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AT THE REAR OF THIS MANUAL.**

# **7A19 AMPLIFIER**

## **INSTRUCTION MANUAL**

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


Serial Number \_\_\_\_\_

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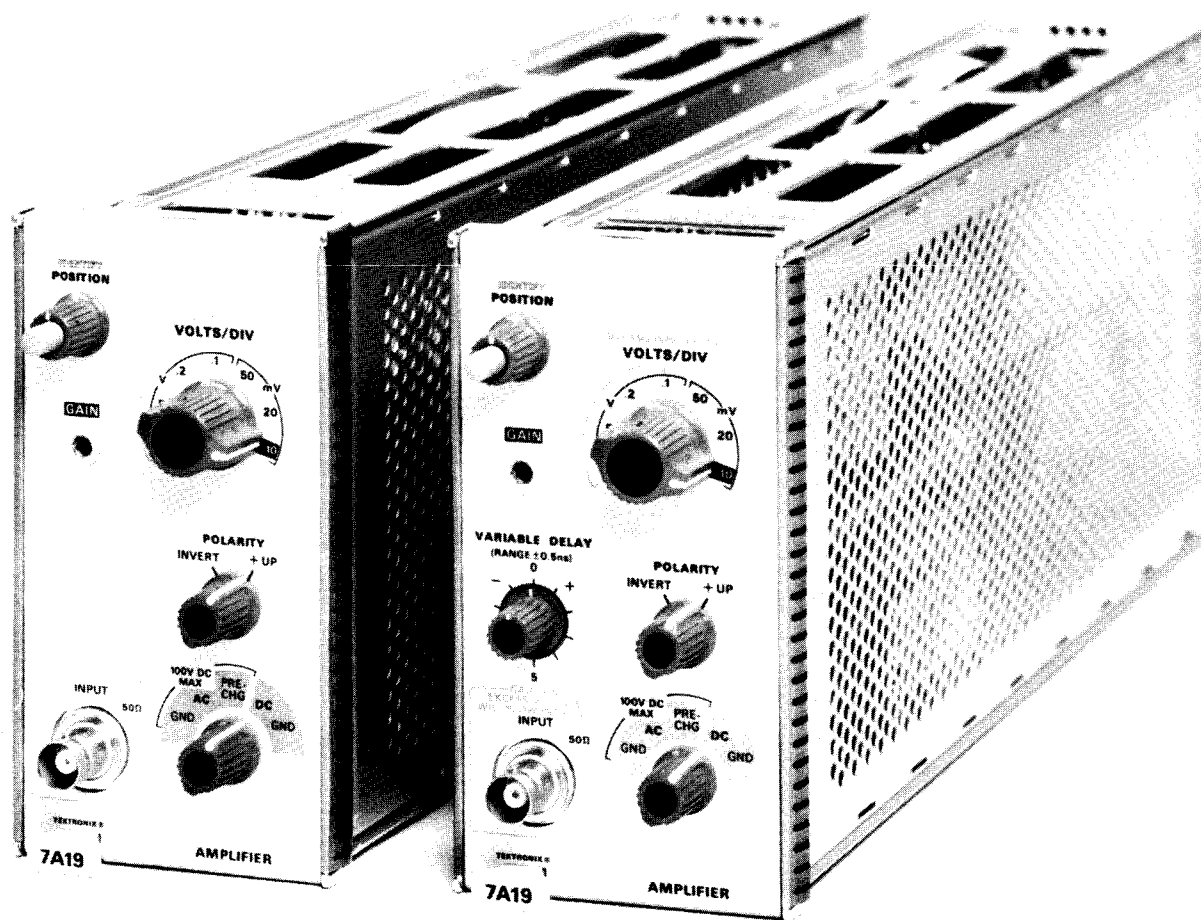
### INSTRUMENT SERIAL NUMBERS

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

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

# TABLE OF CONTENTS

	Page
<b>Section 1 SPECIFICATION</b>	
Introduction . . . . .	1-1
Option 4 . . . . .	1-1
<b>Section 2 OPERATING INSTRUCTIONS</b>	
Front Panel Controls and Connectors . . . . .	2-1
Operating Instructions and Checkout . . . . .	2-1
Applications . . . . .	2-2
<div style="border: 1px solid black; padding: 2px; display: inline-block; margin: 10px 0;"> <b>WARNING</b> </div>	
<p><i>THE REMAINING PORTION OF THIS TABLE OF CONTENTS LISTS THE SERVICING INSTRUCTIONS. THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CALLED OUT IN THE OPERATING INSTRUCTIONS UNLESS QUALIFIED TO DO SO.</i></p>	
<b>Section 3 CIRCUIT DESCRIPTION</b>	
Block Diagram . . . . .	3-1
Detailed Circuit Description . . . . .	3-1
<b>Section 4 MAINTENANCE</b>	
Preventive Maintenance . . . . .	4-1
Troubleshooting . . . . .	4-1
Corrective Maintenance . . . . .	4-3
<b>Section 5 CALIBRATION</b>	
Performance Check . . . . .	5-1
Test Equipment Required . . . . .	5-1
Calibration Procedure . . . . .	5-3
Index to Calibration Procedure . . . . .	5-4
<b>Section 6 ELECTRICAL PARTS LIST</b>	
<b>Section 7 DIAGRAMS</b>	
Circuit Board Illustrations	
Semiconductor Electrode Configurations	
<b>Section 8 MECHANICAL PARTS LIST</b>	
Exploded View Drawing	
<b>CHANGE INFORMATION</b>	



1243-12

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  $\pm 500$  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.	<b>CAUTION</b> <i>Pre-charge circuit must be used for both charging and discharging AC coupling capacitor to potentials greater than 50 divisions equivalent voltage.</i>
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 $\pm 1$ 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 $\pm 8$ divisions
Display Noise (Tangentially Measured)		Less than 0.1 division
DC Drift Drift with ambient temperature (line voltage constant)	$100 \mu\text{V}/^\circ\text{C}$ or less	
Variable Delay (Option 4) Range Accuracy	Variable from $-0.5 \text{ ns}$ to $+0.5 \text{ ns}$  To $1 \text{ ns}$ within $\pm 0.05 \text{ ns}$ 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. 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  $\pm 500$  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 into 50  $\Omega$ , 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  $\pm 500$  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.

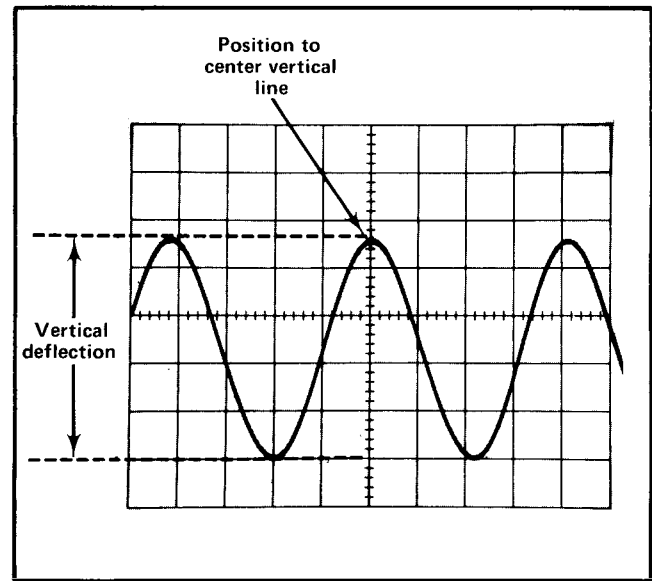


Fig. 2-1. Measuring the peak to peak voltage of a waveform.

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

Substituting the given values:

$$\text{Volts Peak to Peak} = 4.5 \times 1 \times 10$$

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

## Operating Instructions—7A19

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:

$$\begin{array}{l} \text{Instantaneous voltage} = \text{vertical distance (divisions)} \times \text{polarity} \times \text{VOLTS/DIV setting} \times \text{probe attenuation factor} \end{array}$$

Substituting the given values:

$$\text{Instantaneous Voltage} = 3.6 \times 1 \times 0.5 \text{ V} \times 10$$

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.

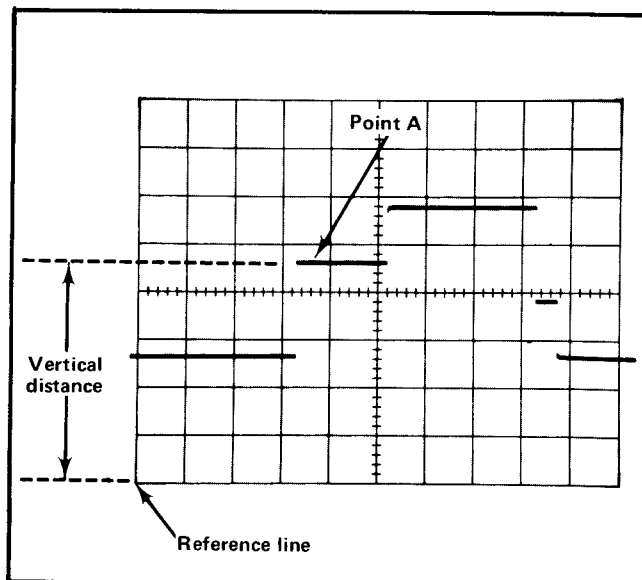


Fig. 2-2. Measuring instantaneous voltage with respect to same reference.

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  $50\ \Omega$  line that is connected to Signal Amplifier, Trigger Amplifier, Limiter, and is terminated in the Signal Line Terminator. 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  $100\ \Omega$  resistors in parallel. Paralleling the  $100\ \Omega$  resistors reduces the inductance associated with the resistors so that the combination will remain  $50\ \Omega$  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  $100\ \Omega$  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  $4.95\ \text{k}\Omega$  and the input to the Attenuator is  $50\ \Omega$ , 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  $50\ \Omega$  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 out 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 descrip-

tion, 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 attempting 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.



*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.** Most electrical and mechanical parts can be obtained through your local Tektronix field office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix Inc., please check the electrical parts list for the proper value, rating, tolerance 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).

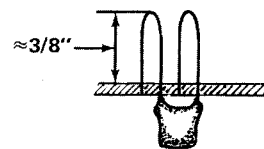
2. Unsolder the two ground straps from either side of the integrated circuit case and unplug the integrated circuit.

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:



1243-01

**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. Include 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:

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of dunnage or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.

