:VOLTS/DIV | 80009 | 263-1064-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| S50 | 105-0322-00 | B010100 | B029999 | ACTR ASSY,CAM S:POLARITY | 80009 | 105-0322-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| S50 | 263-1095-00 | B030000 | | SW CAM ACTR AS:POLARITY | 80009 | 263-1095-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| S50 | 105-0322-00 | B010100 | B039999 | ACTR ASSY,CAM S:POLARITY | 80009 | 105-0322-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| S50 | 263-1095-00 | B040000 | | SW CAM ACTR AS:POLARITY | 80009 | 263-1095-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| S70 | 311-1320-00 | | | RES.,VAR,NONWIR:5K OHM,1W,W/SW | 12697 | 381CM-39700 |
| | ------ ------ | | | (S70, FURNISHED AS A UNIT WITH R68) | | |
| S135 | 105-0323-00 | B010100 | B029999 | ACTR ASSY,CAM S:VOLTS/DIV | 80009 | 105-0323-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| S135 | 263-1096-00 | B030000 | | SW CAM ACTR AS:VOLTS/DIV | 80009 | 263-1096-00 |
| | ------ ------ | | | * STANDARD ONLY | | |
| S135 | 105-0323-00 | B010100 | B039999 | ACTR ASSY,CAM S:VOLTS/DIV | 80009 | 105-0323-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| S135 | 263-1096-00 | B040000 | | SW CAM ACTR AS:VOLTS/DIV | 80009 | 263-1096-00 |
| | ------ ------ | | | * OPTION 4 ONLY | | |
| U40 | 155-0068-00 | | | MICROCIRCUIT,LI:HYBRID,AMPLIFIER | 80009 | 155-0068-00 |
| U100 | 155-0068-00 | | | MICROCIRCUIT,LI:HYBRID,AMPLIFIER | 80009 | 155-0068-00 |
| U110 | 156-0049-00 | | | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 80009 | 156-0049-00 |

# DIAGRAMS

## 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 ($\mu$F).

Resistors = Ohms ($\Omega$).

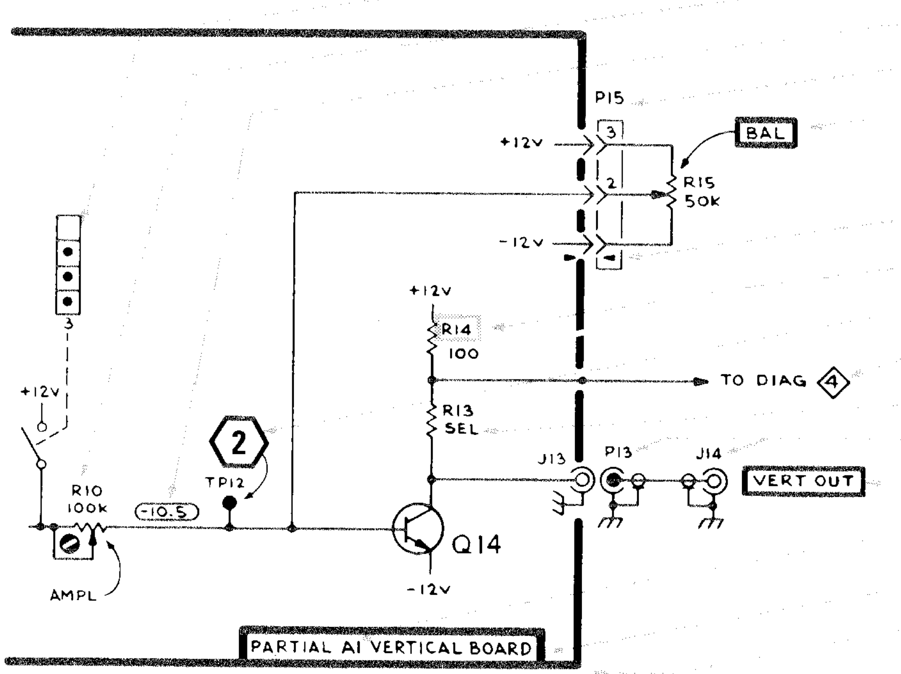
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

| | |
|---|---|
| A | Assembly, separable or repairable (circuit board, etc.) |
| AT | Attenuator, fixed or variable |
| B | Motor |
| BT | Battery |
| C | Capacitor, fixed or variable |
| CB | Circuit breaker |
| CR | Diode, signal or rectifier |
| DL | Delay line |
| DS | Indicating device (lamp) |
| E | Spark Gap |
| F | Fuse |
| FL | Filter |
| H | Heat dissipating device (heat sink, heat radiator, etc.) |
| HR | Heater |
| HY | Hybrid circuit |
| J | Connector, stationary portion |
| K | Relay |
| L | Inductor, fixed or variable |
| LR | Inductor/resistor combination |
| M | Meter |
| P | Connector, movable portion |
| Q | Transistor or silicon-controlled rectifier |
| R | Resistor, fixed or variable |
| RT | Thermistor |
| S | Switch |
| T | Transformer |
| TC | Thermocouple |
| TP | Test point |
| U | Assembly, inseparable or non-repairable (integrated circuit, etc.) |
| V | Electron tube |
| VR | Voltage regulator (zener diode, etc.) |
| Y | Crystal |
| Z | Phase shifter |

The following special symbols are used on the diagrams:




