TEKTRONIX

# INSTRUCTION MANUAL

## TYPE H PLUG-IN UNIT

# PLUG-IN PREAMPLIFIER
# TYPE H

# INSTRUCTION MANUAL

CIRCUIT DIAGRAM

ABBREVIATIONS & WARRANTY

NOTE

THE CONTENTS OF THIS MANUAL APPLY EQUALLY TO THE TYPE 53/54H UNIT AND THE TYPE H UNIT. REFERENCES TO THE TYPE H UNIT IN THE MANUAL SHOULD NOT BE CONSTRUED AS CONFINING THE CONTENTS TO INSTRUMENTS BEARING THIS DESIGNATION.


CTURERS OF CATHODE-RAY AND VIDEO TEST INSTRUMENTS

Sunset Highway and Barnes Road • P. O. Box 831 • Portland 7, Oregon, U. S. A.

Phone: CYpress 2-2611 • Cables: Tektronix

110-008


TYPE H SERIAL NUMBER 1102

# PLUG-IN PREAMPLIFIER
# TYPE H

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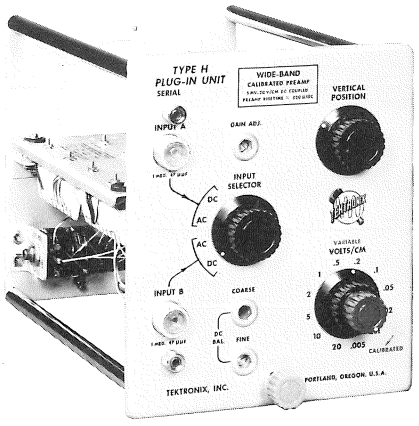
# CONTENTS

# SECTION 1
# DESCRIPTION




The Type H Plug-In Unit is a dc-coupled, high-gain, wide-band, calibrated preamplifier, designed for use with Tektronix 530-, 540-, and 550-Series oscilloscopes.

## TRANSIENT RESPONSE AND PASSBAND

| | Risetime | Passband | |
|---|---|---|---|
| With Instrument Type | INPUT SELECTOR switch in any position | INPUT SELECTOR switch in either DC position | INPUT SELECTOR switch in either AC position |
| 541<br>543<br>545<br>555 | .023 μsec | DC to 15 Mc | 2 cps to 15 Mc<br>.2 cps to 15 Mc with P410 Probe |
| 551 | .025 μsec | DC to 14 Mc | 2 cps to 14 Mc<br>.2 cps to 14 Mc with P410 Probe |
| 533 | .031 μsec | DC to 11 Mc | 2 cps to 11 Mc<br>.2 cps to 11 Mc with P410 Probe |
| 531<br>535<br>536 | .037 μsec | DC to 9.5 Mc | 2 cps to 9.5 Mc<br>.2 cps to 9.5 Mc with P410 Probe |
| 532 | .07 μsec | DC to 5 Mc | 2 cps to 5 Mc<br>.2 cps to 5 Mc with P410 Probe |

Your instrument was adjusted at the factory for optimum transient response. The above table summarizes the risetime and approximate passbands available when the plug-in used in combination with various oscilloscopes.

## OTHER CHARACTERISTICS

### Deflection Factor

.005 v/cm to 20 v/cm, in twelve fixed calibrated steps.

.005 v/cm to 50 v/cm, continuously variable.

### Step Attenuator (VOLTS/CM switch)

A front-panel adjustment is provided for setting the gain of the amplifier. When this adjustment is accurately set, with the VOLTS/CM switch in the .005 position, the vertical-deflection factor for any other position of the switch will be within 3%of the panel reading for that position.

### Maximum allowable combined dc and peak ac input

Voltage: 600 v

### Input Characteristics

Input of plug-in unit: 1 megohm shunted by 47 $\mu\mu$f.

Input of Type P410 probe: 10 megohms shunted by 8 $\mu\mu$f.

### Mechanical

Construction: Aluminum-alloy chassis.

Finish: Photoetched, anodized panel.

Weight: 3½ lbs.

## FRONT-PANEL CONTROLS

THE GAIN ADJ. CONTROL is a screwdriver front-panel control for setting the gain of the plug-in unit and thereby the calibration of the VOLTS/CM switch.

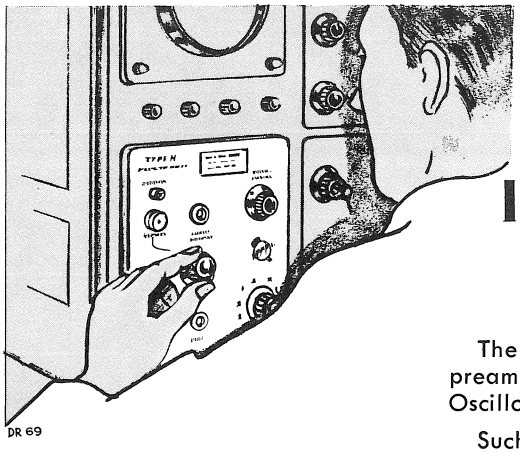
THE VERTICAL POSITION CONTROL is used to position the trace vertically on the face of the oscilloscope screen.

THE INPUT SELECTOR SWITCH is a 4-position switch to select AC or DC coupling from either input connector.


THE INPUT CONNECTORS (Input A, Input B,) coaxial connections for accepting waveforms to be displayed on the oscilloscope screen.

THE DC BALANCE CONTROLS (COARSE and FINE) are front-panel screwdriver controls to be adjusted by the operator to prevent a vertical shift in the crt displays when the VARIABLE CONTROL is rotated.

THE VOLTS/CM SWITCH provides fixed calibrated vertical-deflection factors when the associated VARIABLE CONTROL is set to CALIBRATED. The VARIABLE CONTROL provides continuously variable (uncalibrated) vertical deflection factors between those provided on the VOLTS/CM switch.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# SECTION 2
# OPERATING INSTRUCTIONS

The Type H Plug-In Unit is designed to operate as a preamplifier for Tektronix 530-, 540-, and 550-Series Oscilloscopes.

Such factors as tube aging or handling in shipment can result in a need for readjusting the DC Balance and Gain adjustments of the Type H Preamplifier unit. This can be important when you are making amplitude measurements. We suggest that you check these adjustments when first putting your unit into operation, and periodically thereafter. The adjustment procedures are explained in a later section of these operating instructions.