The carton test strength for your instrument is 200 pounds.



# 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, 50 mV to 2 V into 50 $\Omega$ frequency, 1 kHz.	Used for GAIN Check/Adjust only (step 6).	a. Tektronix PG 506 Calibration Generator. <sup>1</sup>
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. <sup>1</sup>  b. Wavetek 1002 Sweep/Signal Generator.  c. General Radio 1362 UHF oscillator with 1263-C Amplitude Regulating supply.
6. Time Domain Reflectometer	System rise time, 350 ps $\pm$ 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. Differential 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			
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 $\pm$ 5%; length, 10 inches; connectors, GR.	Used for signal connections during reflection coefficient and HF aberrations.	a. TEKTRONIX Part No. 017-0513-00.

<sup>1</sup> Requires TM 500 - Series Power Module

Test Equipment (cont)

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
10. GR Cable	Impedance, 50 ohms $\pm 5\%$ ; 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.
12. Adapter	BNC female to GR.	Used throughout procedures.	a. TEKTRONIX Part No. 017-0063-00.
13. Adapter	BNC "T".	Used for common mode check/adjust.	a. TEKTRONIX Part No. 103-0030-00.
14. Adapter	BNC female to BNC female.	Used for common mode check/adjust.	a. TEKTRONIX Part No. 103-0028-00.
15. Adapter	SMA (3-mm) male to GR.	Used for reflection coefficient and risetime and aberrations.	a. TEKTRONIX Part No. 015-1007-00.
16. 50 $\Omega$ Power Divider	Impedance, 50 ohms; connectors, GR.	Used for reflection coefficient check.	a. TEKTRONIX Part No. 017-0082-00.
17. 10X Attenuator	Impedance, 50 ohms; accuracy, $\pm 2\%$ ; connectors, GR.	Used for frequency response check.	a. TEKTRONIX Part No. 017-0078-00.
18. Plug-in Extender	Rigid plug-in extender for 7000-Series plug-ins.	Used throughout procedures.	a. TEKTRONIX Part No. 067-0589-00.
19. Plug-in Extender	Flexible plug-in extender for 7000-Series plug-ins.	Used for risetime and aberrations check/adjust.	a. TEKTRONIX Part No. 067-0616-00.
20. Signal Pick-off with GR adapters	Signal pick-off connects to the rear connector of 7000-Series vertical amplifiers for gaining access to signal and trigger lines.	Used for common mode check/adjust, HF aberration check and adjust.	a. TEKTRONIX Part No. 067-0655-00.

## CALIBRATION PROCEDURE

### General

The following procedure is arranged so that the 7A19 can be calibrated with the least interaction of adjustments and re-connection of equipment. The control settings and test equipment setup throughout this procedure continue from the preceding step(s) unless otherwise noted. Refer to Fig. 5-1 for location of adjustments.

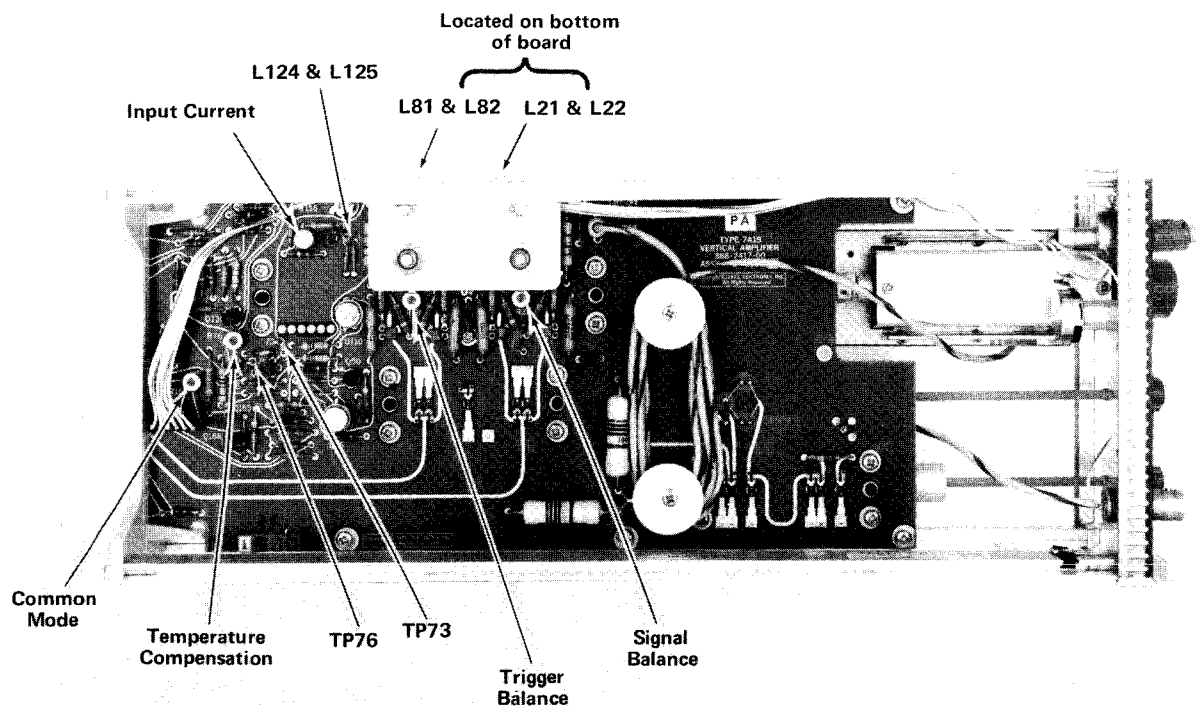
#### NOTE

*Control titles which are printed on the front panel of the 7A19 are capitalized in this procedure (e.g.,*

*POSITION). Internal adjustments and associated equipment controls are initially capitalized only (e.g., oscilloscope Vertical Mode).*

### Preliminary Procedure for Calibration

1. Remove the side panels of the plug-in.
2. Insert 7A19 with plug-in extender in the calibration oscilloscope left vertical compartment.
3. Insert the time-base unit in the calibration oscilloscope B Horizontal compartment.



1243-02

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.

	7A19
POSITION	Center trace
POLARITY	+UP
VOLTS/DIV	10 mV
Input Coupling	GND

#### 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

#### 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  $\pm 50$  mV.
- d. Adjust—the Common Mode Bal control for 0 volts  $\pm 50$  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 ( $\pm 1$  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 (into 50  $\Omega$ ) 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 100-millivolt square-wave output and set the Input Coupling switch to DC.
- c. Check—CRT display for a vertical deflection of five divisions  $\pm 0.15$  division.
- d. Adjust—Front panel GAIN control for exactly five divisions vertical deflection.

## Calibration—7A19

### 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 $\pm 3\%$ Accuracy (Divisions)
10 mV	100 mV	5	Set in step 6
20 mV	0.20 V	5	$\pm 0.15$
50 mV	1.0 V	5	$\pm 0.15$
.1 V	1.0 V	5	$\pm 0.15$
.2 V	2.0 V	5	$\pm 0.15$
.5 V	5.0 V	5	$\pm 0.15$
1 V	10 V	5	$\pm 0.15$

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

- Set 7A19 VOLTS/DIV switch to 10 mV.
- Connect test circuit as shown in Fig. 5-2.
- Set calibration oscilloscope Vertical Mode to Right. Set the vertical plug-in unit to AC and obtain a sensitivity of 500  $\mu$ V/div.

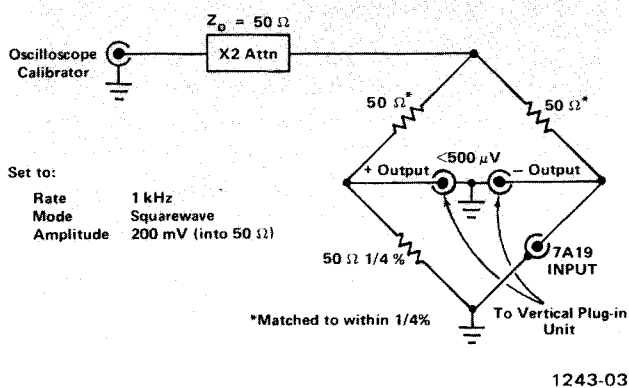


Fig. 5-2. Test circuit for adjusting input Resistance.

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 Flexible Extender to the Signal Pickoff, and plug the Flexible 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  $\Omega$  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.

q. Check — that the aberrations are typically 7% peak to peak or less, for 20 mV/DIV to 1 V/DIV, and 9% peak to peak or less, for 10 mV/DIV.

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.

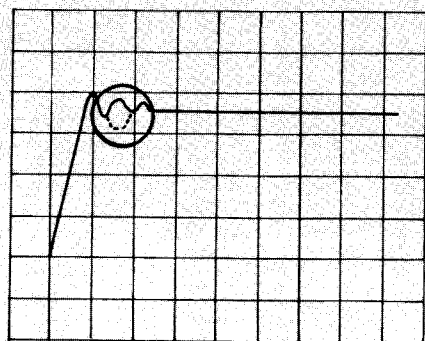
2. Locate the coil that affects that portion of the step waveform by bringing a metal screwdriver or similar metallic object close to each of the six coils.

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 all aberrations are as indicated in step 8-q.