VERTICAL AMPLIFIER 2

Cam Switch Closure Chart

Internal Screwdriver Adjustment

Test Voltage

Plug to E.C. Board

Panel Adjustment

Plug Index

Modified Component—See Parts List

Refer to Waveform

Refer to Diagram Number

SEL Value Selected at Factory

Coaxial Connector

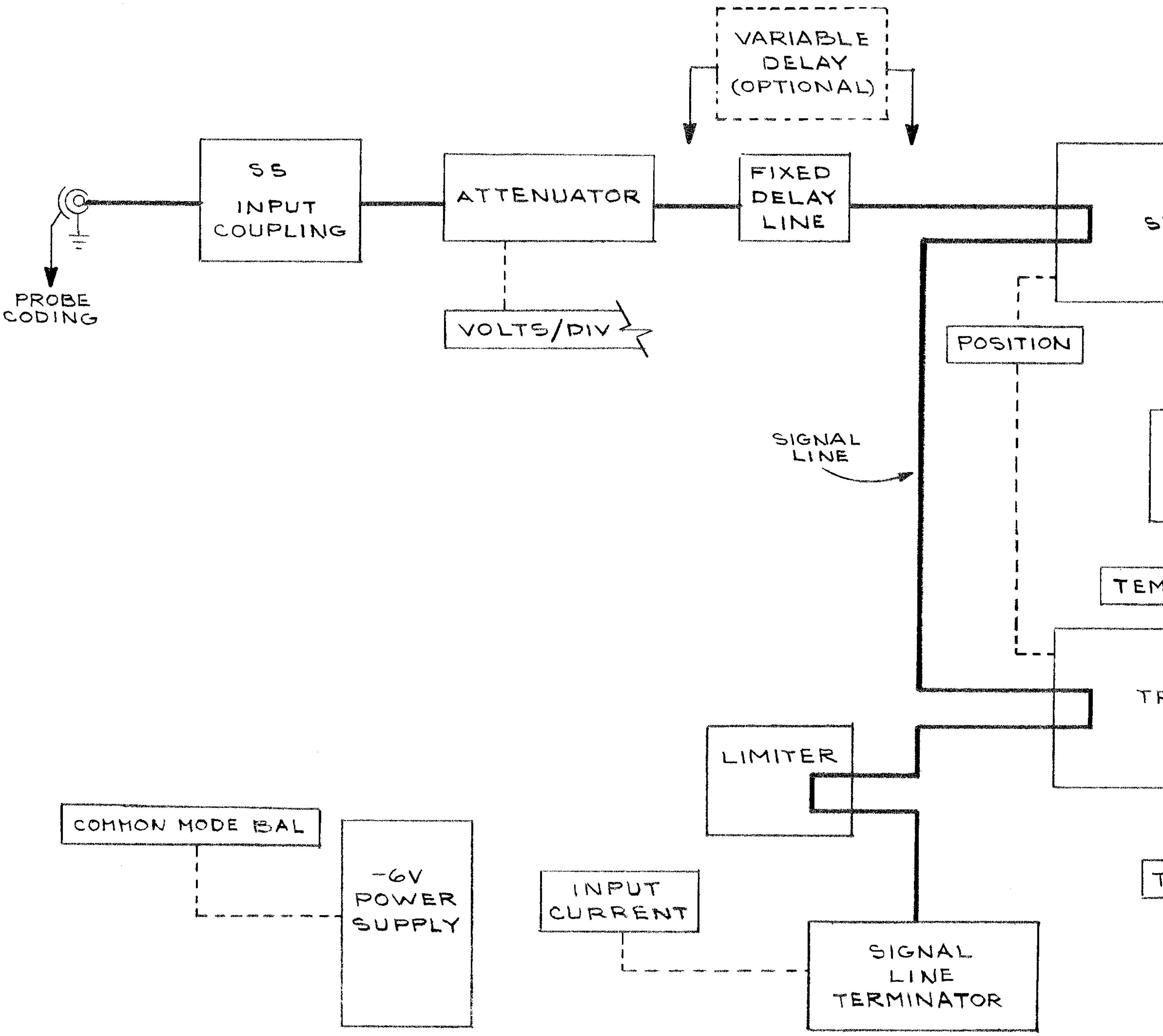
Panel Connector

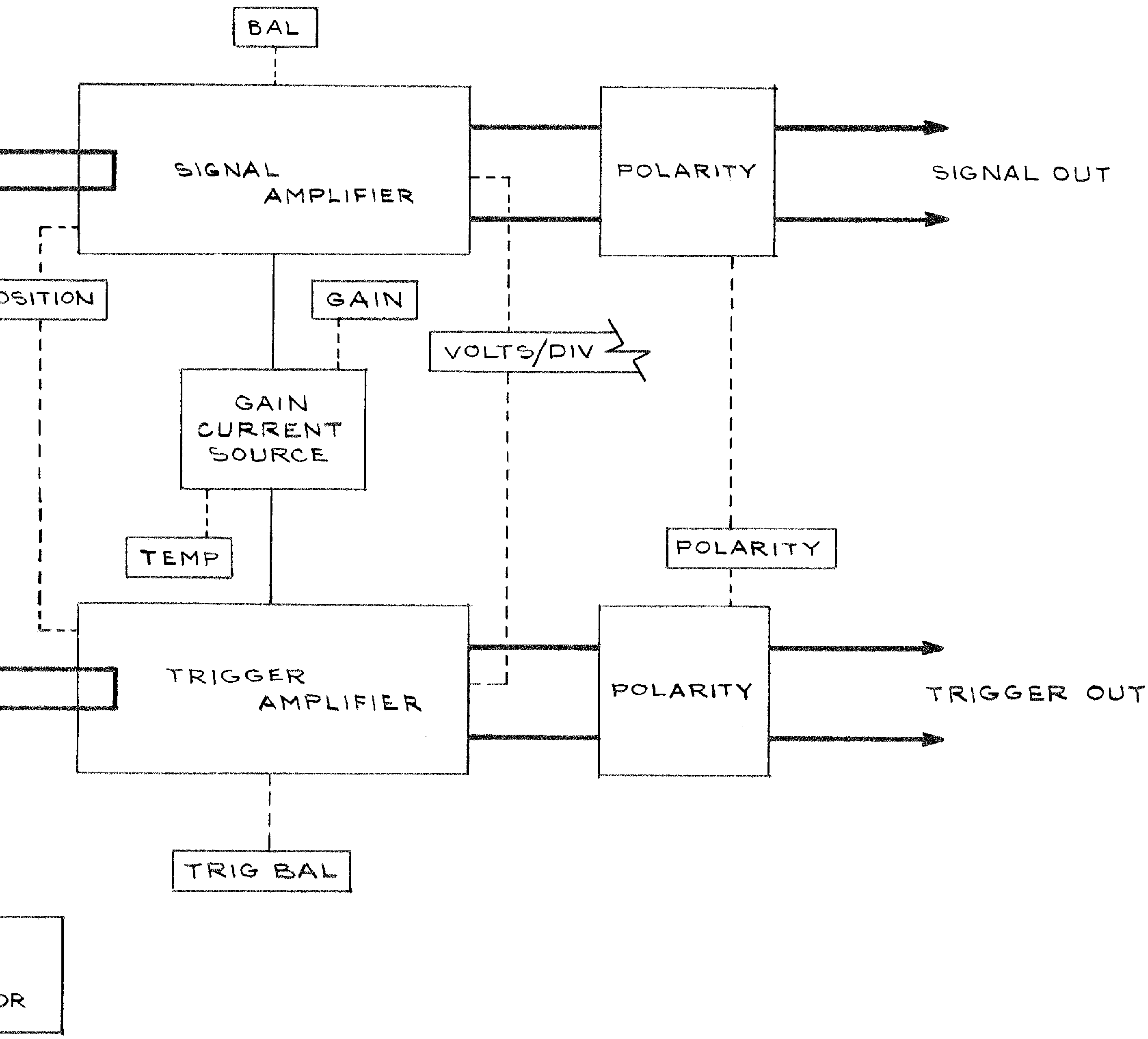
Assembly Number

Board Name

Etched Circuit Board Outlined in Black

Schematic Name and Number


VARIABLE DELAY (OPTIONAL)
SS INPUT COUPLING
ATTENUATOR
FIXED DELAY LINE
PROBE CODING
VOLTS/DIV
POSITION
SIGNAL LINE
LIMITER
COMMON MODE BAL
-6V POWER SUPPLY
INPUT CURRENT
SIGNAL LINE TERMINATOR

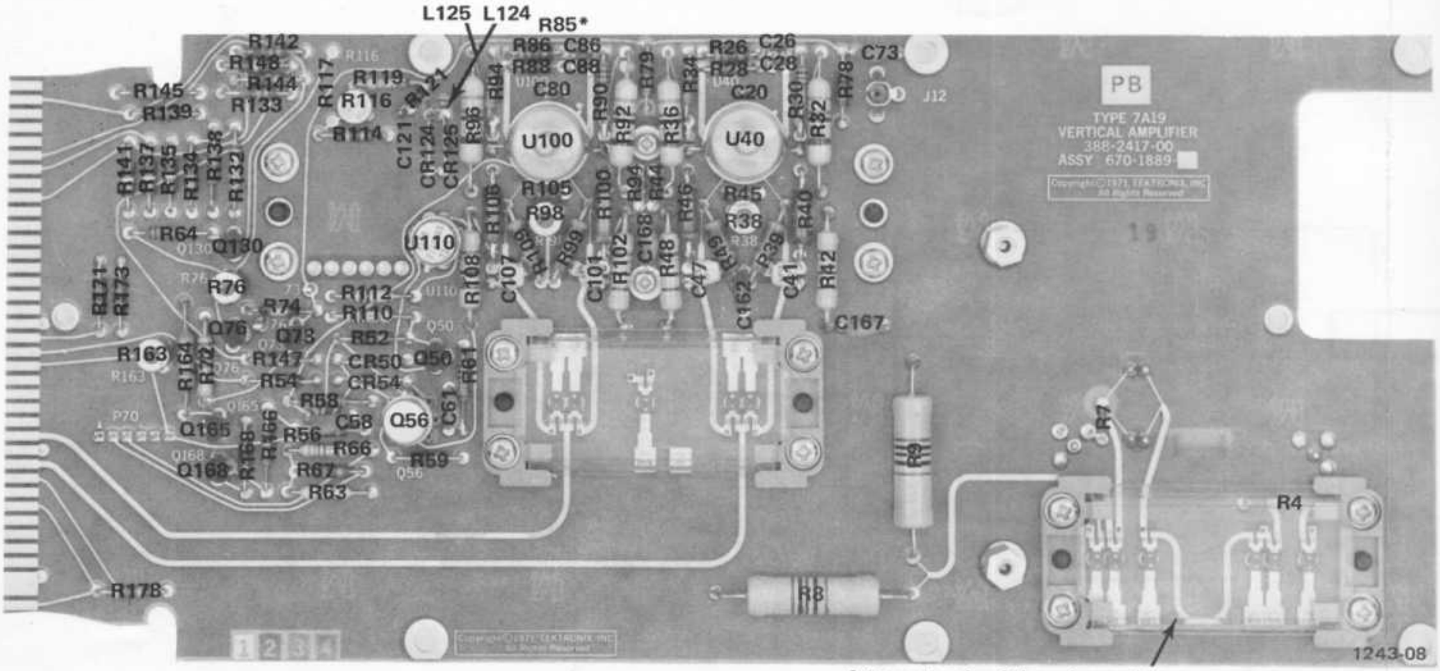



1243-07

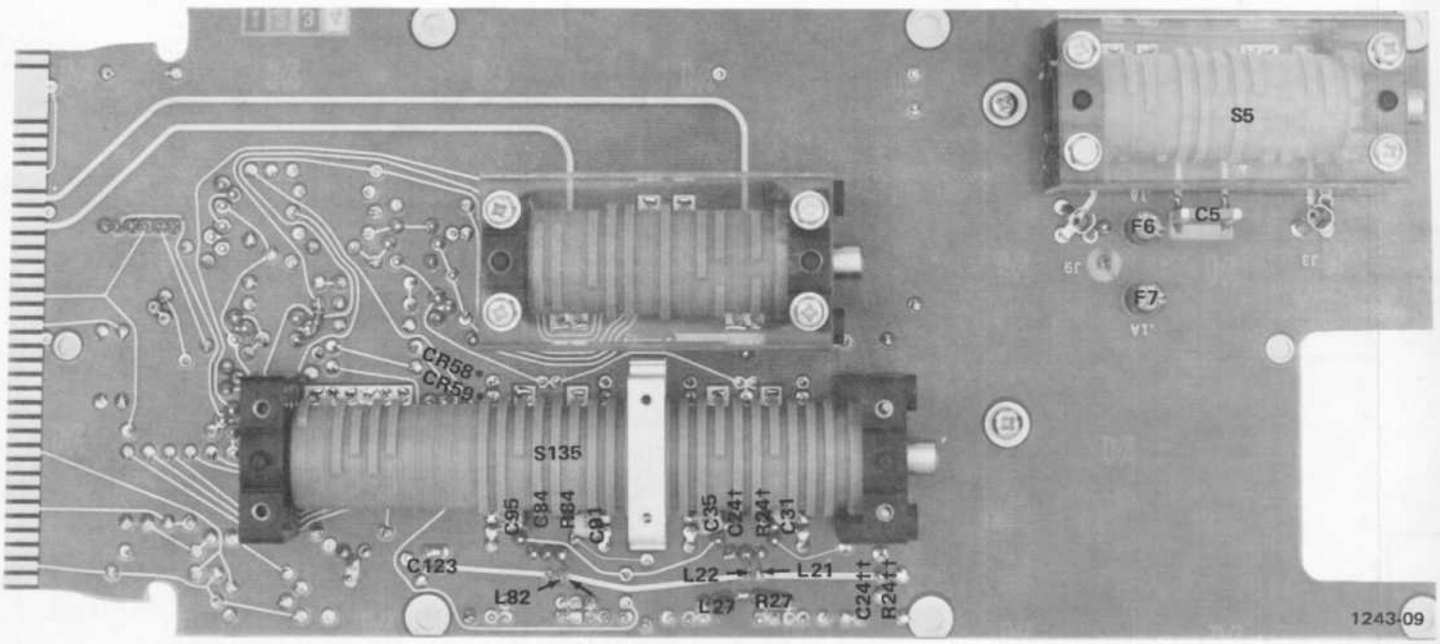
BLOCK DIAGRAM

hq
1171

@




Attenuator circuit board assembly below SN B030000.




A1 7A19 Amplifier board.

* See Parts List for serial number ranges.

† SN B037849 & below.

†† SN B037850 & up.


A2 7A19 Amplifier board Attenuator circuit board assembly above SN B030000.