## INPUT COUPLING

The waveform to be examined may be either ac-or dc-coupled to the oscilloscope. To display both the ac component and the dc component of the waveform, set the INPUT SELECTOR switch to the DC position (for the input connector being used); to display only the ac component of the waveform, set the INPUT SELECTOR switch to the AC position (for the input connector being used).

## DEFLECTION FACTOR

The VOLTS/CM switch controls the vertical deflection factor in accurately calibrated steps. The VARIABLE control provides continuous adjustment of the deflection factor.

NOTE: To make the deflection factor equal to that indicated by the VOLTS/CM switch, set the VARIABLE control to the CALIBRATED position.

## CONNECTING THE OSCILLOSCOPE TO THE SIGNAL SOURCE

Here are some precautions you should observe in connecting your oscilloscope to the source of signals to be displayed.

1. Avoid errors in readings due to stray electric or magnetic coupling between circuits, particularly in the leads connected to the plug-in input circuits. In general, unshielded leads of appreciable length are unsuited to this use. This is true even in the audio-frequency range, except possibly at very low frequencies. (For example, a lead which passes near the crt screen might pick up ripple from the high-voltage supply.) When shielded leads are used, the shields should be grounded to the oscilloscope chassis and to the chassis of the equipment being tested. Coaxial cables are recommended for many purposes.

**2.** In broadband applications, it might be necessary to terminate a coaxial cable with a resistor or an attenuating pad presenting a resistance equal to the characteristic impedance of the cable. This is to prevent resonance effects and ringing—that is, high-frequency damped oscillation. It becomes more necessary to terminate the cable properly as the length of the cable is increased. The termination is generally placed at the oscilloscope end of the cable, although many sources require an additional termination at the source end of the cable as well.

**3.** As nearly as possible, simulate actual operating conditions in the equipment being tested. For example, the equipment should work into a load impedance equal to that which it will see in actual use.

**4.** Consider the effect of loading upon the signal source due to the input circuit of the plug-in-preamplifier. The input circuit can be represented by a resistance of 1 megohm shunted by a capacitance of 47 $\mu\mu$f. In some cases, the effects of these resistive and capacitive loads are not negligible, and to minimize them, you might want to use a probe in the manner described in the next section.

## USE OF PROBES

An attenuator probe lessens both capacitive and resistive loading, at the same time reducing sensitivity. The attenuation introduced by the probe permits measurements of signal voltages in excess of those that can be accommodated by the preamplifier alone. When making amplitude measurements with an attenuator probe, be sure to multiply the observed amplitude by the attenuation of the probe (marked on the probe).

The Type P410 probe, furnished with the 540- and 550-Series oscilloscopes, can be used with the Type H Plug-In Unit in the 530-, 540-, or 550-Series oscilloscopes. The attenuation ratio of this probe is 10 to 1. The probe preserves the transient response inherent in the oscilloscope-plug-in combination, and introduces no ringing. Its use results in an additional frequency-response loss of about 1db at 30 mc.

The Type P510A probe, furnished with the 530-Series oscilloscopes, has an attenuation ratio of 10 to 1. It should be used with the Type H Plug-In only when the preamplifier is used in a 530-Series oscilloscope. If you try to use the Type P510A probe with a 540-Series oscilloscope to observe fast-rising pulses, the tendency of the probe to ring at about 50 mc will become apparent in the oscilloscope display.

To preserve the waveform of the signal being displayed, it is generally necessary to clip the probe ground lead to the chassis of the equipment being tested. Select a ground point near the probe input connection.

**Before using the probe, always check its adjustment.**

An adjustable capacitor in the probe body compensates for variations in input capacitance from one instrument to another. This is to insure the accuracy of pulse and transient measurements. Touch the probe tip to the calibrator output connector and adjust the oscilloscope controls to display several cycles of the waveform. Adjust the probe capacitor for a flat top on the calibrator square wave, as shown in the right-hand drawing of Fig. 2-1.

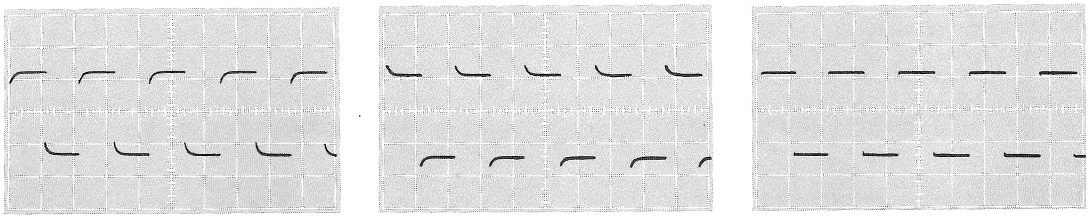



**Fig. 2-1. Adjusting the probe.**
The variable capacitor in the probe body should be adjusted so that the display of the Calibrator waveform has a flat top as shown in the right-hand picture.

## VOLTAGE MEASUREMENTS

We describe here two categories of voltage measurements with the Type H Plug-In Unit: (1) measurement of the peak-to-peak voltage of a displayed waveform and (2) measurement of the peak voltage of a waveform with respect to a reference voltage. The specific examples that follow are intended to show the general procedure. These examples can be modified to suit any particular application.

### How to measure the peak-to-peak voltage.

Suppose a given waveform produces the trace shown in Fig. 2-2 when a 10X probe is used and the plug-in controls are set as follows:

| | |
|---|---|
| INPUT SELECTOR switch | AC |
| VOLTS/CM | .05 |
| VARIABLE | CALIBRATED |

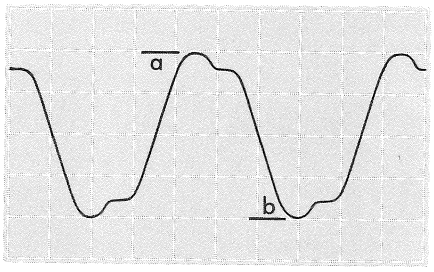



**Fig. 2-2. Measuring peak-to-peak voltage.** The text explains how the calibrated VOLTS/CM switch may be used to measure the peak-to-peak voltage of the typical waveform shown above.