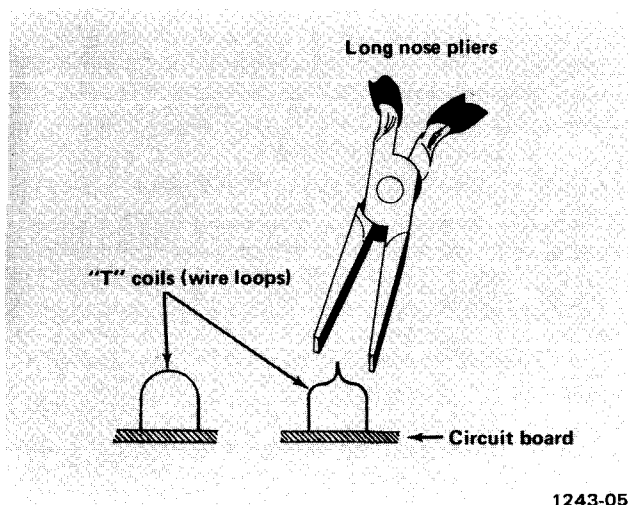
#### NOTE

*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.*



1243-04

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



1243-05

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

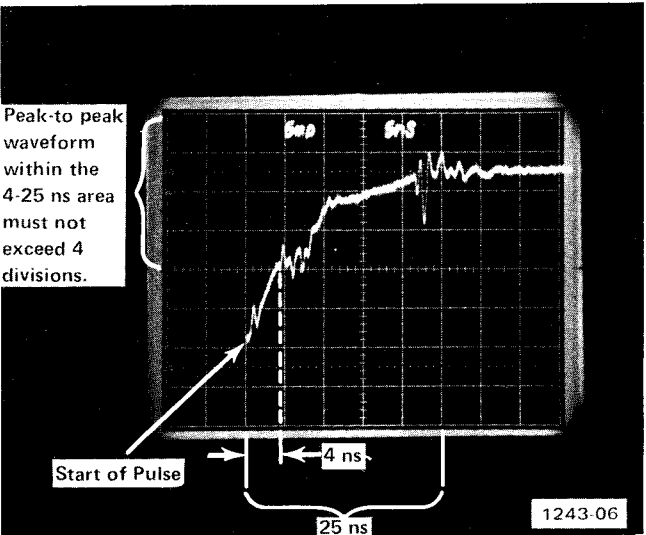


Fig. 5-5. Waveform showing a 4 division display corresponding to a reflection coefficient of 0.1 or less.

✓9. Frequency Response Check

- 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.
- Connect the Constant Amplitude sine-wave generator to the 7A19 using a 10X attenuator and a GR to BNC adapter.
- Set the constant amplitude generator to its reference frequency and adjust the amplitude for a CRT display of exactly 8 divisions.
- Increase the generator frequency to 500 MHz and check that the amplitude of the displayed signal is >5.6 divisions peak to peak.
- 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 24 mV
20 mV	8 div	5.6 div 54 mV
50 mV	8 div	5.6 div 140 mV
0.1 V	8 div	5.6 div 240 mV
0.2 V	8 div	5.6 div 540 mV
0.5 V	8 div	5.6 div
1 V	4 div	2.8 div

- Return VOLTS/DIV to 20 mV.

✓10. Reflection Coefficient Check

- Install the 7S12 with the S1 and S52 heads into the Right Vertical and A Horizontal compartments.
- Install the 7A19 into the Left Vertical compartment.
- Connect the 50  $\Omega$  Power Divider Tee to the S1 head using a 20 inch GR cable.
- Connect the 50  $\Omega$  Power Divider Tee to the Pulse Output of the S52 head using a 10 inch GR cable and GR to 3 mm adapter.
- Connect the 50  $\Omega$  Power Divider Tee to the 7A19 using a 2 ns cable and GR to bnc male adapter.
- Set the 7A19 VOLTS/DIV control to 10 mV/div, POLARITY to + UP, and INPUT to DC.

- 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
mp	pushbutton in

- Position the waveform to midscreen using the DC OFFSET control.
- Set the intensified zone to fall on the rise portion of the pulse, using the TIME/DISTANCE control.
- Push LOCATE button.
- Adjust—Front panel P CAL control for a 4 division peak to peak display.

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

- Position the top portion of the waveform to midscreen, using the DC OFFSET control (see Fig. 5-5).
- Set SCAN control for no rolloff of front corner of the waveform.

- 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

# Replaceable Electrical Parts—7A19

## 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
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012 ROUTE 202	DALLAS, TX 75222 SOMERVILLE, NY 08876
02735	RCA CORPORATION, SOLID STATE DIVISION		
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK 60 S JEFFERSON ROAD	SYRACUSE, NY 13201 WHIPPANY, NJ 07981
03888	KDI PYROFILM CORPORATION	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.		
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET LOWER WASHINGTON STREET	MOUNTAIN VIEW, CA 94042 DOVER, NH 03820
12697	CLAROSTAT MFG. CO., INC.	2905 BLUE STAR ST.	ANAHEIM, CA 92806
15454	RODAN INDUSTRIES, INC.	P O BOX 760	MINERAL WELLS, TX 76067
19701	ELECTRA-MIDLAND CORP., MEPCO ELECTRA INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
24931	SPECIALITY CONNECTOR CO., INC.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
51642	CENTRE ENGINEERING INC.	16931 MILLIKEN AVE.	IRVINE, CA 92713
57668	R-OHM CORP.	2155 N FORBES BLVD	TUCSON, AZ 85705
59660	TUSONIX INC.	644 W. 12TH ST.	ERIE, PA 16512
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	2500 HARBOR BLVD.	FULLERTON, CA 92634
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.		
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST. 800 E. NORTHWEST HWY	PHILADELPHIA, PA 19108 DES PLAINES, IL 60016
75915	LITTELFUSE, INC.	P O BOX 500	BEAVERTON, OR 97077
80009	TEKTRONIX, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91637	DALE ELECTRONICS, INC.	176 E 7TH STREET	PATERSON, NJ 07524
93958	REPUBLIC ELECTRONICS CORPORATION	1501 FIRST ST	SAN FERNANDO, CA 91341
96733	SAN FERNANDO ELECTRIC MFG CO		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff      Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1899-XX		CKT BOARD ASSY: VERTICAL AMPLIFIER		
A1	-----		(NOT AVAILABLE, USE 672-0465-00)		
A2	670-2742-XX	B030000	CKT BOARD ASSY: ATTENUATOR		
A2	-----		(NOT AVAILABLE, USE 672-0430-00)		
C5	283-0278-00		CAP., FXD, CER DI: 2.2UF, 20%, 100V	72982	8150-M100Z5U225M
C20	283-0181-00	B010100	CAP., FXD, CER DI: 1.8PF, 10%, 100V	59660	8101B121COKO189B
C20	283-0158-00	B037850	CAP., FXD, CER DI: 1PF, 10%, 50V	51642	100-050-NP0-109B
C20	-----		(STANDARD ONLY. NOMINAL VALUE, SELECTED)		
C20	283-0181-00	B010100	CAP., FXD, CER DI: 1.8PF, 10%, 100V	59660	8101B121COKO189B
C20	283-0158-00	B043050	CAP., FXD, CER DI: 1PF, 10%, 50V	51642	100-050-NP0-109B
C20	-----		(OPTION 04 ONLY. NOMINAL VALUE, SELECTED)		
C24	283-0069-00	B010100	CAP., FXD, CER DI: 15PF, 20%, 50V	51642	A150050NPU150M
C24	-----		(STANDARD ONLY)		
C24	283-0069-00	B011450	CAP., FXD, CER DI: 15PF, 20%, 50V	51642	A150050NPU150M
C24	-----		(STANDARD ONLY, SELECTED)		
C24	283-0069-00	B010100	CAP., FXD, CER DI: 15PF, 20%, 50V	51642	A150050NPU150M
C24	-----		(OPTION 4 ONLY)		
C24	283-0069-00	B020000	CAP., FXD, CER DI: 15PF, 20%, 50V	51642	A150050NPU150M
C24	-----		(OPTION 04 ONLY. NOMINAL VALUE, SELECTED)		
C26	283-0201-00		CAP., FXD, CER DI: 27PF, 10%, 200V	51642	W150-200 X7R270K
C28	283-0156-00		CAP., FXD, CER DI: 1000PF, + 100-0%, 200V	96733	R2670
C31	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C35	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C41	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C47	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C58	283-0000-00		CAP., FXD, CER DI: 0.001UF, + 100-0%, 500V	59660	831610Y5U0102P
C61	283-0000-00		CAP., FXD, CER DI: 0.001UF, + 100-0%, 500V	59660	831610Y5U0102P
C73	283-0000-00		CAP., FXD, CER DI: 0.001UF, + 100-0%, 500V	59660	831610Y5U0102P
C80	283-0181-00	B010100	CAP., FXD, CER DI: 1.8PF, 10%, 100V	59660	8101B121COKO189B
C80	283-0158-00	B037850	CAP., FXD, CER DI: 1PF, 10%, 50V	51642	100-050-NP0-109B
C80	-----		(STANDARD ONLY)		
C80	283-0181-00	B010100	CAP., FXD, CER DI: 1.8PF, 10%, 100V	59660	8101B121COKO189B
C80	283-0158-00	B043050	CAP., FXD, CER DI: 1PF, 10%, 50V	51642	100-050-NP0-109B
C80	-----		(OPTION 04 ONLY)		
C84	283-0069-00		CAP., FXD, CER DI: 15PF, 20%, 50V	51642	A150050NPU150M
C86	283-0201-00		CAP., FXD, CER DI: 27PF, 10%, 200V	51642	W150-200 X7R270K
C88	283-0156-00		CAP., FXD, CER DI: 1000PF, + 100-0%, 200V	96733	R2670
C91	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C95	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C101	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C107	283-0182-00		CAP., FXD, CER DI: 51PF, 5%, 400V	72982	8121N400A510J
C121	283-0160-00	B010100	CAP., FXD, CER DI: 1.5PF, 10%, 50V	93958	1C15RB
C121	283-0181-00	B037651	CAP., FXD, CER DI: 1.8PF, 10%, 100V	59660	8101B121COKO189B
C121	283-0185-00	B037850	CAP., FXD, CER DI: 2.5PF, 5%, 50V	72982	8101B057C0K0295B
C121	-----		(STANDARD ONLY. NOMINAL VALUE, SELECTED)		
C121	283-0185-00	B043050	CAP., FXD, CER DI: 2.5PF, 5%, 50V	72982	8101B057C0K0295B
C121	-----		(OPTION 04 ONLY. NOMINAL VALUE, SELECTED)		
C123	283-0160-00		CAP., FXD, CER DI: 1.5PF, 10%, 50V	93958	1C15RB
C162	283-0000-00		CAP., FXD, CER DI: 0.001UF, + 100-0%, 500V	59660	831610Y5U0102P
C167	283-0000-00		CAP., FXD, CER DI: 0.001UF, + 100-0%, 500V	59660	831610Y5U0102P
C168	283-0000-00		CAP., FXD, CER DI: 0.001UF, + 100-0%, 500V	59660	831610Y5U0102P