# VOLTAGE AND WAVEFORM TEST CONDITIONS

Typical voltage measurements were obtained under the following conditions unless noted otherwise on the individual diagrams:

**Voltmeter**

| | |
|---|---|
| Type | Non-loading digital multimeter |
| Input impedance | 10 MΩ |
| Range | 0 to 1000 volts |
| Recommended type (as used for voltages on diagrams) | Tektronix DM501 Digital Multimeter |

**7A19 (left vertical compartment)**

| | |
|---|---|
| POLARITY | +UP |
| VOLTS/DIV | 10 mV |
| COUPLING | DC |
| POSITION | Centered |
| Signal Applied | No signal for voltage measurements, 40 mV square wave from oscilloscope Calibrator applied to input connector for waveforms. |

**7A16A (right vertical compartment using a 10X probe with readout coding ring. P6062A probe used for waveforms on diagrams)**

| | |
|---|---|
| Polarity | +UP |
| Bandwidth | Full |
| Position | Centered |
| Coupling | AC |
| Variable | Cal In |

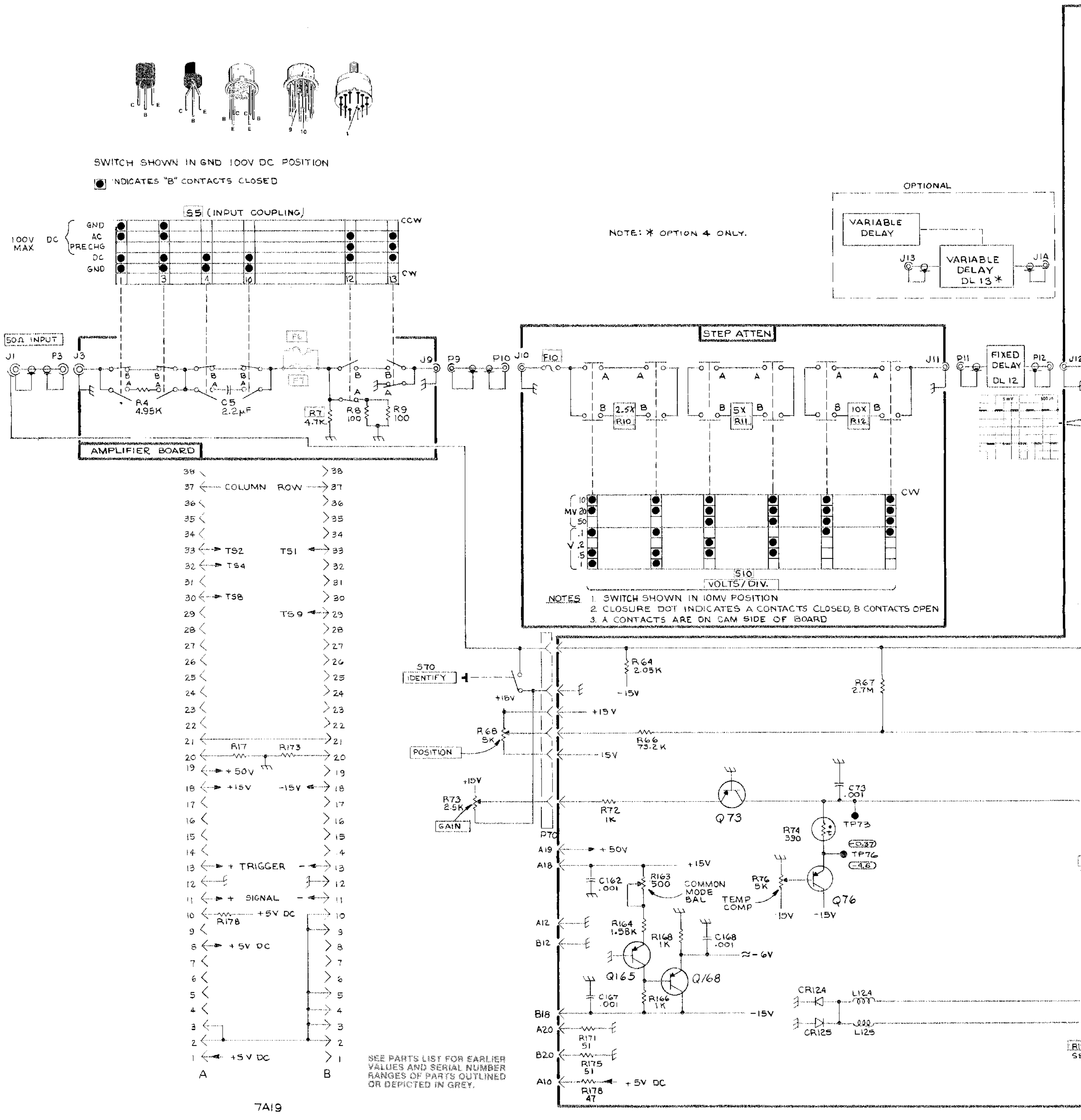
**7B70 (A Horizontal compartment)**

| | |
|---|---|
| Level/Slope | Centered on positive slope |
| Triggering | |
| Mode | P-P Auto |
| Coupling | AC |
| Source | Ext |
| Magnifier | X1 |
| Time/Div | 1 ms |
| Variable | Cal In |

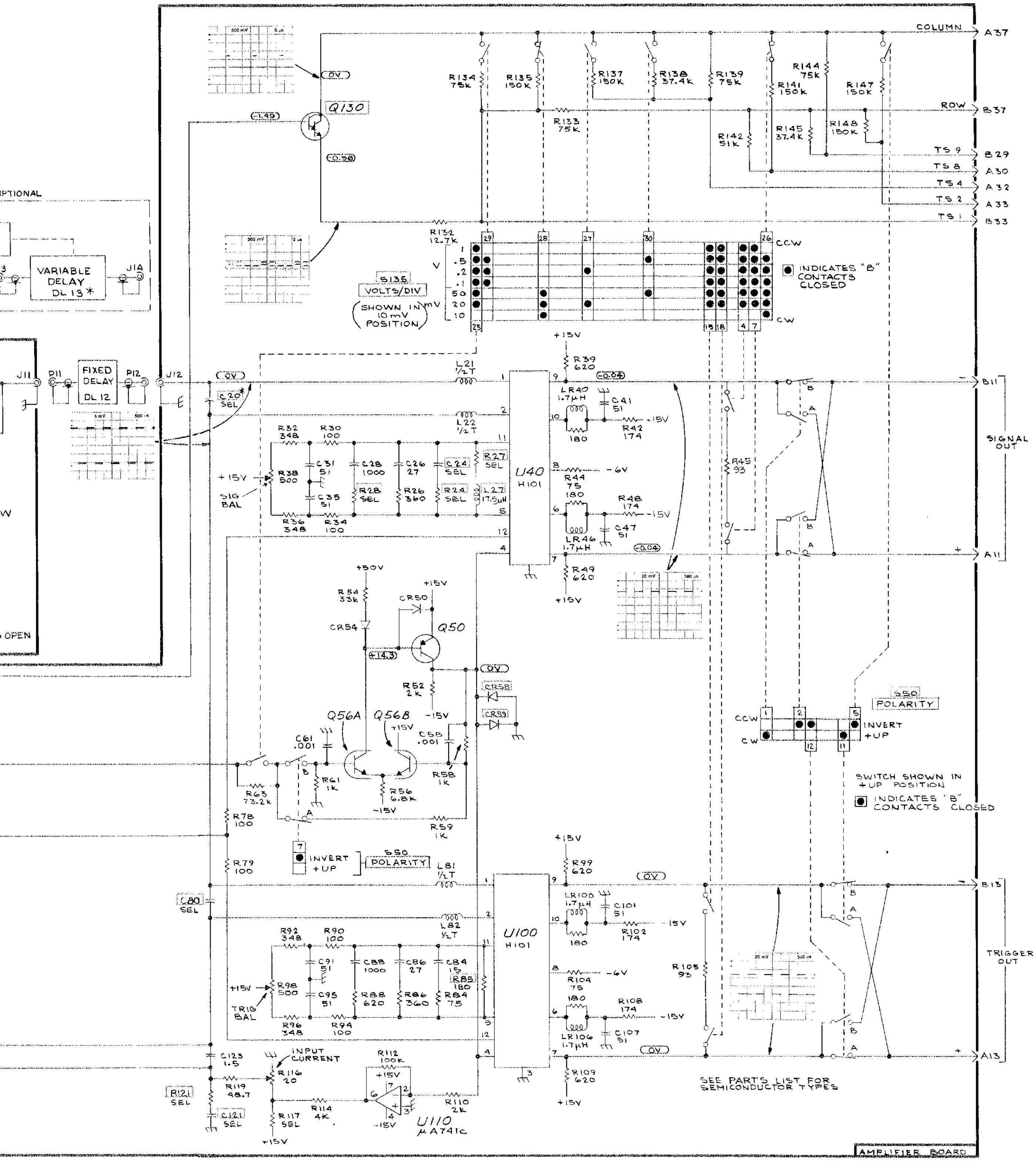
**7704A**

| | |
|---|---|
| Vertical Mode | Right |
| Horizontal Mode | A |
| A Intensity | Optimum |
| B Intensity | Counterclockwise |
| Calibrator | |
| Volts | 40 mV |
| Rate | 1 kHz |
| A Trigger Source | Right Vert |
| B Trigger Source | Left Vert |

All voltages given on the diagrams are in volts. All currents are in milliamps. Waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System. Vertical deflection factor shown on waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams (shown in blue) are not absolute and may vary between instruments because of component tolerances, internal calibration or front panel settings.



SWITCH SHOWN IN GND 100V DC POSITION
INDICATES "B" CONTACTS CLOSED
S5 (INPUT COUPLING)
GND
AC
PRECHG
DC
GND
100V DC MAX
CCW
CW
NOTE: * OPTION 4 ONLY.
OPTIONAL
VARIABLE DELAY
VARIABLE DELAY DL 13 *
J13
J14
50Ω INPUT
J1
P3
J3
R4 4.95K
C5 2.2μF
R7 4.7K
R8 100
R9 100
J9
P9
P10
J10
F10
AMPLIFIER BOARD
STEP ATTEN
2.5X R10
5X R11
10X R12
J11
P11
FIXED DELAY DL 12
P12
S10 VOLTS/DIV.
NOTES 1. SWITCH SHOWN IN 10MV POSITION
2. CLOSURE DOT INDICATES A CONTACTS CLOSED, B CONTACTS OPEN
3. A CONTACTS ARE ON CAM SIDE OF BOARD
COLUMN ROW
TS2
TS4
TS8
TS1
TS9
R17
R173
+50V
+15V
-15V
+ TRIGGER -
+ SIGNAL -
R178
+5V DC
A
B
S70 IDENTIFY
R64 2.05K
R67 2.7M
R68 5K
POSITION
R66 73.2K
R73 2.5K
GAIN
R72 1K
Q73
C73 .001
TP73
R74 390
TP76
Q76
R76 5K
TEMP COMP
C162 .001
R163 500
COMMON MODE BAL
R164 1.58K
R168 1K
C168 .001
≈-6V
Q165
Q168
C167 .001
R166 1K
CR124
L124
CR125
L125
R171 51
R175 51
R178 47
A19
A18
A12
B12
B18
A20
B20
A10
P70
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
7A19




2129-01
REV B, MAR 1979

AMPLIFIER

AMPLIFIER

# REPLACEABLE MECHANICAL PARTS

## PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

## SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

## FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

## INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

*1 2 3 4 5* *Name & Description*

*Assembly and/or Component*
*Attaching parts for Assembly and/or Component*
- - - * - - -