The first step in measuring the peak-to peak voltage of this waveform is to measure the amount of vertical deflection. The distance from point a, the positive peak, to point b, the negative peak, is 4 cm. Multiply this figure by the VOLTS/CM setting, .05, and the result is .2 volt. This figure represents the voltage present at an INPUT connector of the plug-in unit. Multiply this result by 10—the attenuation ratio of the probe. This gives 2 volts as the peak-to-peak voltage of the displayed waveform.

### How to measure a peak waveform voltage with respect to ground.

Set the INPUT SLECTOR switch to DC, and set the VARIABLE control to CALIBRATED. Adjust the oscilloscope for a free-running trace. Touch the probe tip to the oscilloscope ground terminal. Use the VERTICAL POSITION control to set the trace to a convenient position, such as b in Fig. 2-3. Next, disconnect the probe tip from the ground terminal and connect it to the waveform source without disturbing the VERTICAL POSITION control. Adjust the oscilloscope controls for a stable display. Observe the vertical distance between the peak waveform voltage a and the original trace position b. If this distance is inconveniently large or small, reset the VOLTS/CM switch to a more suitable position and repeat the above procedure.

As an example, suppose the vertical distance between a and b is 4 cm when a 10X probe is used and when the VOLTS/CM switch is set at .1. Multiply the distance between a and b (4 cm) by the VOLTS/CM setting (.1 v/cm) and by the probe attenuation ratio (10). This shows the peak voltage of the waveform with respect to ground to be 4 volts.

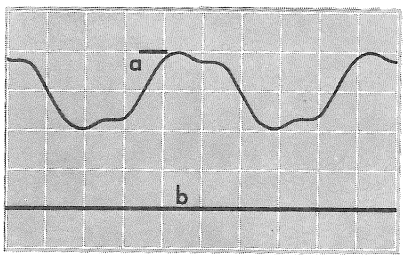



**Fig. 2-3. Measuring a voltage with respect to ground.** The text explains how the voltage difference between point "b" (ground) and point "a" may be measured with the aid of the calibrated VOLTS/CM switch.

## GAIN ADJUSTMENT

The gain adjustment should be checked periodically because aging of the tubes will affect the gain of the plug-in unit. This is done by setting the controls as follows:

| | |
|---|---|
| VOLTS/CM | .005 |
| VARIABLE | CALIBRATED |
| INPUT SELECTOR | INPUT A AC |
| CALIBRATOR (red knob) | MILLIVOLTS |
| CALIBRATOR (black knob) | 20 |

Connect a lead from the output connector of the oscilloscope square-wave calibrator to the Type H INPUT A connector. Set the oscilloscope controls for a stable display of the calibrator waveform. Adjust the GAIN ADJ. control so that the vertical deflection is four major graticule divisions.

## DC BALANCE ADJUSTMENT

The need for adjustment of the DC BAL. controls is indicated by a vertical shift in the position of the trace as the VARIABLE control is rotated.

This adjustment should be made as follows:

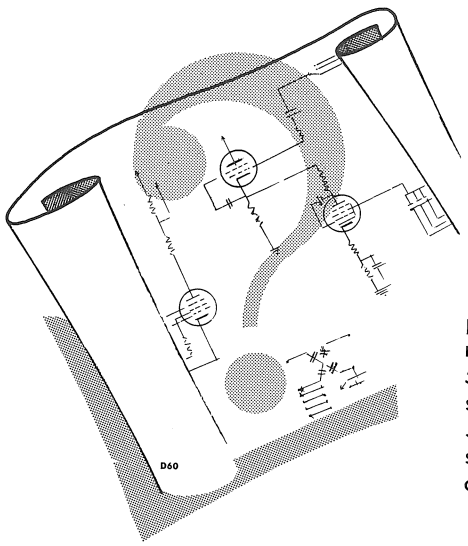
1. Adjust the GAIN ADJ. control as described previously.

2. Connect a lead from the INPUT A connector to ground, and set the INPUT SELECTOR switch to INPUT A AC. Adjust the oscilloscope controls for a free-running trace.

3. Slowly rotate the VARIABLE control back and forth, and adjust the COARSE DC BAL. control for the least amount of vertical shift.

It may be necessary to adjust the VERTICAL POSITION control at the same time to keep the trace in view.

4. Continue rotating the VARIABLE control slowly, and adjust the FINE DC BAL. control until the trace position is no longer affected by the rotation.




# SECTION 3

# CIRCUIT INFORMATION

**The Type H Plug-In Unit is a wide-band, fast-rise preamplifier with dc-coupling over its full sensitivity range. It provides a maximum deflection factor of 5 mv/cm, dc-coupled, with excellent transient response, and may be used with any Tektronix 530-, 540- or 550-Series oscilloscope. It consists of two stages of push-pull amplification, each followed by a cathode-follower.**

## INPUT CIRCUIT

The Type H Preamplifier Plug-In Unit requires an input-signal voltage of .005 volts, peak-to-peak, to produce one centimeter of **calibrated** deflection on the crt of the oscilloscope. To satisfy this condition, yet make the unit applicable to larger input voltages, a precision attenuation network is employed ahead of the amplifier circuits.

When the VOLTS/CM SWITCH is in the .005 position, the signal is coupled "straight through" (that is, without attenuation) to the grid of V3854, one-half of the Input Amplifier stage. For settings of the VOLT/CM switch between .01 and 20, the Attenuators are switched into the circuit, either singly or in tandem pairs, so that the input signal voltage to the Input Amplifier is always .005 v for each centimeter of crt deflection when the VARIABLE knob is in the CALIBRATED position.

The Attenuators are frequency-compensated voltage dividers. For dc and low-frequency signals they are resistance dividers, and the degree of attenuation is determined by the resistance values. The impedance of the capacitors, at dc and low frequencies, is so high that their effect in the circuit is negligible. As the frequency of the input signals increases, however the impedance of the capacitors decreases and their effect in the circuit becomes pronounced. For high-frequency signals the impedance of the capacitors is so low, compared to the resistance of the circuit, that the Attenuators become capacitance dividers.

In addition to providing the proper degree of attenuation, the resistance values of the Attenuators are chosen so as to provide the same input resistance (1 megohm) regardless of the setting of the VOLTS/CM switch. Moreover, the variable capacitor, at the input to each Attenuator, provides a means of adjusting the input capacitance so that it is also the same value (47 micromicrofarads) for all settings of the switch.