# Replaceable Electrical Parts—7A19

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
CR50	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR54	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR58	152-0141-02	B039010	SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR58	-----		(STANDARD ONLY)		
CR58	152-0141-02	B043050	SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR58	-----		(OPTION 04 ONLY)		
CR59	152-0141-02	B039010	SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR59	-----		(STANDARD ONLY)		
CR59	152-0141-02	B043050	SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR59	-----		(OPTION 04 ONLY)		
CR124	152-0333-00		SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR125	152-0333-00		SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR147	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
DL13	119-0321-00	B010100	DELAY LINE,ELEC:VARIABLE	80009	119-0321-00
DL13	-----		(OPTION 04 ONLY)		
DL13	119-0321-02	B043900	DELAY LINE,ELEC:VAR,-0.5NS TO + 0.5NS	80009	119-0321-02
DL13	-----		(OPTION 04 ONLY)		
F6	159-0056-00	B010100	FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW	75915	279.100
F6	-----		(STANDARD ONLY)		
F6	159-0056-00	B010100	FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW	75915	279.100
F6	-----		(OPTION 04 ONLY)		
F7	159-0056-00	B010100	FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW	75915	279.100
F7	-----		(STANDARD ONLY)		
F7	159-0056-00	B010100	FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW	75915	279.100
F7	-----		(OPTION 04 ONLY)		
F10	159-0118-00	B030000	FUSE,THERMAL:50 OHM	80009	159-0118-00
F10	-----		(STANDARD ONLY)		
F10	159-0118-00	B040000	FUSE,THERMAL:50 OHM	80009	159-0118-00
F10	-----		(OPTION 04 ONLY)		
J1	131-1171-00		CONNECTOR,RCPT,:BNC,50 OHM	24931	28JR231-1
L21	-----		(PART OF C20, SEE SVCE MNL MAINT SECTION		
L22	-----		(PART OF C20, SEE SVCE MNL MAINT SECTION		
L27	108-0129-00	B010100	COIL,RF:FIXED,18UH	80009	108-0129-00
L27	108-0409-00	B010880	COIL,RF:17.5UH	80009	108-0409-00
L81	-----		(PART OF C80, SEE SVCE MNL MAINT SECTION		
L82	-----		(PART OF C80, SEE SVCE MNL MAINT SECTION		
L124	-----		(PART OF C123, SEE SVCE MNL MAINT SECTION		
L125	-----		(PART OF C123, SEE SVCE MNL MAINT SECTION		
LR40	108-0412-00		COIL,RF:FIXED,1.6UH	80009	108-0412-00
LR46	108-0412-00		COIL,RF:FIXED,1.6UH	80009	108-0412-00
LR100	108-0412-00		COIL,RF:FIXED,1.6UH	80009	108-0412-00
LR106	108-0412-00		COIL,RF:FIXED,1.6UH	80009	108-0412-00
Q50	151-0220-00		TRANSISTOR:SILICON,PNP	07263	S036228
Q56	151-0232-00		TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q73	151-0188-00		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q76	151-0188-00		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q130	151-0254-00	B010100	TRANSISTOR:SILICON,NPN	03508	X38L3118
Q130	151-0281-00	B037376	TRANSISTOR:SILICON,NPN	03508	X16P4039

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont		Name & Description	Mfr Code	Mfr Part Number
Q165	151-0188-00			TRANSISTOR,SILICON,PNP	04713	SPS6868K
Q168	151-0188-00			TRANSISTOR,SILICON,PNP	04713	SPS6868K
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
R7	-----			(STANDARD ONLY)		
R7	317-0302-00	B011790	B029999	RES.,FXD,CMPSN:3K OHM,5%,0.125W	01121	BB3025
R7	-----			(STANDARD ONLY. NOMINAL VALUE,SELECTED)		
R7	317-0472-00	B030000		RES.,FXD,CMPSN:4.7K OHM,5%,0.125W	01121	BB4725
R7	-----			(STANDARD ONLY)		
R7	317-0202-00	B010100	B019999	RES.,FXD,CMPSN:2K OHM,5%,0.125W	01121	BB2025
R7	-----			(OPTION 04 ONLY)		
R7	317-0302-00	B020000	B039999	RES.,FXD,CMPSN:3K OHM,5%,0.125W	01121	BB3025
R7	-----			(OPTION 04 ONLY. NOMINAL VALUE,SELECTED)		
R7	317-0472-00	B040000		RES.,FXD,CMPSN:4.7K OHM,5%,0.125W	01121	BB4725
R7	-----			(OPTION 04 ONLY)		
R8	324-0097-00			RES.,FXD,FILM:100 OHM,1%,1W	91637	OBD
R9	324-0097-00			RES.,FXD,FILM:100 OHM,1%,1W	91637	OBD
R10	307-1021-00	B030000		ATTENUATOR,FXD:2.5X,50 OHM	80009	307-1021-00
R10	-----			(STANDARD ONLY)		
R10	307-1021-00	B040000		ATTENUATOR,FXD:2.5X,50 OHM	80009	307-1021-00
R10	-----			(OPTION 04 ONLY)		
R11	307-1023-00	B030000		ATTENUATOR,FXD:50 OHM,5X	80009	307-1023-00
R11	-----			(STANDARD ONLY)		
R11	307-1023-00	B040000		ATTENUATOR,FXD:50 OHM,5X	80009	307-1023-00
R11	-----			(OPTION 04 ONLY)		
R12	307-1024-00	B030000		ATTENUATOR,FXD:50 OHM,10X	80009	307-1024-00
R12	-----			(STANDARD ONLY)		
R12	307-1024-00	B040000		ATTENUATOR,FXD:50 OHM,10X	80009	307-1024-00
R12	-----			(OPTION 04 ONLY)		
R24	317-0750-00	B010100	B011449	RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R24	-----			(STANDARD ONLY)		
R24	317-0750-00	B011450		RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R24	-----			(STANDARD ONLY. NOMINAL VALUE,SELECTED)		
R24	317-0750-00	B010100	B019999	RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R24	-----			(OPTION 04 ONLY)		
R24	317-0750-00	B020000		RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R24	-----			(OPTION 04 ONLY. NOMINAL VALUE,SELECTED)		
R26	317-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.125W	01121	BB3615
R27	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R27	-----			(NOMINAL VALUE,SELECTED)		
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,5%,0.25W	01121	CB6215
R28	-----			(NOMINAL VALUE,SELECTED)		
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:TRMR,500 OHM,0.5W	32997	3329H-G48-501
R39	301-0621-00	B010100	B055501	RES.,FXD,CMPSN:620 OHM,5%,0.50W	57668	NTR501E620E
R39	301-0621-03	B055502		RES.,FXD,CMPSN:620 OHM,5%,0.50W,CARBON ONLY	19701	5053CX620R0J
R42	323-0120-00			RES.,FXD,FILM:174 OHM,1%,0.50W	91637	MFF1226G174R0F
R44	317-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R45	325-0027-00			RES.,FXD,FILM:93 OHM,1%,0.5W	03888	AME50-E93R00F

# Replaceable Electrical Parts—7A19

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
R48	323-0120-00	B010100 055501	RES.,FXD,FILM:174 OHM,1%,0.50W	91637	MFF1226G174R0F
R49	301-0621-00		RES.,FXD,CMPSN:620 OHM,5%,0.50W	57668	NTR501E620E
R49	301-0621-03		RES.,FXD,CMPSN:620 OHM,5%,0.50W,CARBON ONLY	19701	5053CX620R0J
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	B010100 055501	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	B010100 B040634	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	311-1320-01		RES.,VAR,NONWIR:5K OHM,10%,1W,SPST SW	12697	CM43494
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	B038100	RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	82-30-1
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		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	B010100 055501	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:TRMR,500 OHM,0.5W	32997	3329H-G48-501
R99	301-0621-00	B010100 055501	RES.,FXD,CMPSN:620 OHM,5%,0.50W	57668	NTR501E620E
R99	301-0621-03		RES.,FXD,CMPSN:620 OHM,5%,0.50W,CARBON ONLY	19701	5053CX620R0J
R102	323-0120-00		RES.,FXD,FILM:174 OHM,1%,0.50W	91637	MFF1226G174R0F
R104	317-0750-00		RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R105	325-0027-00		RES.,FXD,FILM:93 OHM,1%,0.5W	03888	AME50-E93R00F
R108	323-0120-00		RES.,FXD,FILM:174 OHM,1%,0.50W	91637	MFF1226G174R0F
R109	301-0621-00	B010100 055501	RES.,FXD,CMPSN:620 OHM,5%,0.50W	57668	NTR501E620E
R109	301-0621-03		RES.,FXD,CMPSN:620 OHM,5%,0.50W,CARBON ONLY	19701	5053CX620R0J
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	82-38-1
R117	317-0202-00	B010100 B037650	RES.,FXD,CMPSN:2K OHM,5%,0.125W	01121	BB2025
R117	-----		(NOMINAL VALUE,SELECTED)		
R119	321-0067-00		RES.,FXD,FILM:48.7 OHM,1%,0.125W	91637	MFF1816G48R70F
R121	317-0121-00		RES.,FXD,CMPSN:120 OHM,5%,0.125W	01121	BB1215
R121	317-0121-00		RES.,FXD,CMPSN:120 OHM,5%,0.125W	01121	BB1215
R121	-----		(NOMINAL VALUE,SELECTED)		
R132	321-0299-00	B010100 055501	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