*Detail Part of Assembly and/or Component*
*Attaching parts for Detail Part*
- - - * - - -

*Parts of Detail Part*
*Attaching parts for Parts of Detail Part*
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

**Attaching parts must be purchased separately, unless otherwise specified.**

## ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

## ABBREVIATIONS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| " | INCH | ELCTRN | ELECTRON | IN | INCH | SE | SINGLE END |
| # | NUMBER SIZE | ELEC | ELECTRICAL | INCAND | INCANDESCENT | SECT | SECTION |
| ACTR | ACTUATOR | ELCTLT | ELECTROLYTIC | INSUL | INSULATOR | SEMICOND | SEMICONDUCTOR |
| ADPTR | ADAPTER | ELEM | ELEMENT | INTL | INTERNAL | SHLD | SHIELD |
| ALIGN | ALIGNMENT | EPL | ELECTRICAL PARTS LIST | LPHLDR | LAMPHOLDER | SHLDR | SHOULDERED |
| AL | ALUMINUM | EQPT | EQUIPMENT | MACH | MACHINE | SKT | SOCKET |
| ASSEM | ASSEMBLED | EXT | EXTERNAL | MECH | MECHANICAL | SL | SLIDE |
| ASSY | ASSEMBLY | FIL | FILLISTER HEAD | MTG | MOUNTING | SLFLKG | SELF-LOCKING |
| ATTEN | ATTENUATOR | FLEX | FLEXIBLE | NIP | NIPPLE | SLVG | SLEEVING |
| AWG | AMERICAN WIRE GAGE | FLH | FLAT HEAD | NON WIRE | NOT WIRE WOUND | SPR | SPRING |
| BD | BOARD | FLTR | FILTER | OBD | ORDER BY DESCRIPTION | SQ | SQUARE |
| BRKT | BRACKET | FR | FRAME or FRONT | OD | OUTSIDE DIAMETER | SST | STAINLESS STEEL |
| BRS | BRASS | FSTNR | FASTENER | OVH | OVAL HEAD | STL | STEEL |
| BRZ | BRONZE | FT | FOOT | PH BRZ | PHOSPHOR BRONZE | SW | SWITCH |
| BSHG | BUSHING | FXD | FIXED | PL | PLAIN or PLATE | T | TUBE |
| CAB | CABINET | GSKT | GASKET | PLSTC | PLASTIC | TERM | TERMINAL |
| CAP | CAPACITOR | HDL | HANDLE | PN | PART NUMBER | THD | THREAD |
| CER | CERAMIC | HEX | HEXAGON | PNH | PAN HEAD | THK | THICK |
| CHAS | CHASSIS | HEX HD | HEXAGONAL HEAD | PWR | POWER | TNSN | TENSION |
| CKT | CIRCUIT | HEX SOC | HEXAGONAL SOCKET | RCPT | RECEPTACLE | TPG | TAPPING |
| COMP | COMPOSITION | HLCPS | HELICAL COMPRESSION | RES | RESISTOR | TRH | TRUSS HEAD |
| CONN | CONNECTOR | HLEXT | HELICAL EXTENSION | RGD | RIGID | V | VOLTAGE |
| COV | COVER | HV | HIGH VOLTAGE | RLF | RELIEF | VAR | VARIABLE |
| CPLG | COUPLING | IC | INTEGRATED CIRCUIT | RTNR | RETAINER | W/ | WITH |
| CRT | CATHODE RAY TUBE | ID | INSIDE DIAMETER | SCH | SOCKET HEAD | WSHR | WASHER |
| DEG | DEGREE | IDENT | IDENTIFICATION | SCOPE | OSCILLOSCOPE | XFMR | TRANSFORMER |
| DWR | DRAWER | IMPLR | IMPELLER | SCR | SCREW | XSTR | TRANSISTOR |

## CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

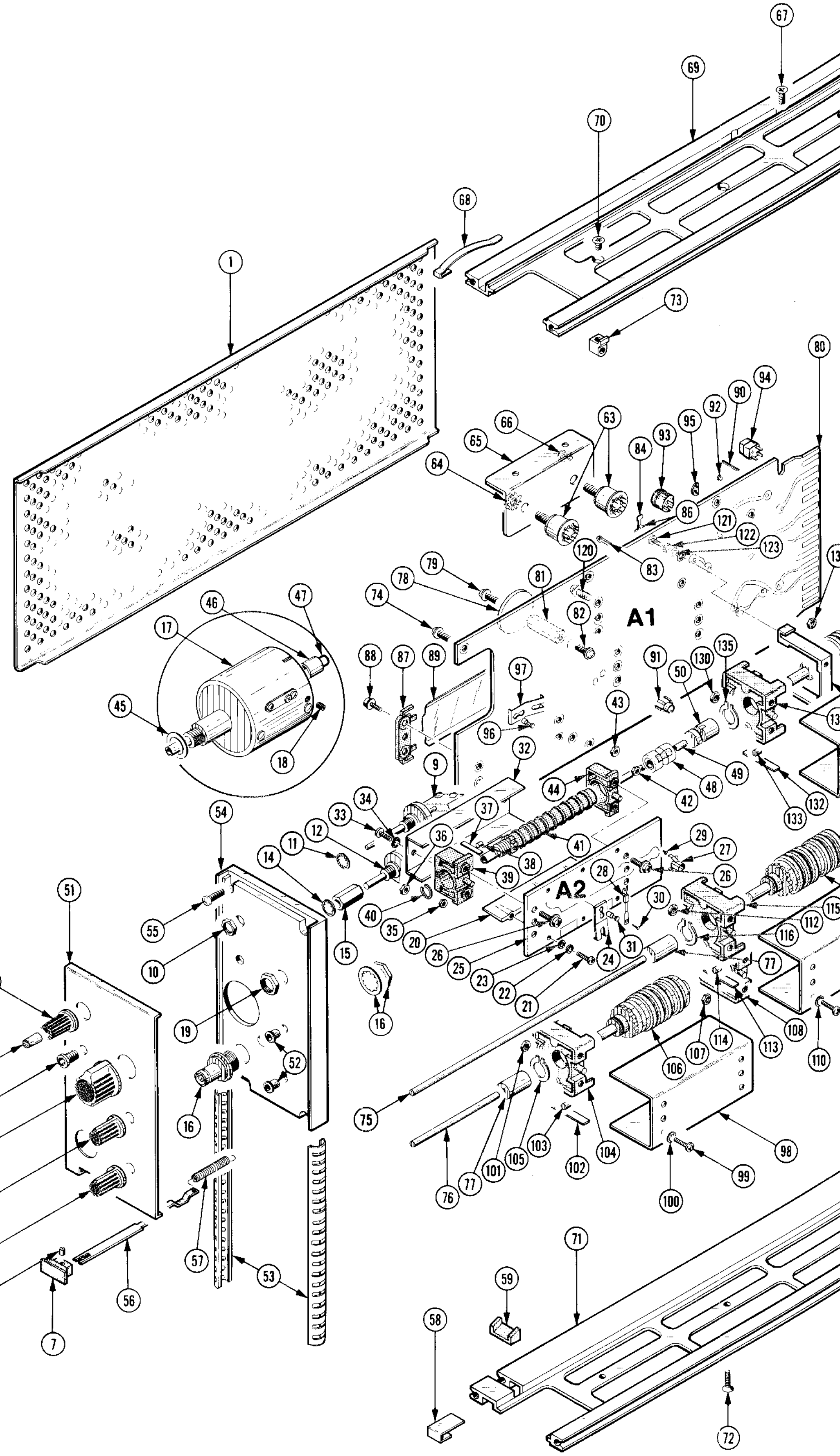
| Mfr. Code | Manufacturer | Address | City, State, Zip |
|---|---|---|---|
| 000CN | OMNI-SPECTRA, INC., AMERICON CABLE DIV. | 2370 OWN STREET | SANTA CLARA, CA 95050 |
| 000CY | NORTHWEST FASTENER SALES, INC. | 7923 SW CIRRUS DRIVE | BEAVERTON, OREGON 97005 |
| 00779 | AMP, INC. | P O BOX 3608 | HARRISBURG, PA 17105 |
| 08261 | SPECTRA-STRIP CORP. | 7100 LAMPSON AVE. | GARDEN GROVE, CA 92642 |
| 12360 | ALBANY PRODUCTS CO., DIV. OF PNEUMO DYNAMICS CORPORATION | 145 WOODWARD AVENUE | SOUTH NORWALK, CT 06586 |
| 13257 | AMERACE, LTD. | 10 ESNA PARK DRIVE | MARKHAM, ONTARIO, CANADA |
| 22526 | BERG ELECTRONICS, INC. | YOUK EXPRESSWAY | NEW CUMBERLAND, PA 17070 |
| 24931 | SPECIALTY CONNECTOR CO., INC. | 3560 MADISON AVE. | INDIANAPOLIS, IN 46227 |
| 26805 | OMNI SPECTRA INC., MICROWAVE CONNECTOR DIV. | 140 FOURTH AVE | WALTHAM, MA 02154 |
| 42838 | NATIONAL RIVET AND MFG. CO. | 1-21 EAST JEFFERSON ST. | WAUPUN, WI 53963 |
| 71785 | TRW, CINCH CONNECTORS | 1501 MORSE AVENUE | ELK GROVE VILLAGE, IL 60007 |
| 73743 | FISCHER SPECIAL MFG. CO. | 446 MORGAN ST. | CINCINNATI, OH 45206 |
| 74445 | HOLO-KROME CO. | 31 BROOK ST. WEST | HARTFORD, CT 06110 |
| 78189 | ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION | ST. CHARLES ROAD | ELGIN, IL 60120 |
| 79136 | WALDES, KOHINOOR, INC. | 47-16 AUSTEL PLACE | LONG ISLAND CITY, NY 11101 |
| 80009 | TEKTRONIX, INC. | P O BOX 500 | BEAVERTON, OR 97077 |
| 83385 | CENTRAL SCREW CO. | 2530 CRESCENT DR. | BROADVIEW, IL 60153 |
| 87308 | N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV. | P. O. BOX 1360 | STATESVILLE, NC 28677 |
| 93459 | WEINSCHEL ENGINEERING COMPANY, INC. | CLOPPER ROAD, P O BOX 577 | GAITHERSBURG, MD 20760 |
| 97464 | INDUSTRIAL RETAINING RING CO. | 57 CORDIER ST. | IRVINGTON, NJ 07111 |
| 98291 | SEALECTRO CORP. | 225 HOYT | MAMARONECK, NY 10544 |