Two INPUT connectors, with more than 60-db. isolation between them, are provided on the Type H Plug-In Unit. By means of the INPUT SELECTOR switch, either connector (INPUT A or INPUT B) can be switched into the circuit. In addition, either INPUT connector can be ac- or dc-coupled to the Attenuator circuits, depending on the setting of the INPUT SELECTOR switch. In the AC positions of the switch, the signal is coupled through C3804. In the DC positions, C3804 is bypassed with a direct connection.

## INPUT AMPLIFIER

The Input Amplifier (V3854-V4854) is a cathode-coupled phase inverter stage. That is, it converts a single-ended input signal to a push-pull output signal. The input signal is applied to the grid of V3854. R3846 is the input grid resistor. (This resistor becomes a part of each attenuation network when the VOLTS/CM switch is turned away from the .005 position). R3850, bypassed by C3850, prevents the grid from drawing excessive current (in the event the stage is overdriven) when DC input-coupling is used. R3851 is a suppressor for parasitic oscillations.

The time constant network R3855, R3856 and C3855, located in the cathode circuit of V3854, compensates for the tendency of cascaded amplifiers to produce a rolloff at the leading corner of fast-rise pulses. R3856 provides a means for adjusting the compensation for optimum results.

V4854 operates as a grounded-grid amplifier; its input signal is developed across the cathode resistors R3857-R3858. The signal produced at the plate of V4854 is equal in amplitude, but opposite in polarity, to the signal developed at the plate of V3854. Hence, a push-pull output signal is produced in the plate circuit of the Input Amplifier stage.

In addition to furnishing one-half of the push-pull output signal from the Input Amplifier stage, V4854 also couples a manually adjustable dc voltage from the DC BAL controls to the grid of V3863B. The function of this dc voltage will be explained a bit later.

The peaking coils in both plate circuits of the Input Amplifier compensate the stage for the high-frequency attenuation produced by the tube and stray capacitance in the circuit. The variable inductors (L3853-L4853) provide a means for adjusting the stage for optimum transient response.

The First C.F. stage, V3863, serves two important functions: The grid circuits presents a high-impedance, low-capacitance load to the Input Amplifier; the cathode circuits provide the necessary low impedance to drive the input capacitance of the Output Amplifier. The interstage peaking coils, L3871 and L4871, provide peaking for the leading edge of fast vertical signals.

## OUTPUT AMPLIFIER

The Output Amplifier stage (V3874-V4874) contains two gain adjustments. The VARIABLE control R3878 (front-panel adjustment) regulates the gain over a $2\frac{1}{2}$ to 1 range by varying the degeneration in the cathode circuit. The GAIN ADJ. R3880 (screw-driver adjustment) varies the current flowing through the tubes. This varies the transconductance of the tubes and thus regulates the gain. The GAIN ADJ. control is adjusted so that the amount of crt deflection agrees with the setting of the VOLTS/CM switch, when the VARIABLE knob is turned full right (CW) to the CALIBRATED position.

In order that there will be no vertical shift of the crt beam as the VARIABLE control is adjusted, the voltages at the cathodes of the Output Amplifier must remain equal and constant. When the VARIABLE control is turned full right to the CALIBRATED position there is zero resistance between the two cathodes, and the cathode voltages will of course be equal. As the control is turned away from the CALIBRATED position, however, the resistance between the two cathodes will increase. If no provisions were made to insure that the cathode voltages remain constant, the added resistance could produce a difference in potential between the two cathodes which would result in a vertical shift of the crt beam. By means of the DC BAL. controls, however, the voltage at the cathode of V4874 can be adjusted to equal the voltage at the cathode of V3874, when the VARIABLE control is adjusted for maximum resistance. The DC BAL. controls R4831 (COARSE) and R4835 (FINE), together with R4841 and R4842, form a divider to set the voltage at the grid of V4854. This dc voltage is coupled through the cathode follower V3863B to the grid, and then to the cathode, of V4874. When these controls are properly adjusted, the cathodes of the Output Amplifier will remain at the same potential as the VARIABLE control is rotated, and no vertical shift of the crt beam will result.

(Note: The DC BAL. controls are actually used to balance the entire vertical deflection system in the oscilloscope. Their precise function is to insure that the dc potential between the vertical deflection plates does not vary as the VARIABLE control is rotated through its range. However, if the main Vertical Amplifier in the oscilloscope, and the Output C.F. in the plug-in unit, are in the proper state of balance, the DC BAL controls

may be adjusted so that the potentials at the cathodes of the Output Amplifier remain equal and constant as the VARIABLE control is rotated.)

Additional high-frequency compensation occurs in the plate circuits of the Output Amplifier. A fixed amount of compensation is provided by L3873 and L3891 in one plate circuit, and by L4873 and L4891 in the other. The variable inductors L3874 and L4874, and the variable capacitors C3873 and C4873, provide a means for adjusting the compensation for optimum results.

Vertical positioning of the crt beam is accomplished through the action of the VERTICAL POSITION control R3885 (front-panel adjustment) and the VERT. POS. RANGE control R3886 (screwdriver adjustment). These control circuits are identical, so a description of one will be applicable to the other. The VERT. POS. RANGE control is a dual control, connected between +225 v and ground. It is connected electrically so that as the voltage between ground and the movable arm in one increases, the voltage between ground and the movable arm in the other decreases. The voltage at each arm of the control can vary a maximum of 225 volts, as the control is adjusted. This 225-volt variation is attenuated by a factor of 330 to 1.6 (the ratio of R3887 to R3874 on one side, and the ratio of R4887 to R4874 on the other) so that the maximum variation in voltage at the grids of V3893 is about 1 volt. This change in grid voltage at the Output C.F. stage will be reflected as a change in vertical deflection-plate voltage at the crt, since direct coupling is used between these two points. The VERT. POS. RANGE control is adjusted to center the crt beam vertically when the VERTICAL POSITION control is set to mid-scale.

The Output C.F. stage operates much the same as the First C.F. stage. That is, it provides a high-impedance, low-capacitance load to the Output Amplifier, and provides the necessary low impedance to drive the capacitance of the Interconnecting Plug and the input capacitance of the main Vertical Amplifier in the oscilloscope.