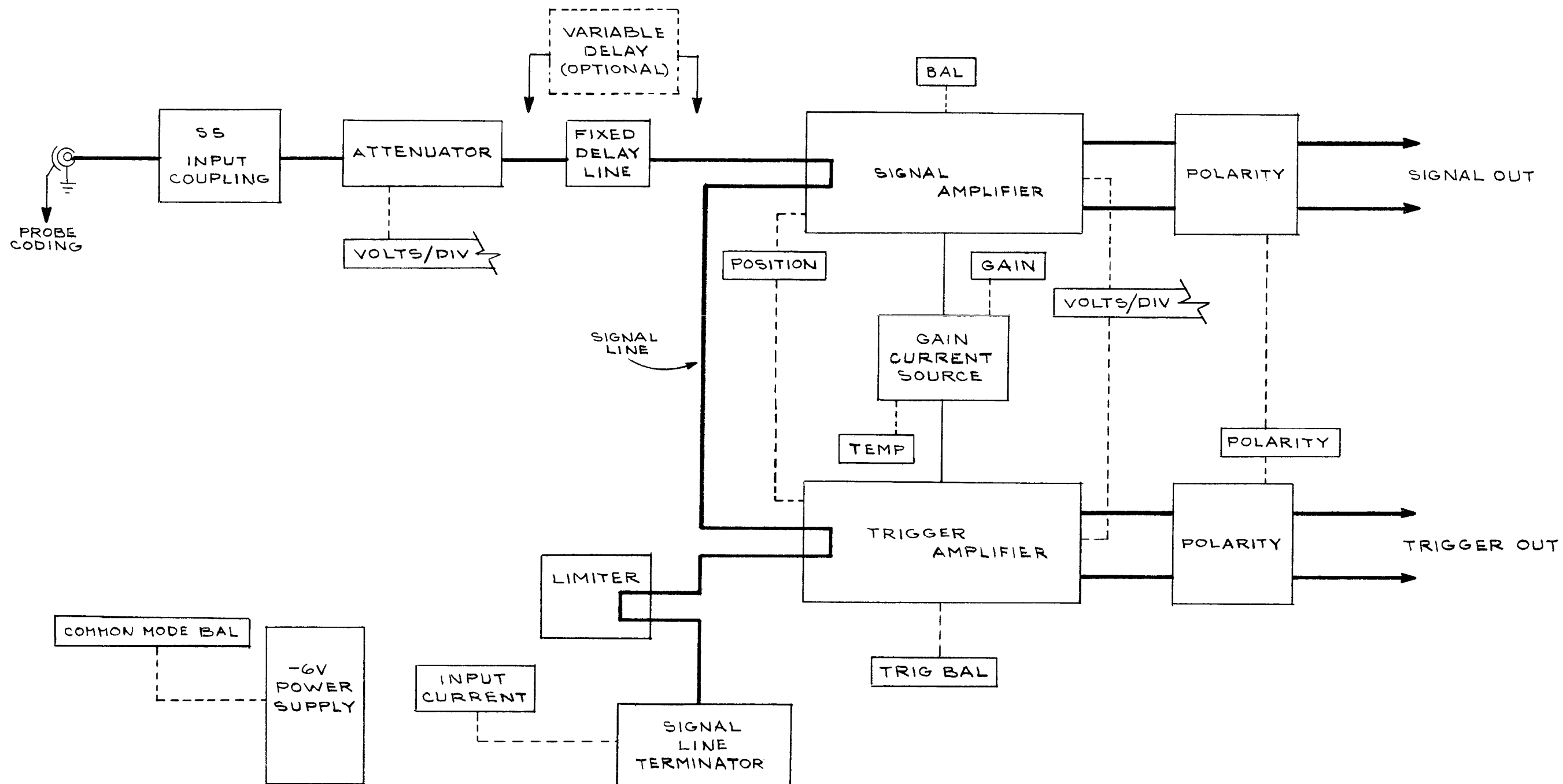
Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
R139	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R141	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R142	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R144	315-0753-00			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:TRMR,500 OHM,0.5W	32997	3329H-G48-501
R164	322-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.25W	75042	CEBT0-1581F
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
S5	-----			(STANDARD ONLY)		
S5	263-1094-00	B030000		SW CAM ACTR AS:INPUT	80009	263-1094-00
S5	-----			(STANDARD ONLY)		
S5	105-0321-00	B010100	B039999	ACTR ASSY,CAM S:INPUT	80009	105-0321-00
S5	-----			(OPTION 04 ONLY)		
S5	263-1094-00	B040000		SW CAM ACTR AS:INPUT	80009	263-1094-00
S5	-----			(OPTION 04 ONLY)		
S10	263-1064-00	B030000		SW CAM ACTR AS:VOLTS/DIV	80009	263-1064-00
S10	-----			(STANDARD ONLY)		
S10	263-1064-00	B040000		SW CAM ACTR AS:VOLTS/DIV	80009	263-1064-00
S10	-----			(OPTION 04 ONLY)		
S50	105-0322-00	B010100	B029999	ACTR ASSY,CAM S:INVERT	80009	105-0322-00
S50	-----			(STANDARD ONLY)		
S50	263-1095-00	B030000		SW CAM ACTR AS:POLARITY	80009	263-1095-00
S50	-----			(STANDARD ONLY)		
S50	105-0322-00	B010100	B039999	ACTR ASSY,CAM S:INVERT	80009	105-0322-00
S50	-----			(OPTION 04 ONLY)		
S50	263-1095-00	B040000		SW CAM ACTR AS:POLARITY	80009	263-1095-00
S50	-----			(OPTION 04 ONLY)		
S70	-----			(PART OF R68)		
S135	105-0323-00	B010100	B029999	ACTR ASSY,CAM S:VOLTS/DIV	80009	105-0323-00
S135	-----			(STANDARD ONLY)		
S135	263-1096-00	B030000		SW CAM ACTR AS:VOLTS/DIV	80009	263-1096-00
S135	-----			(STANDARD ONLY)		
S135	105-0323-00	B010100	B039999	ACTR ASSY,CAM S:VOLTS/DIV	80009	105-0323-00
S135	-----			(OPTION 04 ONLY)		
S135	263-1096-00	B040000		SW CAM ACTR AS:VOLTS/DIV	80009	263-1096-00
S135	-----			(OPTION 04 ONLY)		
U40	155-0068-00			MICROCIRCUIT,L1:AMPLIFIER	80009	155-0068-00
U100	155-0068-00			MICROCIRCUIT,L1:AMPLIFIER	80009	155-0068-00
U110	156-0049-00			MICROCIRCUIT,L1:OPERATIONAL AMPLIFIER	02735	CA741CT



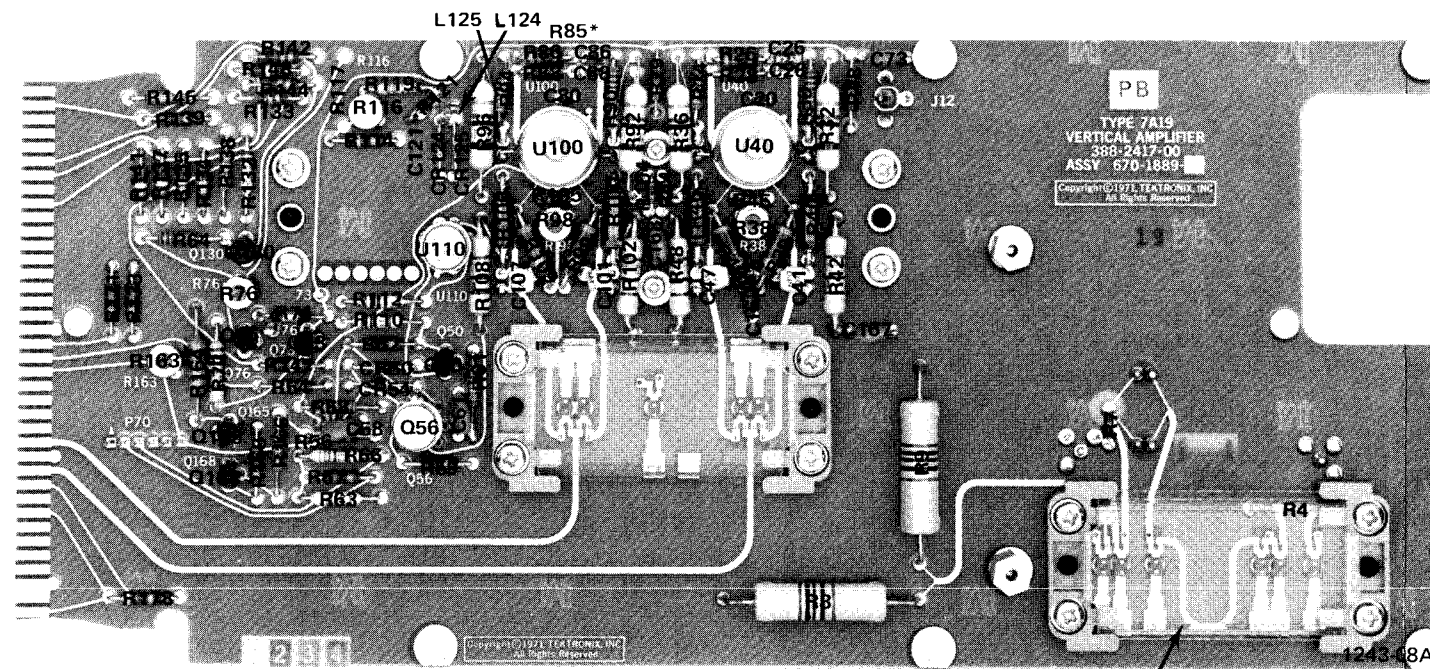




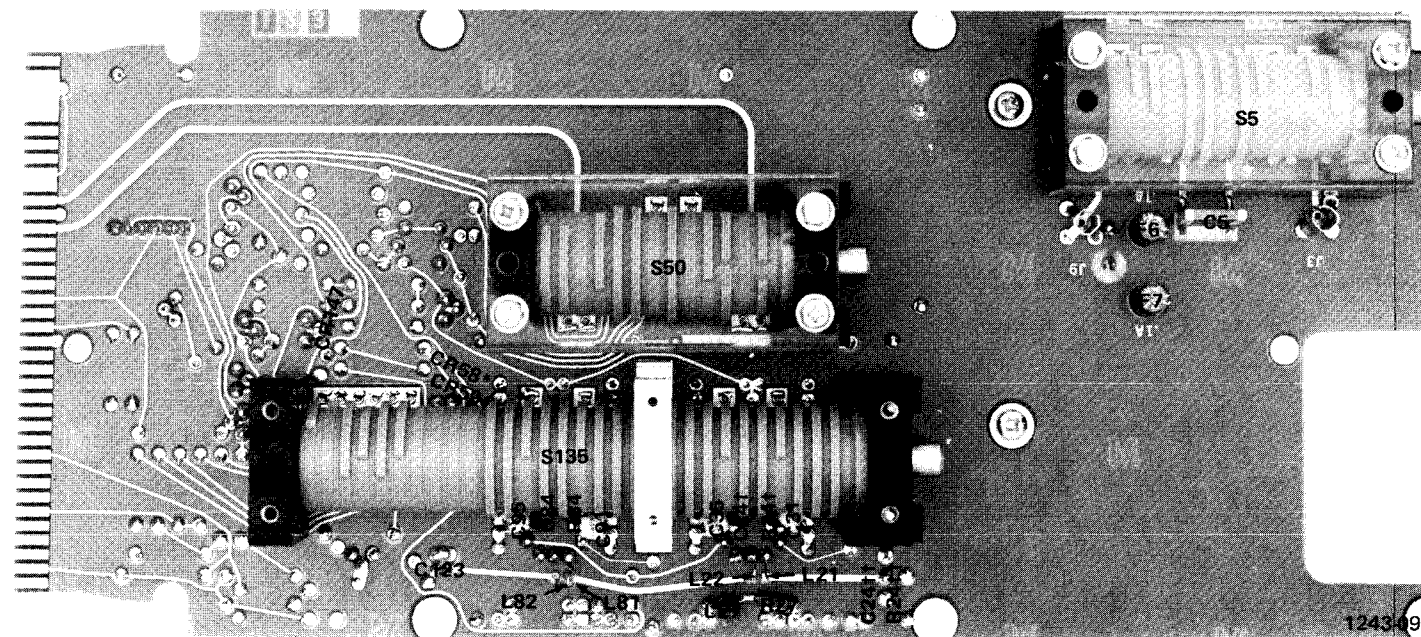




7A19



**Attenuator circuit board assembly below SN B030000.**

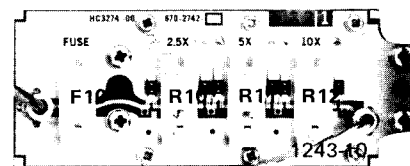


**A1-7A19 Amplifier board.**

**\*See Parts List for serial number ranges.**

† SN B037849 &amp; below.