| 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 | 337-1064-04 | | | 2 | SHIELD,ELEC:RIGHT SIDE | 80009 | 337-1064-00 |
| -2 | 366-1059-00 | | | 1 | PUSH BUTTON:GRAY | 80009 | 366-1059-00 |
| -3 | 366-1077-00 | | | 1 | KNOB:GRAY | 80009 | 366-1077-00 |
| | 213-0153-00 | | | 1 | . SETSCREW:5-40 X 0.125,STL BK OXD,HEX | 000CY | OBD |
| -4 | 366-1028-00 | | | 1 | KNOB:GRAY | 80009 | 366-1028-00 |
| | 213-0153-00 | | | 2 | . SETSCREW:5-40 X 0.125,STL BK OXD,HEX | 000CY | OBD |
| -5 | 366-1209-00 | | | 1 | KNOB:GRAY | 80009 | 366-1209-00 |
| | 213-0153-00 | | | 1 | . SETSCREW:5-40 X 0.125,STL BK OXD,HEX | 000CY | OBD |
| -6 | 366-1209-00 | | | 1 | KNOB:GRAY | 80009 | 366-1209-00 |
| | 213-0153-00 | | | 1 | . SETSCREW:5-40 X 0.125,STL BK OXD,HEX | 000CY | OBD |
| -7 | 366-1058-31 | | | 1 | KNOB:LATCH | 80009 | 366-1058-31 |
| | | | | | (ATTACHING PARTS) | | |
| -8 | 214-1095-00 | | | 1 | PIN,SPG,SPLIT:0.094 OD X 0.187 INCH LONG | 13257 | 52-022-094-0187 |
| | | | | | - - - * - - - | | |
| -9 | ----- ----- | | | 1 | RESISTOR,VAR:(SEE R68 EPL) | | |
| | | | | | (ATTACHING PARTS) | | |
| -10 | 210-0583-00 | | | 1 | NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS | 73743 | 2X20224-402 |
| -11 | 210-0046-00 | | | 1 | WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL | 78189 | 1214-05-00-0541C |
| | | | | | - - - * - - - | | |
| -12 | ----- ----- | | | 1 | RESISTOR,VAR:(SEE R73 EPL) | | |
| | | | | | (ATTACHING PARTS) | | |
| -13 | 358-0342-00 | | | 1 | BSHG,MACH.THD:0.25 X 32 X 0.352 INCH LONG | 80009 | 358-0342-00 |
| -14 | 210-0046-00 | | | 1 | WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL | 78189 | 1214-05-00-0541C |
| -15 | 129-0252-00 | | | 1 | SPACER,POST:0.45 LONG X 0.312 HEX | 80009 | 129-0252-00 |
| | | | | | - - - * - - - | | |
| -16 | 131-1171-00 | | | 1 | CONNECTOR,RCPT,:BNC,50 OHM | 24931 | 28JR231-1 |
| -17 | 119-0319-00 | B010100 | B029999 | 1 | ATTENUATOR,VAR: | 93459 | 2980-2 |
| | 672-0430-00 | B030000 | | 1 | CKT BOARD ASSY:ATTENUATOR | 80009 | 672-0430-00 |
| | | | | | (ATTACHING PARTS) | | |
| -18 | 213-0022-00 | B010100 | B029999X | 2 | SETSCREW:4-40 X 0.188 INCH,HEX SOC STL | 74445 | OBD |
| -19 | 210-0590-00 | B010100 | B029999 | 1 | NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL | 73743 | 2X28269-402 |
| | 220-0495-00 | B030000 | | 1 | NUT,PLAIN,HEX.:0.375-32 X 0.438 INCH BRS | 73743 | OBD |
| | | | | | - - - * - - - | | |
| | ----- ----- | | | - | . CKT BOARD ASSY INLCUDES: | | |
| -20 | 337-1418-01 | B030000 | | 2 | . SHIELD,ELEC:CAM SWITCH | 80009 | 337-1418-01 |
| | | | | | (ATTACHING PARTS FOR EACH) | | |
| -21 | 211-0001-00 | B030000 | | 1 | . SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL | 83385 | OBD |
| -22 | 210-0053-00 | B030000 | | 1 | . WASHER,LOCK:INTL,0.092 ID X 0.175"OD,STL | 83385 | OBD |
| -23 | 210-1008-00 | B030000 | | 1 | . WASHER,FLAT:0.09 ID X 0.188" OD,BRS | 12360 | OBD |
| | | | | | - - - * - - - | | |
| -24 | 344-0248-00 | B030000 | | 4 | . CLIP,ATTENUATOR: | 80009 | 344-0248-00 |
| -25 | ----- ----- | B030000 | | 1 | . CKT BOARD ASSY:ATTENUATOR(SEE A2 EPL) | | |
| | | | | | (ATTACHING PARTS) | | |
| -26 | 211-0116-00 | B030000 | | 4 | . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | | | | | - - - * - - - | | |
| | ----- ----- | | | - | . . CKT BOARD ASSY INCLUDES: | | |
| -27 | 131-1003-00 | B030000 | | 1 | . . CONNECTOR BODY,:CKT BD MT,2 PRONG | 80009 | 131-1003-00 |
| -28 | 131-1031-00 | B030000 | | 6 | . . CONTACT ASSY,EL:CAM SWITCH,TOP | 80009 | 131-1031-00 |
| | 131-1030-00 | B030000 | | 6 | . . CONT ASSY,ELEC:CAM SWITCH,BOTTOM | 80009 | 131-1030-00 |
| -29 | 136-0252-01 | B030000 | | 2 | . . CONTACT,ELEC:0.178 INCH LONG | 00779 | 1-332095-2 |
| -30 | 210-0779-00 | B030000 | | 6 | . . RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG | 42838 | RA-29952715 |
| -31 | 214-1797-00 | B030000 | | 8 | . . PIN,ATTEN CLIP: | 80009 | 214-1797-00 |
| | 263-1064-00 | B030000 | | 1 | . SW CAM ACTR AS:VOLTS/DIVISION | 80009 | 263-1064-00 |
| -32 | 200-1653-00 | B030000 | | 1 | . . COVER,CAM SW: | 80009 | 200-1653-00 |
| | | | | | (ATTACHING PARTS) | | |
| -33 | 211-0022-00 | B030000 | | 2 | . . SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL | 83385 | OBD |
| -34 | 210-0001-00 | B030000 | | 2 | . . WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL | 78189 | 1202-00-00-0541C |
| | | | | | - - - * - - - | | |
| -35 | 210-0405-00 | B030000 | | 1 | . . NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS | 73743 | 2X12157-402 |
| -36 | 210-0406-00 | B030000 | | 2 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -37 | 214-1126-02 | B030000 | | 2 | . . SPRING,FLAT:RED COLORED | 80009 | 214-1126-02 |
| -38 | 214-1127-00 | B030300 | | 1 | . . ROLLER,DETENT:0.125 DIA X 0.125 INCH L | 80009 | 214-1127-00 |
| -39 | 401-0053-00 | B030000 | | 1 | . . BEARING,CAM SW:FRONT,W/0.375-32 EXT THD | 80009 | 401-0053-00 |