There is additional "leading edge" peaking in this stage. Peaking coils L3896 and L4896 form a series-resonant circuit, in their respective circuits, with the stray capacitance. These series circuits are damped by the cathode impedance of each side of V3893. Due to the fairly large cathode resistors employed (9.1K), the cathode impedance is approximately equal to the reciprocal of the transconductance of the tube (1/Gm). By varying the current through the tube, the H.F. PEAKING control (R3897) can vary the transconductance, thereby varying the effect of the peaking circuits. Cross-coupling capacitors C3894 and C4894 also contribute to the high-frequency response of the stage. These capacitors tend to provide a 180-degree phase differential between the signals developed in the cathode circuits, even though the grid signals may not be 180 degrees out of phase.

## HEATER CIRCUIT

The heaters in the Type H Plug-In Unit are supplied with direct current from the +100-volt regulated supply. This prevents the possibilty of 60-cycle cathode modulation, which might result if the heaters were supplied with alternating current.

Power for the heater circuit (+75 v at 150 ma) is obtained from pin 15 of the Interconnecting Plug. The manner in which this power is obtained from the +100-volt regulator is shown in Fig. 3-1. For those instruments employing Delaying Sweep, the heaters of two of the tubes in

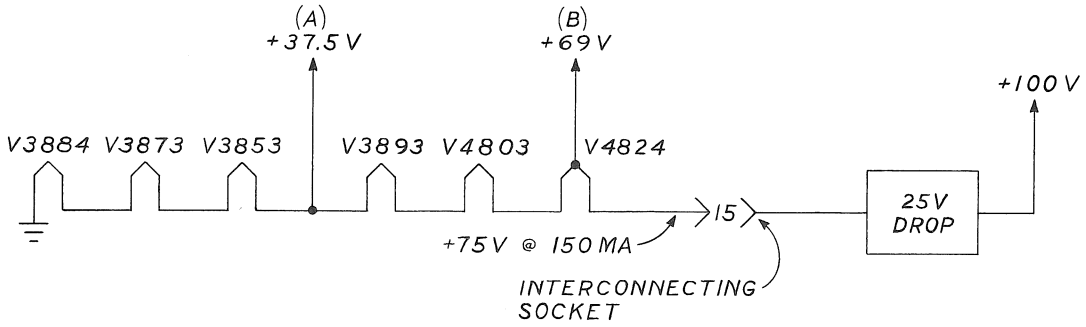
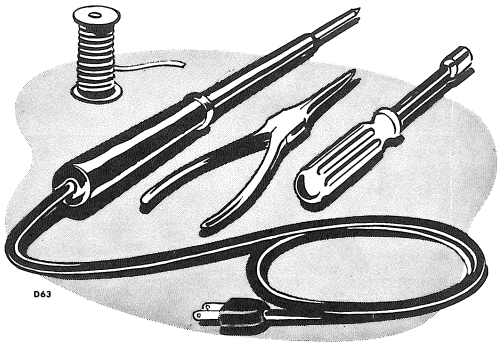



Fig. 3-1. Heater Circuit

the Delaying Sweep Generator are connected in series with the heater circuit of the Plug-In unit to provide the necessary 25-volt drop. In those instruments employing only one Sweep Generator, a resistor connected between the heater string and the +100-volt bus provides the necessary drop.

The heater circuit also provides a constant voltage source for the amplifier tubes; point (A) provides +37.5 volts for the plate circuit of the Input Amplifier, and point (B) provides +69 volts for the plate circuit of the Output Amplifier. The heater circuit does not supply any current for the amplifier tubes; it simply acts as a low-impedance divider to "fix" the voltage at points (A) and (B).




# SECTION 4
# MAINTENANCE

**NOTE**
Always include the instrument TYPE and SERIAL NUMBER in any correspondence concerning the instrument.

## REPLACEMENT PARTS

### Standard Parts

Replacement parts for the Type H Plug-In Unit can be obtained from Tektronix at current net prices. However, since most of the components are standard electronic or radio parts, they can usually be obtained locally in less time than required to obtain them from the factory. There are a few exceptions to this, and these are noted in the Parts List. Before ordering or purchasing parts, be sure to consult the Parts List to determine the tolerances required.

### Aged and Selected Tubes

To obtain maximum reliability and performance, we check some of the tubes used in our instruments for such characteristics as $G_m$, microphonics, balance, etc. We age other tubes to stabilize their characteristics. The checked tubes are labeled and identified with a part number beginning with 157-_____. The 12AU6 tubes in the Input Amplifier stage are aged and checked for $G_m$ and grid current. These tubes are assigned the part number 157-050. The 12AU6 tubes in the Output Amplifier are aged and checked for $G_m$; they are assigned the part number 157-038. We suggest that you obtain these checked tubes, for replacment purposes, from the factory or from your local Tektronix field office.

Raw-stock...that is, unchecked tubes... are unlabeled tubes assigned the part number 154-_____. The 12AT7 tubes in the cathode-follower stages are raw-stock tubes. However, since the Type H Unit is a fast-rise preamplifier, tubes that develop a cathode-interface layer can be a source of trouble. To be assured of optimum transient response, be sure that any 12AT7 tubes used as replacements are good quality tubes.

### Tektronix-Manufactured Parts

Tektronix manufactures almost all of the mechanical parts, and some of the electronic components, used in this instrument. When ordering mechanical parts be sure to describe the part fully to prevent delays in filling your order. Your local Tektronix Field Engineer will be pleased to assist you.

The Tektronix-manufactured electronic components are identified in the Parts List. These components, as well as the mechanical parts, must be obtained from the factory or from your local Tektronix field office.

Since the production of your instrument, some of the Tektronix-manufactured components or parts may have been superceded by a newer, improved component or part. The part number of these newer components will not be listed in the Parts List. If you order a Tektronix-manufactured component, and if it has been superceded by a newer, improved component the new component will be shipped in place of the original

one. Your local Tektronix field office has knowledge of these changes and may call you if a change in your purchase order is necessary.

Where necessary, replacement-information notes accompany the improved component to aid in its installation.

### Parts Ordering Information

You will find a serial number on the frontispiece of this manual. This is the serial number of the instrument for which this manual was prepared. Be sure that the number in the manual matches the serial number of the instrument.

Each component in this instrument has a six-digit Tektronix part number. This number, together with a description of the part, will be found in the Parts List. When ordering parts, be sure to include both a description of the part as well as the part number. For example, a certain resistor should be ordered as follows: R3878, a 660-ohm VARIABLE control, part number 311-140, for a Type H Plug-In Preamplifier serial number _____. When parts are ordered in this manner, we are able to fill your order promptly and delays that might result from transposed numbers in the part number are avoided.