†† SN B037850 &amp; 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 M $\Omega$
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)

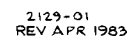
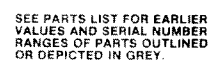
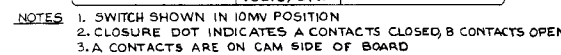
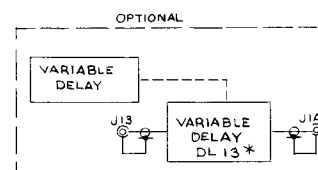
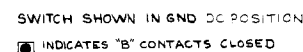
Level/Slope	Centered on positive slope
Triggering Mode	P-P Auto
Coupling	AC
Source	Ext
Magnifier	X1
Time/Div	1 ms
Variable	Cal In

### 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.









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

# Replaceable Mechanical Parts—7A19

## CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRHUS DRIVE	BEAVERTON, OR 97005
000FW	WESTERN SINTERING CO INC.	2620 STEVENS DRIVE	RICHLAND, WA 99352
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
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22599	ESNA, DIV. OF AMERACE CORPORATION	16150 STAGG STREET	VAN NUYS, CA 91409
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
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
92101	SCHULZE MFG, 50 INGOLD RD BURLINGAME, CA 94010		
93459	WEINSCHEL ENGINEERING COMPANY, INC.	CLOPPER ROAD, P O BOX 577	GAITHERSBURG, MD 20760
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111
98291	SEAELECTRO 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	B010100	B041799	2		SHIELD,ELEC:SIDE PLUG-IN UNITS	80009	337-1064-00
	337-1064-12	B041800		2		SHIELD,ELEC:SIDE FOR PLUG-IN UNIT	80009	337-1064-12
-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:GRAY	80009	366-1058-31
						***** (ATTACHING PARTS) *****		
-8	214-1095-00			1		PIN,SPG,SPLIT:0.094 OD X 0.187 INCH LONG	22599	52-022-094-0187
						***** (END ATTACHING PARTS) *****		
-9	-----			1		RESISTOR,VAR: (SEE R68 REPL)		
						***** (ATTACHING PARTS) *****		
-10	210-0583-00			1		NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-11	210-0046-00			1		WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						***** (END ATTACHING PARTS) *****		
-12	-----			1		RESISTOR,VAR: (SEE R73 REPL)		
						***** (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:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
-15	129-0252-00			1		SPACER,POST:0.45 LONG X 0.312 HEX	80009	129-0252-00
						***** (END ATTACHING PARTS) *****		
-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:ATTEN	80009	672-0430-00
						***** (ATTACHING PARTS) *****		
-18	213-0022-00	B010100	B029999	2		SETSCREW:4-40 X 0.188 INCH,HEX SOC S	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
						***** (END ATTACHING PARTS) *****		
	-----			-		CKT BOARD ASSY INCLUDES:		
-20	337-1418-01	B030000	B039749	2		.SHIELD,ELEC:CAM SWITCH CASTING	80009	337-1418-01
	337-1418-02	B039750		2		.SHIELD,ELEC:CIRCUIT BOARD	80009	337-1418-02
						***** (ATTACHING PARTS) *****		
-21	211-0001-00	B030000		6		.SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	87308	OBD
-22	210-0053-00	B030000		6		.WASHER,LOCK:INTL,0.092 ID X 0.175"OD,S	83385	OBD
-23	210-1008-00	B030000		6		.WASHER,FLAT:0.09 ID X 0.188" OD,BRS	12360	OBD
						***** (END ATTACHING PARTS) *****		
-24	344-0248-00	B030000		4		.CLIP,ATTENUATOR:	80009	344-0248-00
-25	-----			1		.CKT BOARD ASSY:ATTENUATOR(SEE A2 REPL)		
						***** (ATTACHING PARTS) *****		
-26	211-0116-00	B030000	B040799	4		.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B040800		4		.SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
						***** (END ATTACHING PARTS) *****		
	-----			-		.CKT BOARD ASSY INCLUDES:		
-27	131-1003-00	B030000		2		.CONN,RCPT,ELEC:CKT BD MT,3 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	B041349	6		.CONT ASSY,ELEC:CAM SWITCH,BOTTOM	80009	131-1030-00
	131-1030-01	B041350	B042469	6		.CONT ASSY,ELEC:CAM SWITCH,BOTTOM	80009	131-1030-01
	131-1030-00	B042470		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	B040050	6		.RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
	210-3082-00	B040051		6		.EYELET,METALLIC:0.047 OD X 0.133 L,BRASS	80009	210-3082-00
-31	214-1797-00	B030000		8		.PIN,ATTEN CLIP:	80009	214-1797-00
	263-1064-00	B030000		1		.SW CAM ACTR AS:VOLTS/DIV	80009	263-1064-00
-32	200-1653-00	B030000		1		.COVER,CAM SW:17 ELEMENTS	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,ST	78189	1202-00-00-0541C
						***** (END ATTACHING PARTS) *****		