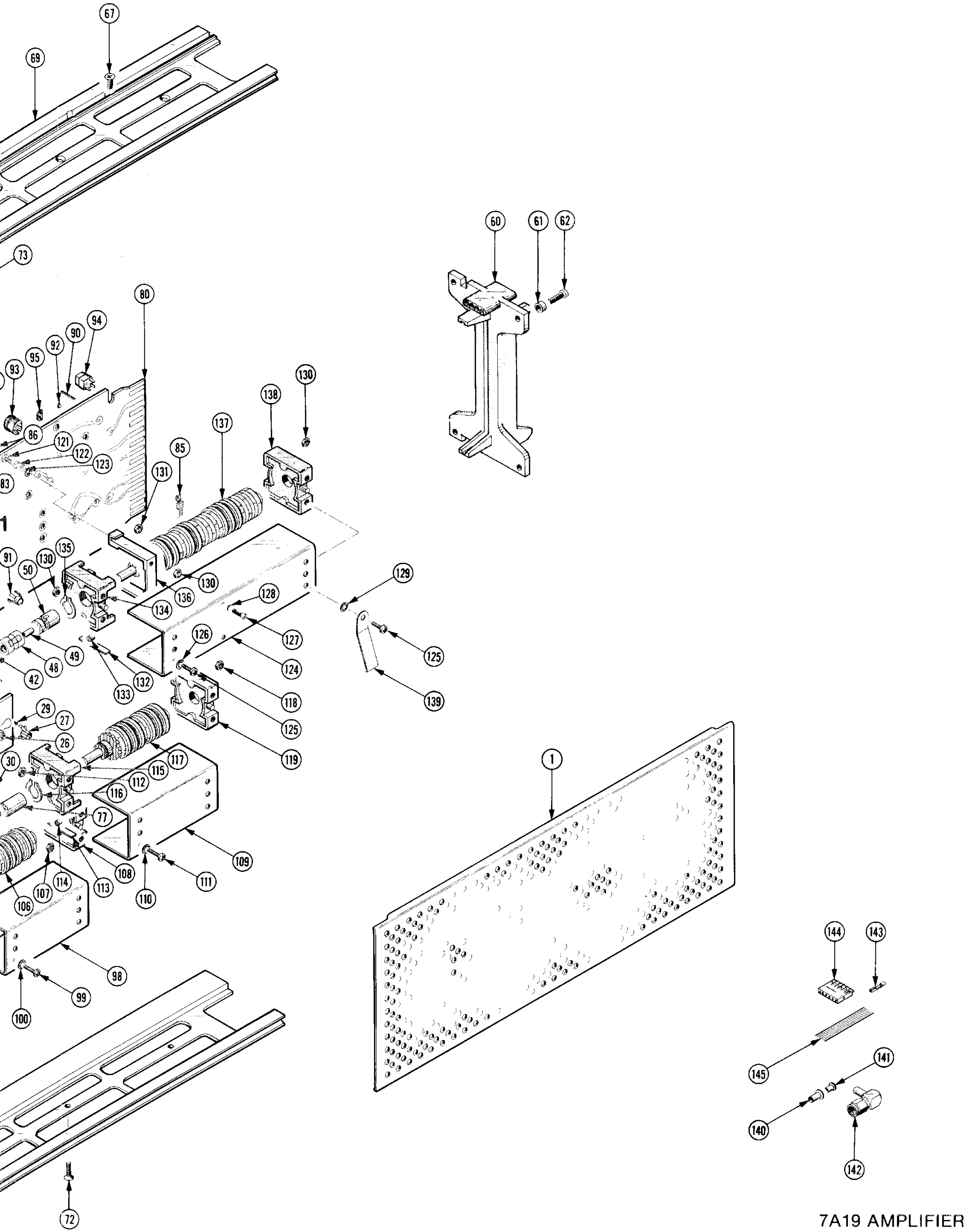
| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Qty | 1 2 3 4 5 Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|---|
| 1-41 | 105-0560-00 | B030000 | | 1 | . . ACTUATOR,CAM SW:ATTENUATOR | 80009 | 105-0560-00 |
| -42 | 210-0405-00 | B030000 | | 1 | . . NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS | 73743 | 2X12157-402 |
| -43 | 210-0406-00 | B030000 | | 2 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -44 | 401-0061-00 | B030000 | | 1 | . . BEARING,CAM SW:REAR | 80009 | 401-0061-00 |
| -45 | 210-0976-00 | B010100 | B029999X | 1 | WASHER,FLAT:0.390 ID X 0.562 OD | 80009 | 210-0976-00 |
| -46 | 358-0448-00 | B010100 | B029999X | 1 | BSHG,MACH THD: | 80009 | 358-0448-00 |
| -47 | 384-1126-00 | B010100 | B029999X | 1 | EXTENSION SHAFT: | 80009 | 384-1126-00 |
| -48 | 376-0051-00 | | | 1 | CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS | 80009 | 376-0051-00 |
| -49 | 384-0421-00 | B010100 | B029999 | 1 | EXTENSION SHAFT:2.85 LONG X 0.1247 OD SST | 80009 | 384-0421-00 |
| | 384-1240-00 | B030000 | | 1 | EXTENSION SHAFT:2.5 LONG X 0.125 OD | 80009 | 384-1240-00 |
| -50 | 376-0052-00 | | | 1 | CPLG,SHAFT,FLEX:FOR 0.125 X 0.25 INCH SHAFT | 80009 | 376-0052-00 |
| -51 | 333-1543-00 | | | 1 | PANEL,FRONT: | 80009 | 333-1543-00 |
| -52 | 348-0031-00 | | | 2 | GROMMET,PLASTIC:0.156 INCH DIA | 80009 | 348-0031-00 |
| -53 | 348-0235-00 | | | 2 | SHLD GSKT,ELEC:4.734 INCH LONG | 80009 | 348-0235-00 |
| -54 | 386-1447-59 | B010100 | B029999 | 1 | SUBPANEL,FRONT: | 80009 | 386-1447-59 |
| | 386-1447-77 | B030000 | | 1 | SUBPANEL,FRONT: | 80009 | 386-1447-77 |
| | | | | | (ATTACHING PARTS) | | |
| -55 | 213-0192-00 | | | 4 | SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL | 87308 | OBD |
| | | | | | - - - * - - - | | |
| -56 | 105-0076-02 | | | 1 | REL BAR,LATCH:PLUG-IN UNIT | 80009 | 105-0076-02 |
| -57 | 214-1280-00 | | | 1 | SPRING,HLCPS:0.14 OD X 1.126"L,0.16"DIA W | 80009 | 214-1280-00 |
| -58 | 214-1054-00 | | | 1 | SPRING,FLAT:0.825 X 0.322,SST | 80009 | 214-1054-00 |
| -59 | 105-0075-00 | | | 1 | PAWL:0.475 X 0.21 X 0.184 INCH,PLSTC | 80009 | 105-0075-00 |
| -60 | 386-1402-00 | | | 1 | PANEL,REAR: | 80009 | 386-1402-00 |
| | | | | | (ATTACHING PARTS) | | |
| -61 | 213-0192-00 | | | 4 | SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL | 87308 | OBD |
| -62 | 361-0326-00 | | | 1 | SPACER,SLEEVE:0.18 ID X 0.25 OD X 0.10"L | 80009 | 361-0326-00 |
| | | | | | - - - * - - - | | |
| -63 | ----- ----- | | | 2 | INTEGRATED CKT: | | |
| | | | | | (ATTACHING PARTS) | | |
| -64 | 220-0410-00 | | | 1 | NUT,EXTENDED WA:10-32 X 0.375 INCH,STL | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -65 | 214-1653-00 | | | 1 | HEAT SINK,ELEC: | 80009 | 214-1653-00 |
| | | | | | (ATTACHING PARTS) | | |
| -66 | 210-0586-00 | | | 2 | NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL | 78189 | 211-041800-00 |
| -67 | 211-0101-00 | | | 2 | SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -68 | 214-1061-00 | | | 1 | SPRING,GROUND:FLAT | 80009 | 214-1061-00 |
| -69 | 426-0505-13 | | | 1 | FR SECT,PLUG-IN:TOP | 80009 | 426-0505-13 |
| | | | | | (ATTACHING PARTS) | | |
| -70 | 211-0105-00 | | | 3 | SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -71 | 426-0499-07 | | | 1 | FR SECT,PLUG-IN:BOTTOM | 80009 | 426-0499-07 |
| | | | | | (ATTACHING PARTS) | | |
| -72 | 211-0105-00 | | | 3 | SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -73 | 220-0547-01 | | | 6 | NUT,BLOCK:0.38 X 0.25 X 0.282"OA | 80009 | 220-0547-01 |
| | | | | | (ATTACHING PARTS FOR EACH) | | |
| -74 | 211-0116-00 | | | 1 | SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -75 | 384-1148-00 | | | 1 | EXTENSION SHAFT:3.14 L X 0.123 OD,EPOXY-GL | 80009 | 384-1148-00 |
| -76 | 384-1149-00 | | | 1 | EXTENSION SHAFT:7.0 INCH LONG | 80009 | 384-1149-00 |
| -77 | 376-0008-00 | | | 2 | CPLG,SHAFT,RIGI: | 80009 | 376-0008-00 |
| -78 | 210-1018-00 | | | 2 | WASHER,FLAT:0.173 ID X 0.875 OD | 80009 | 210-1018-00 |
| | | | | | (ATTACHING PARTS) | | |
| -79 | 211-0116-00 | | | 1 | SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | | | | | - - - * - - - | | |
| | 672-0465-00 | XB030000 | | 1 | CKT BOARD ASSY:VERTICAL AMPLIFIER | 80009 | 672-0465-00 |
| -80 | ----- ----- | B010100 | B029999 | 1 | . CKT BOARD ASSY:INTERFACE(SEE A1 EPL) | | |
| | ----- ----- | B030000 | | 1 | . CKT BOARD ASSY:INTERFACE(SEE A1 EPL) | | |
| -81 | 129-0363-00 | | | 2 | . . POST,ELEC-MECH:HEX.,0.25 X 0.436 INCH LONG | 80009 | 129-0363-00 |
| | | | | | (ATTACHING PARTS FOR EACH) | | |
| -82 | 211-0116-00 | | | 1 | . . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -83 | 214-0579-00 | | | 2 | . . TERM.,TEST PT:BRS CD PL | 80009 | 214-0579-00 |
| -84 | 131-1030-00 | | | 11 | . . CONT ASSY,ELEC:CAM SWITCH,BOTTOM | 80009 | 131-1030-00 |