### Soldering Precautions

In the production of Tektronix instruments a special silver-bearing solder is used to establish a bond to the ceramic terminal strips. This bond may be broken by repeated use of ordinary tin-lead solder, or by the application of too much heat. However, occasional use of ordinary solder will not break the bond if too much heat is not applied.

In shops responsible for the maintenance of several Tektronix instruments, it is advisable to have a stock of solder containing about 3% silver. This type of solder is used frequently in printed circuitry and should be readily available. Or it can be purchased directly from Tektronix in one-pound rolls (order by part number 002-664).

## TROUBLESHOOTING PROCEDURE

### General Information

Any defect that may be apparent in the crt display of an oscilloscope, or the absence of a display, may be due to a malfunction in either the plug-in unit or the oscilloscope itself. The faulty unit can readily be determined by inserting another plug-in unit, known to be in operating condition, into the oscilloscope and checking the results. If the trouble is still apparent it can be assumed that the original plug-in unit is not at fault and that the trouble lies somewhere within the oscilloscope. However, should the trouble appear to have been corrected, it is almost a certainty that the defect lies within the plug-in unit itself.

Tube failure is the most prevalent cause of circuit failure. For this reason, the first step in troubleshooting any circuit is to check for defective tubes, preferably by direct substitution. Do not depend on tube testers to adequately indicate the suitability of a tube for certain positions in the instrument. The criterion for usability of a tube is whether or not it performs satisfactorily in the instrument. Be sure to return any tubes found to be good to their **original** socket. If this procedure is followed, less recalibration of the instrument will be required upon completion of the servicing. (See "Aged and Selected Tubes," Page 4-1.)

If replacement of a defective tube does not correct the trouble, then check that components through which the tube draws current have not been damaged. Shorted tubes will often overload and damage plate load and cathode resistors. These components can sometimes be detected by a visual examination of the circuit. If no damaged components are apparent, however, it will be necessary to make measurements or other checks within the circuit to locate the trouble.

The first step in troubleshooting a Type H Plug-In Unit, after determining that tubes are not at fault, is to determine the stage in which the trouble is being produced. The procedure for this will be explained in the section on trouble analysis that follows. Once the trouble has been isolated to a particular stage, the component(s) causing the trouble can be found by voltage and resistance measurements, short and continuity checks, or component substitution.

## Trouble Analysis and Circuit Isolation

Troubles that can be caused by a malfunctioning or improperly adjusted Type H Unit are:

1. Loss of trace.
2. Inability to position the trace.
3. No waveform display (horizontal trace present).
4. Insufficient vertical gain.
5. Waveform distortion.

This section contains information for isolating the source of each type of trouble to a particular stage, and in some instances to a particular component. The Circuit Description may prove useful when troubleshooting within a particular stage.

It will be necessary to remove the left side cover and the bottom plate from the oscilloscope to troubleshoot the plug-in unit.

### 1. Loss of trace

For the beam to be visible on the crt, the dc output voltages (at pins 1 and 3 of the interconnecting plug) must be essentially equal... that is, within a fraction of a volt. As little as a 0.2-volt difference between these two points may position the beam above or below the range of visibility.

The dc output voltages depend on the dc balance of the amplifier. Since the amplifier is dc-coupled from input to output, a condition anywhere between these two points that will unbalance the output voltages more than 0.2 volt may cause a loss of the trace. A possible cause of this condition would be an improper adjustment of either or both of the DC BAL controls. To check the settings of these controls, proceed as follows:

a. Adjust the oscilloscope Time Base controls for a free-running sweep.
b. Set the FINE DC BAL. control to the center of its range.
c. Adjust the COARSE DC BAL control slowly, observing the crt to see if the trace appears. If the trace appears during this check, adjust the controls in accordance with the instructions in the Operating Instructions section of this manual.

Another cause of this trouble could be an improper adjustment of the VERT. POS. RANGE control R3886. The setting of this control can be checked as follows:

a. Adjust the oscilloscope Time-Base controls for a free-running sweep.
b. Set the VERTICAL POSITION control to the center of its range.
c. Adjust the VERT. POS. RANGE control slowly, observing the crt to see if the trace appears. If the trace appears during this check, adjust the control in accordance with the instructions in the Recalibration Procedure.

If the loss of the trace is not due to an improper control adjustment, the dc unbalance is being produced by defective tubes, defective cathode, screen and plate resistors, shorted or leaky capacitors, open peaking coils, or improper resistance ratios in the voltage dividers. A step by step isolation procedure can then be used to determine the stage in which the unbalance is being produced. This procedure is accomplished by shorting together corresponding points on opposite sides of the amplifier, starting at the output and working back toward the Input Amplifier stage. For example, when pins 1 and 3 of the interconnecting plug are shorted together (with the Time-Base controls adjusted for a free-running trace) the voltages at these points will be equal and the trace will appear at or near the center of the crt. From this point, the shorting strap can be moved back, in successive steps, to

a. The cathodes (pins 3 and 8) of V3893.
b. The grids (pins 2 and 7) of V3893.
c. The plates (pin 5) of V3874 and V4874.
d. The grids (pin 1) of V3874 and V4874.
e. The cathodes (pins 3 and 8) of V3863.
f. The grids ( pins 2 and 7) of V3863.

Following this procedure a point will be reached where the trace cannot be made to appear when corresponding sides of the amplifier are shorted together. When this occurs, the defect has been isolated to the stage in which these points are located. For example, if the trace appears when the grids of the Output C.F. are shorted together, but does not appear when the plates of the Output Amplifier stage are shorted together, an open peaking coil L3874, L3891, L4874 or L4891 is indicated.

Whenever any points between the grids of the Output Amplifier and the grids of the First C.F. are shorted together, the effect of the vertical positioning controls must be considered. It will be necessary to check the adjustment of both the VERTICAL POSITION control and the VERT. POS. RANGE control when any points between these two stages are shorted together.

There is a possibilty that the loss of trace may be due to a defective heater circuit. This condition can be determined by observing the tubes in the plug-in unit for heater glow. If no glow is observed, it will most likely be due to an open heater in one of the tubes. Other possibilities are shorted capacitors C4821, C4823 and C4825.