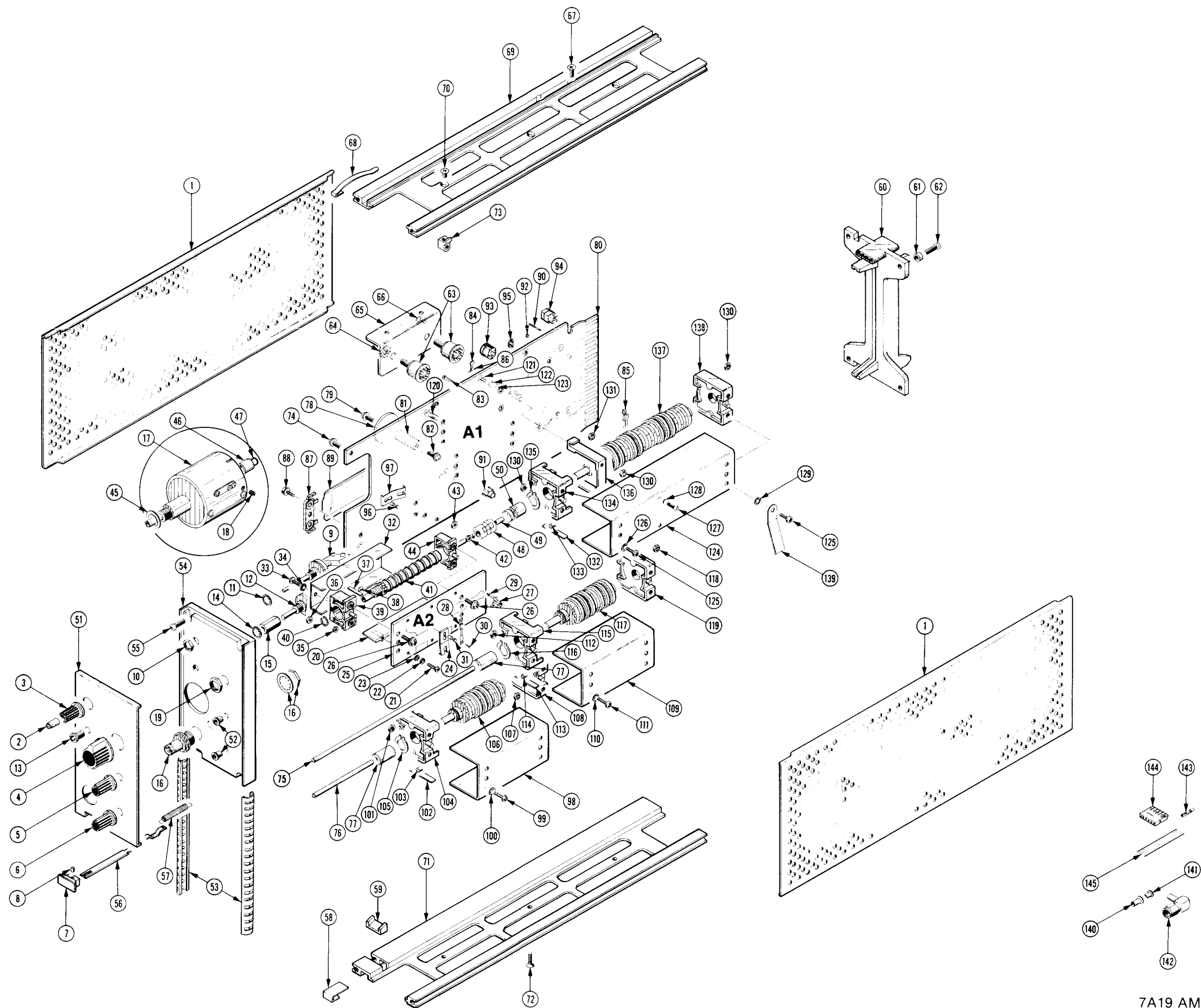
# Replaceable Mechanical Parts—7A19

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-35	210-0405-00	B030000	1		.NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
-36	210-0406-00	B030000	2		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-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,SST	80009	214-1127-00
-39	401-0053-00	B030000	1		.BEARING,CAM SW:FRONT,W/0.375-32 EXT THD	80009	401-0053-00
					*****{ATTACHING PARTS}*****		
-40	354-0219-00	B030000	1		.RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
					*****{END ATTACHING PARTS}*****		
-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	12157-50
-43	210-0406-00	B030000	2		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-44	401-0061-00	B030000	1		.BEARING,CAM SW:REAR	80009	401-0061-00
-45	210-0976-00	B010100	1	B029999	WASHER,FLAT:0.390 ID X 0.562 OD	80009	210-0976-00
-46	358-0448-00	B010100	1	B029999	BSHG,MACH.THD:0.136 ID X 0.25 L,BRS CU-SN	80009	358-0448-00
-47	384-1126-00	B010100	1	B029999	EXTENSION SHAFT:0.65 L X 0.122 OD AL	80009	384-1126-00
-48	376-0051-00		1		CPLG.SHAFT,FLEX:0.127 ID X 0.375 ID DELRIN	80009	376-0051-00
-49	384-0421-00	B010100	1	B029999	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 SHAF	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	92101	OBD
-54	386-1447-59	B010100	1	B029999	SUBPANEL,FRONT:	80009	386-1447-59
	386-1447-77	B030000	1		SUBPANEL,FRONT:	80009	386-1447-77
					*****{ATTACHING PARTS}*****		
-55	213-0192-00	B010100	4	B041094	SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
	213-0793-00	B041095	4		SCREW,TPG,TF:6-32 X 0.4375,TAPTITE,FIL	93907	OBD
					*****{END ATTACHING PARTS}*****		
-56	105-0076-02	B010100	1	B042954	REL BAR,LATCH:PLUG-IN UNIT	80009	105-0076-02
	105-0076-04	B0429555	1		RELEASE BAR,LCH:PLUG-IN UNIT	80009	105-0076-04
-57	214-1280-00		1		SPRING,HLCPS:0.14 OD X 1.126"L,0.16"DIA	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		BOLT,LATCH:7A & 7B SER PL-IN	80009	105-0075-00
-60	386-1402-00		1		PANEL,REAR:	80009	386-1402-00
					*****{ATTACHING PARTS}*****		
-61	361-0326-00		1		SPACER,SLEEVE:0.18 ID X 0.25 OD X 0.10"L	80009	361-0326-00
-62	213-0192-00	B010100	4	B041094	SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
	213-0793-00	B041095	4		SCREW,TPG,TF:6-32 X 0.4375,TAPTITE,FIL	93907	OBD
					*****{END ATTACHING PARTS}*****		
-63	-----		2		INTEGRATED CKT:		
					*****{ATTACHING PARTS}*****		
-64	220-0410-00		1		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
					*****{END ATTACHING PARTS}*****		
-65	214-1653-00		1		HT SK,MICROCKT:ALUMINUM	80009	214-1653-00
					*****{ATTACHING PARTS}*****		
-66	210-0586-00		2		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-67	211-0101-00		2		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
					*****{END ATTACHING PARTS}*****		
	334-3438-00	B042200	1		MARKER,IDENT:MARKED TURN OFF POWER	80009	334-3458-00
-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 ST	83385	OBD
					*****{END ATTACHING PARTS}*****		
-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 ST	83385	OBD
					*****{END ATTACHING PARTS}*****		
-73	220-0547-01		6		NUT,BLOCK:0.38 X 0.26 X 0.282 (2)4-40	000FW	OBD
					*****{ATTACHING PARTS}*****		
-74	211-0116-00		6		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					*****{END ATTACHING PARTS}*****		
-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

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-77	376-0008-00			2						CPLG.SHAFT,RGD:0.125 & 0.255 ID,AL	80009	376-0008-00
-78	210-1018-00			2						WASHER,FLAT:0.173 ID X 0.075 OD ***** (ATTACHING PARTS) *****	80009	210-1018-00
-79	211-0116-00			1						SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS ***** (END ATTACHING PARTS) *****	83385	OBD
	672-0465-00			1						CKT BOARD ASSY:VERT AMPL	80009	672-0465-00
-80	-----			1						CKT BOARD ASSY:VERT AMPL(SEE A1 REPL)		
-81	129-0363-00			2						POST,ELEC-MECH:HEX,0.25 X 0.436 INCH LO ***** (ATTACHING PARTS) *****	80009	129-0363-00
-82	211-0116-00			2						SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS ***** (END ATTACHING PARTS) *****	83385	OBD
-83	214-0579-00			2						TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-84	131-1030-00			11						CONT ASSY,ELEC:CAM SWITCH BOTTOM	80009	131-1030-00
-85	131-1031-00			22						CONTACT ASSY,EL:CAM SWITCH TOP ***** (ATTACHING PARTS) *****	80009	131-1031-00
-86	210-0779-00			22						RIVET,TUBULAR:0.051 OD X 0.151 INCH LONG ***** (END ATTACHING PARTS) *****	42838	RA-29952715
-87	352-0336-00			4						HOLDER,COVER: ***** (ATTACHING PARTS) *****	80009	352-0336-00
-88	211-0116-00			16						SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS ***** (END ATTACHING PARTS) *****	83385	OBD
-89	200-1415-00			2						COVER,CONTACTS:1.95 L,OLEAR PLASTIC	80009	200-1415-00
-90	131-0589-00			6						TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-91	131-1003-00			3						CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-92	136-0252-04	B010100	B033739	67						SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
	136-0252-07	B033740	B043419	43						SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0252-07	B043420		67						SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0352-00	B010100	B030000	4						CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
-93	136-0235-00	B033740	B043419	1						SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-94	136-0220-00	B033740	B043419	5						SKT,PL-IN ELEK:TRANSISTOR J CONTACT,POB	71785	133-23-11-034
-95	136-0350-00	B033740	B043419	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 ***** (ATTACHING PARTS) *****	80009	263-1094-00
	211-0116-00	B010100	B040799	4						SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B040800		4						SCR,ASSEM WSHR:4-40 X 0.25 BRS NI PL ***** (END ATTACHING PARTS) *****	78189	OBD
-98	200-1343-00			1						COVER,CAM SW:13 ELEMENTS ***** (ATTACHING PARTS) *****	80009	200-1343-00
-99	211-0008-00			4						SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-100	210-0004-00			4						WASHER,LOCK:#4 INTL 0.015 THK,STL CD PL ***** (END ATTACHING PARTS) *****	000BK	OBD
-101	210-0406-00			4						NUT,PLAIN,HEX:4-40 X 0.188 INCH,BRS	73743	12161-50
-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,SST	80009	214-1127-00
-104	401-0081-00			1						BEARING,CAM SW:FRONT ***** (ATTACHING PARTS) *****	80009	401-0081-00
-105	354-0391-00			1						RING,RETAINING:0.395" FREE ID X 0.025" S ***** (END ATTACHING PARTS) *****	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	12161-50
-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 ***** (ATTACHING PARTS) *****	80009	263-1095-00
	211-0116-00	B010100	B040799	4						SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B040800		4						SCR,ASSEM WSHR:4-40 X 0.25 BRS NI PL ***** (END ATTACHING PARTS) *****	78189	OBD

# Replaceable Mechanical Parts—7A19

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-109	200-1343-00		1		..COVER,CAM SW:13 ELEMENTS .....(ATTACHING PARTS).....	80009	200-1343-00
-110	211-0008-00		4		..SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-111	210-0004-00		4		..WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	OBD
	211-0022-00	B010100	2		..SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
	210-0001-00	B010100	2		..WASHER,LOCK:INTL,0.092 ID X 0.18"OD,ST .....(END ATTACHING PARTS).....	78189	1202-00-00-0541C
-112	210-0406-00		4		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-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,SST	80009	214-1127-00
-115	401-0081-00		1		..BEARING,CAM SW:FRONT .....(ATTACHING PARTS).....	80009	401-0081-00
-116	354-0391-00		1		..RING,RETAINING:0.395"FREE ID X 0.025" S .....(END ATTACHING PARTS).....	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	12161-50
-119	401-0146-00		1		..BEARING,CAM SW:REAR	80009	401-0146-00
	105-0323-00	B010100	1		..ACTR ASSY,CAM S:VOLTS/DIV	80009	105-0323-00
	263-1096-00	B030000	1		..SW CAM ACTR AS:VOLTS/DIV .....(ATTACHING PARTS).....	80009	263-1096-00
-120	211-0116-00	B010100	4		..SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0116-00	B023000	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
	211-0292-00	B040800	4		..SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
	211-0180-00	B010100	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,PNH,STL	83385	OBD
-122	210-0053-00		2		..WASHER,LOCK:INTL,0.092 ID X 0.175"OD,S	83385	OBD
-123	210-1008-00	B034430	2		..WASHER,FLAT:0.09 ID X 0.188" OD,BRS .....(END ATTACHING PARTS).....	12360	OBD
-124	200-1344-00	B010100	1		..COVER,CAM SW:30 ELEMENTS	80009	200-1344-00
	200-1344-01	B022300	1		..COVER,CAM SW:30 ELEMENTS .....(ATTACHING PARTS).....	80009	200-1344-01
-125	211-0008-00		6		..SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-126	210-0004-00	B010100	4		..WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	OBD
	210-0004-00	B022300	5		..WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	OBD
-127	211-0022-00	B010100	2		..SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-128	210-0001-00	B010100	2		..WASHER,LOCK:INTL,0.092 ID X 0.18"OD,ST	78189	1202-00-00-0541C
-129	210-0007-00	B023000	1		..WASHER,LOCK:#8 EXT,0.02 THK,STL CD PL .....(END ATTACHING PARTS).....	78189	1108-00-00-0541C
-130	210-0406-00	B010100	8		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
	210-0406-00	B022300	12		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
	210-0406-00	B034430	10		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-131	210-0405-00	B034430	2		..NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
-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,SST	80009	214-1127-00
-134	401-0081-00		1		..BEARING,CAM SW:FRONT .....(ATTACHING PARTS).....	80009	401-0081-00
-135	354-0391-00		1		..RING,RETAINING:0.395"FREE ID X 0.025" S .....(END ATTACHING PARTS).....	97464	3100-43-CD
-136	407-0926-00	B010100	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		..ACTR ASSY,CAM S:VOLTS/DIV	80009	105-0320-00
-138	401-0146-00		1		..BEARING,CAM SW:REAR	80009	401-0146-00
-139	214-1712-00		1		..SPRING,FLAT:1.625 X 0.4,CU BE	80009	214-1712-00
	198-2051-00		1		..WIRE SET,ELEC:	80009	198-2051-00
-140	210-0774-00		4		..EYELET,METALLIC:0.152 OD X 0.245 INCH L,B	80009	210-0774-00
-141	210-0775-00		4		..EYELET,METALLIC:0.126 OD X 0.23 INCH L,BR	80009	210-0775-00
-142	131-0977-00	B010100	1		..CONNECTOR,PLUG:,RIGHT ANGLE,MALE	98291	050-628-9188-310
-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