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Qty | 1 2 3 4 5 Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|---|
| 1-85 | 131-1031-00 | | | 22 | . . CONTACT ASSY,EL:CAM SWITCH,TOP | 80009 | 131-1031-00 |
| | | | | | (ATTACHING PARTS FOR EACH) | | |
| -86 | 210-0779-00 | | | 1 | . . RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG | 42838 | RA-29952715 |
| | | | | | - - - * - - - | | |
| -87 | 352-0336-00 | | | 4 | . . HOLDER,COVER: | 80009 | 352-0336-00 |
| | | | | | (ATTACHING PARTS FOR EACH) | | |
| -88 | 211-0116-00 | | | 4 | . . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -89 | 200-1415-00 | | | 2 | . . COVER,CONTACTS: | 80009 | 200-1415-00 |
| -90 | 131-0589-00 | | | 6 | . . TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL | 22526 | 47350 |
| -91 | 131-1003-00 | | | 3 | . . CONNECTOR BODY,:CKT BD MT,2 PRONG | 80009 | 131-1003-00 |
| -92 | 136-0252-04 | B010100 | B033739 | 67 | . . SOCKET,PIN TERM:0.188 INCH LONG | 22526 | 75060 |
| | 136-0252-04 | B033740 | | 43 | . . SOCKET,PIN TERM:0.188 INCH LONG | 22526 | 75060 |
| | 136-0352-00 | B010100 | B030000X | 4 | . . CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN | 00779 | 50462-7 |
| -93 | 136-0235-00 | B033740 | | 1 | . . SOCKET,PLUG-IN:6 CONTACT,ROUND | 71785 | 133-96-12-062 |
| -94 | 136-0220-00 | B033740 | | 5 | . . SOCKET,PLUG-IN:3 PIN,SQUARE | 71785 | 133-23-11-034 |
| -95 | 136-0350-00 | B033740 | | 1 | . . SOCKET,PLUG-IN:3 PIN,LOW PROFILE | 80009 | 136-0350-00 |
| -96 | 214-1797-00 | B030000 | | 4 | . . PIN,ATTEN CLIP: | 80009 | 214-1797-00 |
| -97 | 344-0248-00 | B030000 | | 2 | . . CLIP,ATTENUATOR: | 80009 | 344-0248-00 |
| | 105-0321-00 | B010100 | B029999 | 1 | . ACTR ASSY,CAM S:INPUT | 80009 | 105-0321-00 |
| | 263-1094-00 | B030000 | | 1 | . SW CAM ACTR AS:INPUT | 80009 | 263-1094-00 |
| -98 | 200-1343-00 | | | 1 | . . COVER,CAM SW: | 80009 | 200-1343-00 |
| | | | | | (ATTACHING PARTS) | | |
| -99 | 211-0008-00 | | | 4 | . . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL | 83385 | OBD |
| -100 | 210-0004-00 | | | 4 | . . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL | 78189 | 1204-00-00-0541C |
| | | | | | - - - * - - - | | |
| -101 | 210-0406-00 | | | 4 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -102 | 214-1139-03 | | | 1 | . . SPRING,FLAT:RED COLORED | 80009 | 214-1139-03 |
| -103 | 214-1127-00 | | | 1 | . . ROLLER,DETENT:0.125 DIA X 0.125 INCH L | 80009 | 214-1127-00 |
| -104 | 401-0081-00 | | | 1 | . . BEARING,CAM SW:FRONT | 80009 | 401-0081-00 |
| | | | | | (ATTACHING PARTS) | | |
| -105 | 354-0391-00 | | | 1 | . . RING,RETAINING:0.395"FREE ID X 0.025" STL | 97464 | 3100-43-CD |
| | | | | | - - - * - - - | | |
| -106 | 105-0319-00 | | | 1 | . . ACTR ASSY,CAM S:INPUT/INVERT | 80009 | 105-0319-00 |
| -107 | 210-0406-00 | | | 4 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -108 | 401-0146-00 | | | 1 | . . BEARING,CAM SW:REAR | 80009 | 401-0146-00 |
| | 105-0322-00 | B010100 | B029999 | 1 | . ACTR ASSY,CAM S:INVERT | 80009 | 105-0322-00 |
| | 263-1095-00 | B030000 | | 1 | . SW CAM ACTR AS:POLARITY | 80009 | 263-1095-00 |
| -109 | 200-1343-00 | | | 1 | . . COVER,CAM SW: | 80009 | 200-1343-00 |
| | | | | | (ATTACHING PARTS) | | |
| -110 | 211-0008-00 | | | 4 | . . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL | 83385 | OBD |
| -111 | 210-0004-00 | | | 4 | . . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL | 78189 | 1204-00-00-0541C |
| | 211-0022-00 | B010100 | B022299X | 2 | . . SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL | 83385 | OBD |
| | 210-0001-00 | B010100 | B022299X | 2 | . . WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL | 78189 | 1202-00-00-0541C |
| | | | | | - - - * - - - | | |
| -112 | 210-0406-00 | | | 4 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -113 | 214-1139-03 | | | 1 | . . SPRING,FLAT:RED COLORED | 80009 | 214-1139-03 |
| -114 | 214-1127-00 | | | 1 | . . ROLLER,DETENT:0.125 DIA X 0.125 INCH L | 80009 | 214-1127-00 |
| -115 | 401-0081-00 | | | 1 | . . BEARING,CAM SW:FRONT | 80009 | 401-0081-00 |
| | | | | | (ATTACHING PARTS) | | |
| -116 | 354-0391-00 | | | 1 | . . RING,RETAINING:0.395"FREE ID X 0.025" STL | 97464 | 3100-43-CD |
| | | | | | - - - * - - - | | |
| -117 | 105-0319-00 | | | 1 | . . ACTR ASSY,CAM S:INPUT/INVERT | 80009 | 105-0319-00 |
| -118 | 210-0406-00 | | | 4 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -119 | 401-0146-00 | | | 1 | . . BEARING,CAM SW:REAR | 80009 | 401-0146-00 |
| | 105-0323-00 | B010100 | B029999 | 1 | . ACTR ASSY,CAM S:VOLTS/DIVISION | 80009 | 105-0323-00 |
| | 263-1096-00 | B030000 | | 1 | . SW CAM ACTR AS:VOLTS/DIVISION | 80009 | 263-1096-00 |
| | | | | | (ATTACHING PARTS) | | |
| -120 | 211-0116-00 | B010100 | B022999 | 4 | . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | 211-0116-00 | B023000 | B034429 | 6 | . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | 211-0116-00 | B034430 | | 4 | . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | 211-0180-00 | B010100 | B022299X | 2 | . SCR,ASSEM WSHR:2-56 X 0.25 INCH,PNH BRS | 83385 | OBD |
| -121 | 211-0062-00 | B034430 | | 2 | . SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL | 83385 | OBD |
| -122 | 210-0053-00 | | | 2 | . WASHER,LOCK:INTL,0.092 ID X 0.175"OD,STL | 83385 | OBD |
| -123 | 210-1008-00 | B034430 | | 2 | . WASHER,FLAT:0.09 ID X 0.188" OD,BRS | 12360 | 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 |
|---|---|---|---|---|---|---|---|
| 1-124 | 200-1344-00 | B010100 | B022299 | 1 | . . COVER,CAM SW: | 80009 | 200-1344-00 |
| | 200-1344-01 | B022300 | | 1 | . . COVER,CAM SW: | 80009 | 200-1344-01 |
| | | | | | (ATTACHING PARTS) | | |
| -125 | 211-0008-00 | | | 6 | . . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL | 83385 | OBD |
| -126 | 210-0004-00 | B010100 | B022299 | 4 | . . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL | 78189 | 1204-00-00-0541C |
| | 210-0004-00 | B022300 | | 5 | . . WASHER,LOCK:#4 INTL,0.015THK,STL CD PL | 78189 | 1204-00-00-0541C |
| -127 | 211-0022-00 | B010100 | B022299X | 2 | . . SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL | 83385 | OBD |
| -128 | 210-0001-00 | B010100 | B022299X | 2 | . . WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL | 78189 | 1202-00-00-0541C |
| -129 | 210-0007-00 | XB023000 | | 1 | . . WASHER,LOCK:#8 EXT,0.02 THK,STL CD PL | 78189 | 1108-00-00-0541C |
| | | | | | - - - * - - - | | |
| -130 | 210-0406-00 | B010100 | B022299 | 8 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| | 210-0406-00 | B022300 | B034429 | 12 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| | 210-0406-00 | B034430 | | 10 | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -131 | 210-0405-00 | XB034430 | | 2 | . . NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS | 73743 | 2X12157-402 |
| -132 | 214-1139-03 | | | 1 | . . SPRING,FLAT:RED COLORED | 80009 | 214-1139-03 |
| -133 | 214-1127-00 | | | 1 | . . ROLLER,DETENT:0.125 DIA X 0.125 INCH L | 80009 | 214-1127-00 |
| -134 | 401-0081-00 | | | 1 | . . BEARING,CAM SW:FRONT | 80009 | 401-0081-00 |
| | | | | | (ATTACHING PARTS) | | |
| -135 | 354-0391-00 | | | 1 | . . RING,RETAINING:0.395"FREE ID X 0.025" STL | 97464 | 3100-43-CD |
| | | | | | - - - * - - - | | |
| -136 | 407-0926-00 | B010100 | B022299 | 1 | . . BRACKET,COVER:CAM SWITCH,ALUMINUM | 80009 | 407-0926-00 |
| | 407-1199-00 | B022300 | | 1 | . . BRACKET,COVER:ABS | 80009 | 407-1199-00 |
| -137 | 105-0320-00 | | | 1 | . . DRUM,CAM SWITCH: | 80009 | 105-0320-00 |
| -138 | 401-0146-00 | | | 1 | . . BEARING,CAM SW:REAR | 80009 | 401-0146-00 |
| -139 | 214-1712-00 | | | 1 | SPRING,FLAT:GROUNDING | 80009 | 214-1712-00 |
| -140 | 210-0774-00 | | | 4 | EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS | 80009 | 210-0774-00 |
| -141 | 210-0775-00 | | | 4 | EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS | 80009 | 210-0775-00 |
| -142 | 131-0977-00 | B010100 | B029999X | 1 | CONNECTOR,PLUG,:RIGHT ANGLE,MALE | 98291 | 050-028-0000-220 |
| -143 | 131-0707-00 | | | 6 | CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD | 22526 | 47439 |
| -144 | 352-0164-00 | | | 1 | CONN BODY,PL,EL:6 WIRE BLACK | 80009 | 352-0164-00 |
| -145 | 175-0829-00 | | | FT | WIRE,ELECTRICAL:6 WIRE RIBBON | 08261 | SS-0626-710610C |

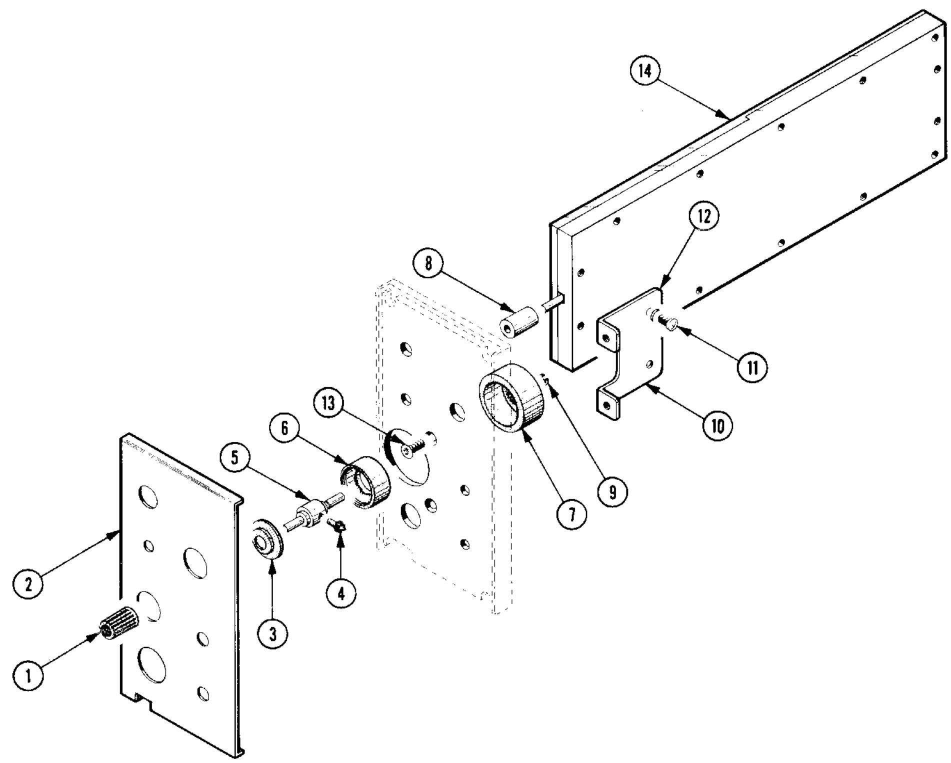

67
69
70
68
1
73
80
94
90
92
95
93
63
66
65
84
64
86
121
122
123
83
120
79
78
81
74
A1
82
135
130
91
50
88
87
89
97
43
46
47
17
45
96
18
9
32
44
42
48
49
133
132
54
34
33
37
11
12
14
36
41
38
39
29
27
26
28
A2
30
115
112
116
40
35
20
26
25
24
31
77
55
10
15
16
51
3
23
22
21
19
52
2
13
4
106
107
114
113
108
110
16
75
101
105
103
104
102
98
77
76
100
99
5
6
57
53
8
7
56
71
59
58
72