### 2. Inability to position the trace

If a trace is visible on the crt, but it cannot be moved with the VERTICAL POSITION control, some defect that is rendering this control inoperative is indicated. If the trace can be moved with the VERT. POS. RANGE control, the VERTICAL POSITION control itself is probably defective. If the trace cannot be moved with the VERT. POS. RANGE control, however, the trouble will lie in some circuit following the Output Amplifier stage. The trouble could be an open H.F. PEAKING control R3897. It could also be a short between correspondingly-opposite sides of the amplifier; an examination of the lead dress, or a continuity check with an ohmmeter, would reveal this condition.

### 3. No waveform display (horizontal trace present)

If a horizontal trace is present on the crt, but you are unable to obtain a waveform display, an open circuit somewhere in the amplifier is indicated. However, since a horizontal trace is present, the defective component is one that does not affect the dc balance of the amplifier.

If the trace can be moved over its normal range with the VERTICAL POSITION control the trouble is occuring somewhere ahead of the plate circuit of the Output Amplifier stage. The trouble could be an open cathode resistor or an open screen divider in either the Input Amplifier or the Output Amplifier. If the trace cannot be moved with the VERTICAL POSITION control, the trouble will be originating in the output stage. This could be an open H.F. PEAKING control R3897.

### 4. Insufficient vertical gain

If the vertical deflection on the crt no longer corresponds to the calibrated value, a change in the gain characteristics of the plug-in is indicated. If only a small change in the gain has occurred, the unit can generally be recalibrated to restore the gain to its calibrated value. If the change in gain is more pronounced, however, a change of tubes or circuit components is indicated.

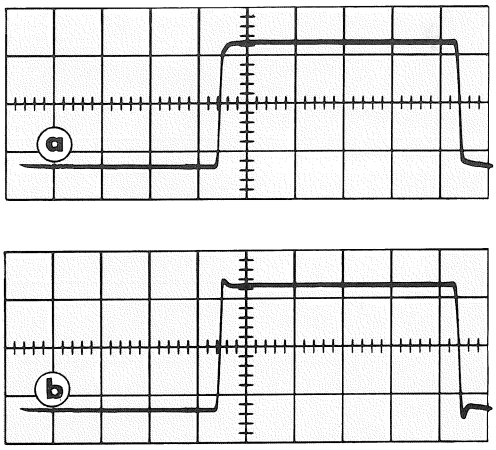



Fig. 4-1 Two types of high-frequency distortion: (a) rolloff, and (b) overshoot.

If tubes are causing the trouble, it will most likely be the 12AU6 tubes in either the Input Amplifier or the Output Amplifier stage. It is unlikely that the cathode-follower tubes will affect the gain to any large degree.

An open VARIABLE control will greatly decrease the gain of the Output Amplifier stage. The gain can also be decreased by an increase in the value of the cathode resistors, or by a change in the values of the screen dividers.

### 5. Waveform distortion

Any waveform distortion that may be produced by a Type H Unit will be of a high-frequency nature. There will be no low-frequency distortion, since the amplifier is dc-coupled from input to output (unless one or more of the tubes enter into heavy grid current, a condition that will produce other types of distortion as well).

High-frequency distortion will generally be manifest in either a rolloff or an overshoot at the leading corner of a fast-rise step function. Fig. 4-1(a) shows an example of rolloff. The tubes should first be checked for this type of distortion. If a tube cannot deliver current, instantaneously on demand, the high-frequency response of the amplifier will deteriorate. An improper adjustment of any of the peaking coils can produce a rolloff. A misadjusted H.F. PEAKING control can also produce a slight roll-

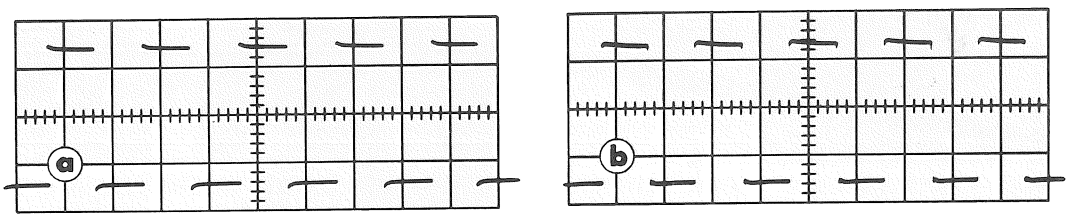
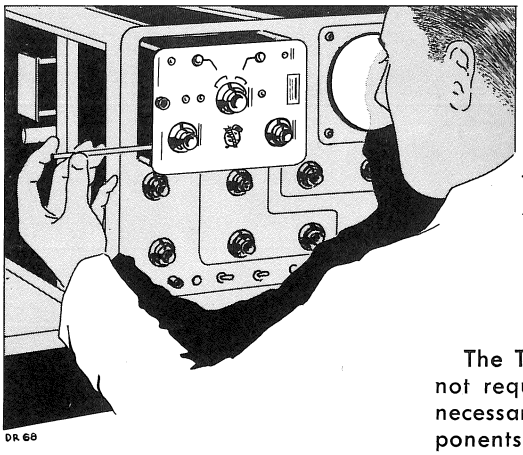



Fig. 4-2 Interface distortion: (a) 100-kc square wave at 5 μsec/cm; (b) 500-kc square wave at 1 μsec/cm.

off, but this will only be visible at the faster sweep rates. Shorted or partially shorted peaking coils are often a source of high-frequency rolloff; this condition is generally produced by hot solder falling on the coils. Be especially careful when soldering around any of the peaking coils.

Cross-coupling capacitors C3894 and C4894 are very important in maintaining the proper rise-time of fast-rise pulses. An open condition in either capacitor will seriously affect the high-frequency response.

Excessive high-frequency peaking, due to improper adjustment of the peaking controls, can produce the overshoot condition shown in Fig. 4-1(b). Refer to the Recalibration Procedure for the proper method of adjusting these controls. However, an overshoot at the leading edge of a fast-rise pulse is often the result of cathode interface in the amplifier tubes. Since the time constant of the interface layer is normally in the range from .1 to 3 μsec, the effect of interface is most noticeable on waveforms whose period is very long compared to the interface time constant. Fig. 4-2(a) shows the effect of interface on a 100-kc fast-rise pulse, with the oscilloscope sweep rate set for 5 μsec/cm. This same distortion is less noticeable on the 500-kc square wave, at a sweep rate of 1 μsec/cm, shown in Fig. 4-2(b). Since this type of distortion is produced by the tubes themselves, it is important that the tubes be checked when such distortion is evident.