7A19 AMPLIFIER

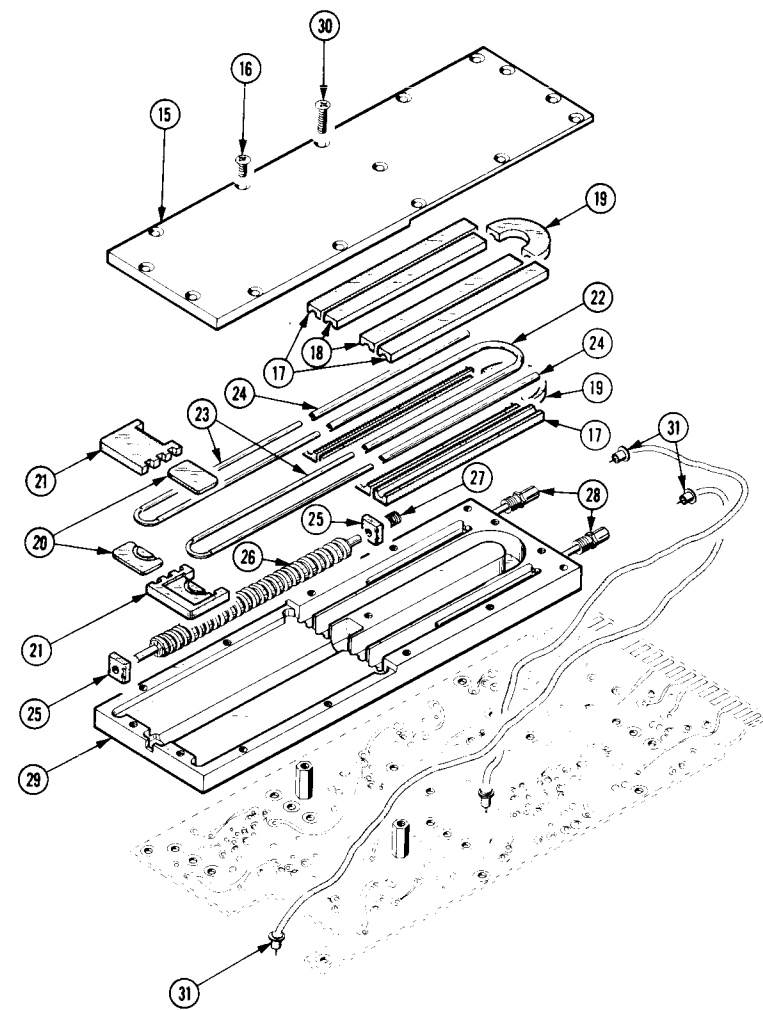
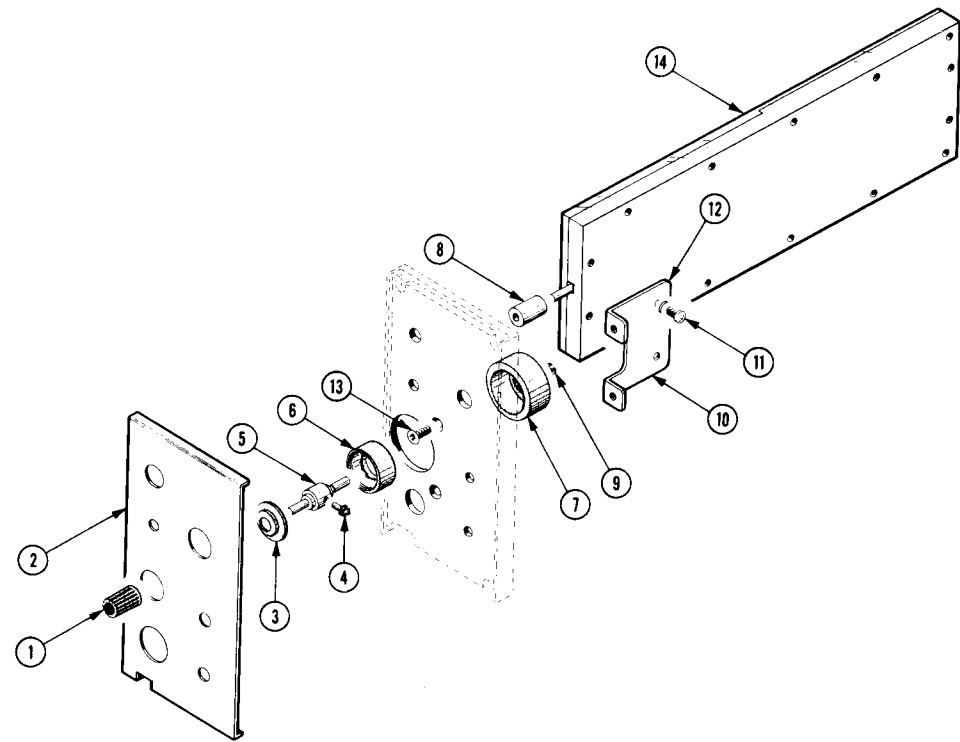




Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	366-1023-01		1		KNOB,GY,0.127 ID X 0.392 OD X 0.	80009	366-1023-01
-2	333-1544-00		1		PANEL,FRONT:	80009	333-1544-00
-3	354-0425-00		1		RING,INDICATOR: TURNS REDUCTION DRIVE	80009	354-0425-00
-4	401-0150-00		1		GEAR,SPUR: PLSTC,0.180 OD X 0.289 L	80009	401-0150-00
-5	384-0827-00		1		SHAFT,STRAIGHT:	80009	384-0827-00
-6	380-0271-00		1		HOUSING,IND: INNER,ACETAL	80009	380-0271-00
-7	380-0270-00		1		HSG,TURNS RDCN: OUTER,ACETAL	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 ***** (ATTACHING PARTS) *****	80009	407-1015-00
-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 S	83385	OBD
-13	211-0101-00		2		SCREW,MACHINE: 4-40 X 0.25,100 DEG,FLH STL ***** (END ATTACHING PARTS) *****	83385	OBD
-14	-----		1		DELAY LINE,ELEC: VARIABLE (SEE DL13 REPL)		
-15	200-1315-00	B010100	B019999	1	.COVER,DLY LINE:	80009	200-1315-00
	200-1315-01	B020000	B043899	1	.COVER,DLY LINE:	80009	200-1315-01
-16	211-0038-00	B010100	B019999	9	.SCREW,MACHINE: 4-40 X 0.312,FLH,100 DEG	83385	OBD
	211-0038-00	B020000	B043899	11	.SCREW,MACHINE: 4-40 X 0.312,FLH,100 DEG	83385	OBD
-17	352-0294-00	B010100	B043899	4	.HOLDER,DELAY LI: POLYETHYLENE	80009	352-0294-00
-18	352-0295-00	B010100	B043899	4	.HOLDER,DELAY LI: POLYETHYLENE	80009	352-0295-00
-19	352-0297-00	B010100	B043899	1	.HOLDER,DELAY LI: POLYETHYLENE	80009	352-0297-00
-20	200-1311-00	B010100	B043899	2	.CAP,DRIVE BLOCK: VARIABLE DELAY LINE	80009	200-1311-00
-21	391-0095-00	B010100	B043899	2	.GEAR RACK: NAT PLSTC,LEFT AND RIGHT	80009	391-0095-00
-22	119-0315-00	B010100	B043899	1	.DELAY LINE,ELEC:	80009	119-0315-00
-23	119-0314-00	B010100	B043899	2	.DELAY LINE,ELEC: MOVING	80009	119-0314-00
-24	119-0316-00	B010100	B019999	2	.DELAY LINE,ELEC: STRAIGHT	80009	119-0316-00
-25	401-0148-00	B010100	B043899	2	.BEARING,PR SCR: PLASTIC,0.490 L X 0.140 W	80009	401-0148-00
-26	384-0895-00	B010100	B043899	1	.SHAFT,STRAIGHT: 4.475 L X 0.375 OD,AL	80009	384-0895-00
-27	214-0966-00	B010100	B043899	1	.SPRING,HLCPS: 0.212 OD X 0.438 L,SST	80009	214-0966-00
	131-0850-00	B010100	B019999	2	.CONN,FEEDTHRU: 3MM FEMALE EA END	26805	2084-5059-02
-28	103-0156-00	B010100	B019999	2	.ADAPTER,CONN: DELAY LINE	80009	103-0156-00
	131-1304-00	B020000	B043899	2	.CONTACT,ELEC: VARIABLE DELAY LINE	80009	131-1304-00
-29	380-0267-00	B010100	B019999	1	.HSG,DELAY LINE: ALUMINUM	80009	380-0267-00
	380-0267-01	B020000	B043899	1	.HSG,DELAY LINE: ALUMINUM **** (ATTACHING PARTS FOR DELAY LINE) ****	80009	380-0267-01
-30	211-0106-00			2	SCREW,MACHINE: 4-40 X 0.625" 100 DEG,FLH,ST ***** (END ATTACHING PARTS) *****	83385	OBD
	131-0888-00	B010100	B019999	2	CONNECTOR,PLUG: MALE	26805	2031-5006-95
	131-0977-00	B010100	B019999	1	CONNECTOR,PLUG: RIGHT ANGLE,MALE	98291	050-628-9188-310
-31	210-0774-00	B010100	B019999	1	EYELET,METALLIC: 0.152 OD X 0.245 INCH L,BR	80009	210-0774-00
	210-0774-00	B020000		3	EYELET,METALLIC: 0.152 OD X 0.245 INCH L,BR	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	No. 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



## **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.



Date: June 20, 1983 Change Reference: M51648

Product: 7A19 Manual Part No.: 070-2129-00

**DESCRIPTION**

EFF SN B065430

**REPLACEABLE ELECTRICAL PARTS CHANGES**

CHANGE TO:

S135                      263-1096-01                      SW CAM ACTR AS:VOLTS/DIV