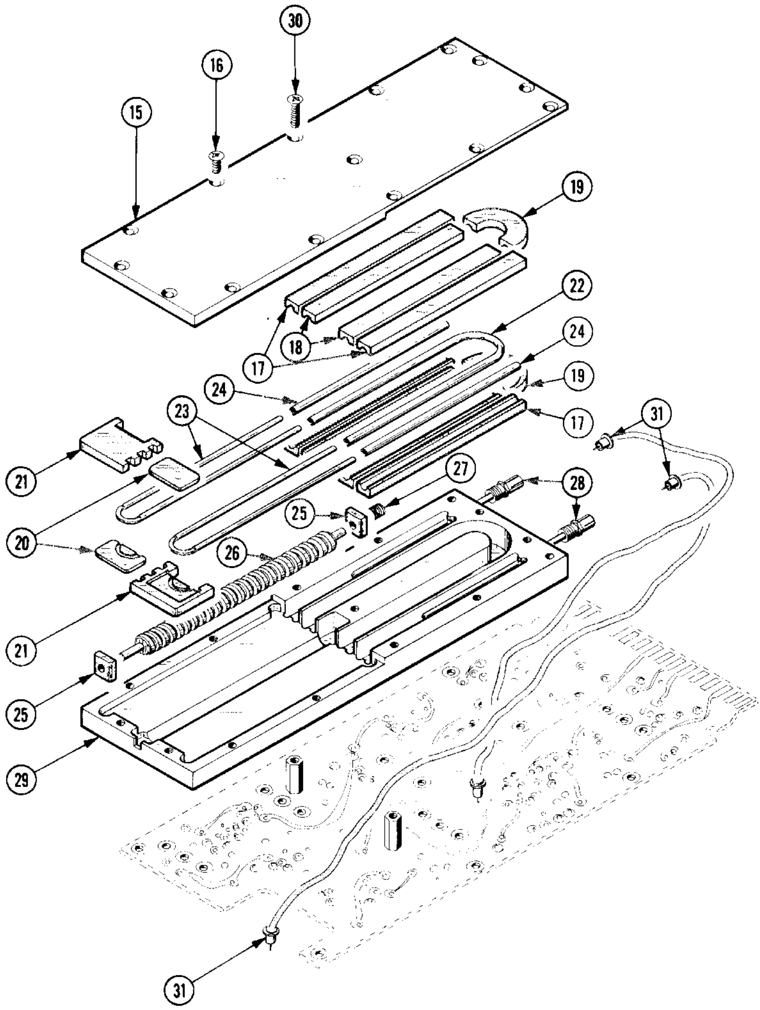
@




7A19 AMPLIFIER

FIG. 2 OPTION 950 A




30
16
15
19
22
24
19
17
18
17
24
23
21
31
27
28
25
20
26
21
25
29
31

| 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 | 366-1023-01 | | | 1 | KNOB:GRAY | 80009 | 366-1023-01 |
| -2 | 333-1544-00 | | | 1 | PANEL,FRONT: | 80009 | 333-1544-00 |
| -3 | 354-0425-00 | | | 1 | RING,INDICATOR: | 80009 | 354-0425-00 |
| -4 | 401-0150-00 | | | 1 | GEAR,SPUR:DRIVE,10 TOOTH | 80009 | 401-0150-00 |
| -5 | 384-0827-00 | | | 1 | SHAFT,STRAIGHT: | 80009 | 384-0827-00 |
| -6 | 380-0271-00 | | | 1 | HOUSING,IND:INNER | 80009 | 380-0271-00 |
| -7 | 380-0270-00 | | | 1 | HOUSING, IND:OUTER | 80009 | 380-0270-00 |
| -8 | 376-0029-00 | | | 1 | CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L | 80009 | 376-0029-00 |
| -9 | 354-0163-00 | | | 1 | RING,RETAINING:TRUARC,CAD PLATE | 79136 | 5133-12MD |
| -10 | 407-1015-00 | | | 1 | BRACKET,ANGLE:VAR DELAY LINE,ALUMINUM | 80009 | 407-1015-00 |
| | | | | | (ATTACHING PARTS) | | |
| -11 | 211-0007-00 | | | 2 | SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL | 83385 | OBD |
| -12 | 210-0054-00 | | | 2 | WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL | 83385 | OBD |
| -13 | 211-0101-00 | | | 2 | SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL | 83385 | OBD |
| | | | | | - - - * - - - | | |
| -14 | 119-0321-00 | | | 1 | DELAY LINE,ELEC: | 80009 | 119-0321-00 |
| -15 | 200-1315-00 | B010100 | B019999 | 1 | . COVER,DLY LINE: | 80009 | 200-1315-00 |
| | 200-1315-01 | B020000 | | 1 | . COVER DLY LINE: | 80009 | 200-1315-01 |
| -16 | 211-0038-00 | B010100 | B019999 | 9 | . SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL | 83385 | OBD |
| | 211-0038-00 | B020000 | | 11 | . SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL | 83385 | OBD |
| -17 | 352-0294-00 | | | 4 | . HOLDER,DLY LINE: | 80009 | 352-0294-00 |
| -18 | 352-0295-00 | | | 4 | . HOLDER,DLY LINE: | 80009 | 352-0295-00 |
| -19 | 352-0297-00 | | | 1 | . HOLDER,DLY LINE: | 80009 | 352-0297-00 |
| -20 | 200-1311-00 | | | 2 | . CAP,DRIVE BLOCK: | 80009 | 200-1311-00 |
| -21 | 391-0095-00 | | | 2 | . GEAR RACK: | 80009 | 391-0095-00 |
| -22 | 119-0315-00 | | | 1 | . DELAY LINE,ELEC: | 80009 | 110-0315-00 |
| -23 | 119-0314-00 | | | 2 | . DELAY LINE,ELEC: | 80009 | 119-0314-00 |
| -24 | 119-0316-00 | B010100 | B019999 | 2 | . DELAY LINE,ELEC: | 80009 | 119-0316-00 |
| -25 | 401-0148-00 | | | 2 | . SUPPORT SHAFT: | 80009 | 401-0148-00 |
| -26 | 384-0895-00 | | | 1 | . SHAFT,STRAIGHT: | 80009 | 384-0895-00 |
| -27 | 214-0966-00 | | | 1 | . SPRING,HLCPS: | 80009 | 214-0966-00 |
| | 131-0850-00 | B010100 | B019999 | 2 | . CONN,FEEDTHRU:3MM FEMALE EAEND | 000CN | 2084-0000 |
| -28 | 103-0156-00 | B010100 | B019999 | 2 | . JACK,TIP: | 80009 | 103-0156-00 |
| | 131-1304-00 | B020000 | | 2 | . CONN,PLUG,ELEC: | 80009 | 131-1304-00 |
| -29 | 380-0267-00 | B010100 | B019999 | 1 | . HSG,DELAY LINE:ALUMINUM | 80009 | 380-0267-00 |
| | 380-0267-01 | B020000 | | 1 | . HSG,DELAY LINE: | 80009 | 380-0267-01 |
| | | | | | (ATTACHING PARTS FOR DELAY LINE) | | |
| -30 | 211-0106-00 | | | 2 | SCREW,MACHINE:4-40 X 0.625"100 DEG,FLH,STL | 83385 | OBD |
| | | | | | - - - * - - - | | |
| | 131-0888-00 | B010100 | B019999 | 2 | CONNECTOR,PLUG,:MALE | 26805 | 2031-5006-95 |
| | 131-0977-00 | B010100 | B019999X | 1 | CONNECTOR,PLUG,:RIGHT ANGLE,MALE | 98291 | 050-028-0000-220 |
| -31 | 210-0774-00 | B010100 | B019999 | 1 | EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS | 80009 | 210-0774-00 |
| | 210-0774-00 | B020000 | | 3 | EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS | 80009 | 210-0774-00 |
| | 210-0775-00 | B010100 | B019999 | 1 | EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS | 80009 | 210-0775-00 |
| | 210-0775-00 | B020000 | | 3 | EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS | 80009 | 210-0775-00 |

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Qty | 1 2 3 4 5 Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|---|
| | 070-2129-00 | | | 1 | MANUAL,TECH:INSTRUCTION | 80009 | 070-2129-00 |

FIG. 3 STANDARD ACCESSORIES

## MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

## 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 |
| 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 |
| PG 508 replaces 114<br>115<br>2101 | Performance of replacement equipment is the same or better than equipment being replaced. | |
| 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 | | |
| 067-0532-01 | SG 503 - Frequency range 250 kHz to 250 MHz. | 0532-01 - Frequency range 65 MHz to 500 MHz. |
| SG 504 replaces 067-0532-01 | SG 504 - Frequency range 245 MHz to 1050 MHz. | 0532-01 - Frequency range 65 MHz to 500 MHz. |
| 067-0650-00 | | |
| TG 501 replaces 180, 180A | TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time. | 180A - Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously. |
| 181 | | 181 - Multiple time-marks |
| 184 | TG 501 - Trigger output-slaved to market output from 5 sec through 100 ns. One time-mark can be generated at a time. | 184 - Separate trigger pulses of 1 and 0.1 sec; 10, 1, and 0.1 ms; 10 and 1 μs. |
| 2901 | TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time. | 2901 - 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.**

Tektronix
COMMITTED TO EXCELLENCE

# MANUAL CHANGE INFORMATION

Change Reference: C2/479 Date: 4/23/79

Product: 7A19 070-2129-00

| CHANGE | DESCRIPTION |
|---|---|

TEXT CORRECTIONS

SECTION 2 OPERATING INSTRUCTIONS

Page 2-2 Vertical Gain Check and Adjustment
First sentence of the paragraph

CHANGE TO:

To check the gain of the 7A19, set the VOLTS/DIV switch to 10 mV and connect 20 mV (into 50 ohm), 1 kHz signal from the oscilloscope Calibrator to the INPUT connector.

SECTION 5 CALIBRATION

Page 5-2 Test Equipment
Item 4-Minimum Specifications

CHANGE TO:

Amplitude accuracy within 0.25%; range, 50 mV to 2 V into 50 ohm; frequency, 1 kHz.

Page 5-5 Step 5, Temperature Compensation Adjust, part a.

CHANGE TO:

a. Connect a 1kHz, 0.2 V (into 50 ohm) square-wave signal from the oscilloscope Calibrator to the 7A19 INPUT using a 42 inch BNC cable.

Page 5-5 Step 6, GAIN Check/Adjust, part b, c and d.

CHANGE TO:

b. Set the Standard Amplitude Calibrator for a 50 mV square-wave output and set the Input Coupling switch to DC.

c. Check-CRT display for a vertical deflection of five divisions ±0.15 division.

d. Adjust-Front panel GAIN control for exactly five divisions vertical deflection.