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# SECTION 5

# RECALIBRATION

The Type H Unit is a stable preamplifier and should not require frequent recalibration. However, it will be necessary to check the calibration when tubes and components are changed, and a periodic check of the calibration is desirable from the standpoint of preventive maintenance. Minor operational deficiencies that may not be apparent in normal usage can often be detected during a calibration check.

## EQUIPMENT REQUIRED

The following equipment, or its equivalent, is required to check the calibration of the Type H Unit.

1. Tektronix Oscilloscope, Type 541, 543 or 545.

2. Tektronix Type 190 or 190A Constant-Amplitude Signal Generator.

   **Specifications:**

   **a. Sine-wave output, variable in frequency from 500 kc to at least 15 mc.**

   **b. Output amplitude of 15 mv, amplitude to remain constant over above frequency range.**

3. Tektronix Type 105 Square-Wave Generator

   **Specifications:**

   **a. Square-wave output, repetition rate of 1 kc and 450 kc.**

   **b. Output amplitude variable over the range from 17.5 mv to 17.5 v.**

   **c. Risetime not to exceed .02 $\mu$sec.**

4. 5:1 L Attenuator Pad (Tektronix Type B52-L5).

5. 10:1 L Attenuator Pad (Tektronix Type B52-L10).

6. 10:1 T Attenuator Pad (Tektronix Type B52-T10).

7. 52-ohm Terminating Resistor (Tektronix Type B52-R).

8. Input Capacitance Standardizer (Tektronix Type CS-47).

9. 52-ohm Coaxial Cable (Tektronix Type P52).

10. DC Volt-Ohmmeter.

11. Alignment Tools (see Fig. 5-1).

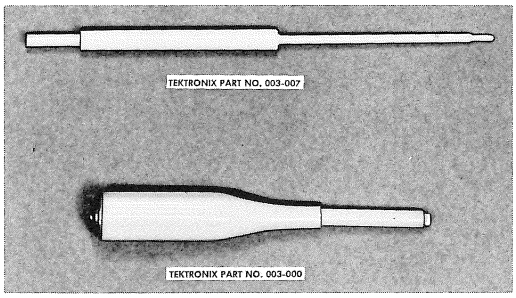



**Fig. 5-1. Low capacitance, insulated alignment tools used to adjust the Type H Plug-In Unit**

# CHECKING THE CALIBRATION

## 1. Preliminary

Before installing the Type H Plug-In Unit in the oscilloscope, make a careful visual inspection of the wire dress. This is particularly important if any soldering has been done to the unit. Then make the following resistance-to-ground checks at the 16-pin interconnecting plug. The table below lists the nominal resistance value from each pin to ground.

NOMINAL RESISTANCES AT INTERCONNECTING PLUG

| PIN NUMBER | RESISTANCE-TO-GROUND |
|---|---|
| 1 | 10 kΩ |
| 2 | 0 |
| 3 | 10 kΩ |
| 4 | infinite |
| 5 | infinite |
| 6 | infinite |
| 7 | infinite |
| 8 | infinite |
| 9 | 55 kΩ |
| 10 | 2 kΩ |
| 11 | 12 kΩ |
| 12 | infinite |
| 13 | infinite |
| 14 | infinite |
| 15 | 75 Ω |
| 16 | infinite |

Install the Type H Unit in the oscilloscope, turn on all equipment and allow 15 minutes for warmup. Unless otherwise stated, set up the oscilloscope controls as follows:

| | |
|---|---|
| HORIZONTAL DISPLAY | INTERNAL SWEEP (Type 541)<br>NORMAL (Type 543)<br>MAIN SWEEP NORMAL (Type 545) |
| TRIGGERING MODE | AUTOMATIC |
| TRIGGERING SLOPE | —INT. |
| STABILITY | Not used in Automatic mode. |
| TRIGGERING LEVEL | Not used in Automatic mode. |
| TIME/CM | 1 MILLISEC |
| VARIABLE | CALIBRATED (Type 543) |
| 5X MAGNIFIER | OFF (Type 541-545) |
| MULTIPLIER | 1 (Type 541-545) |

Set the controls on the Type H Plug-In Unit as follows:

| | |
|---|---|
| VOLTS/CM | .005 |
| VARIABLE | CALIBRATED |
| INPUT SELECTOR | INPUT A DC |
| VERTICAL POSITION | Trace centered on crt. |

Remove the left-side cover from the oscilloscope; then lay the instrument on its right side and remove the bottom plate. It will be convenient to leave the instrument in this position (on its right side). If sufficient time has been allowed for warmup (about 15 minutes) you can now proceed to check the calibration of the plug-in unit.

## 2. DC Output Level

Measure the voltage between pin 1 and ground, and between 3 and ground, of the interconnecting plug. These voltages should measure +67.5 volts ±1 volt.

## 3. DC Balance

Adjust the FOCUS, INTENSITY and ASTIGMATISM controls for a well-defined trace of suitable intensity; adjust the SCALE ILLUM control for a pleasing level. Rotate the VARIABLE control on the plug-in unit back and forth over its range. If the trace remains stationary, as the VARIABLE control is rotated, no adjustment of the DC BAL. controls is necessary. If the trace shifts vertically, as the VARIABLE control is rotated, adjust the COARSE DC BAL. control until the trace remains almost stationary; final adjustment is made with the FINE DC BAL. control.

## 4. Vertical Position Range

a. If the plug-in unit is to be used only with the oscilloscope in which it is being checked, the adjustment of the VERT. POS. RANGE control can be checked as follows: Set the VERTICAL POSITION control to mid-range. If the trace does not coincide with the center of the graticule, adjust the VERT. POS. RANGE control until coincidence is obtained.

b. If the plug-in unit is to be used with oscilloscopes other than the one in which it is being checked, the adjustment of the VERT. POS. RANGE control should be made as follows: Set the VERTICAL POSITION control to mid-range. Short together pins 1 and 3 of the interconnecting plug and observe the exact position of the trace; this is the electrical center of the vertical deflection system in the oscilloscope. Remove the short and adjust the VERT. POS. RANGE control so that the trace is positioned at the electrical center of the vertical deflection system. The final setting of the VERT. POS. RANGE control should be within the center one-half of its range.

### 5. Gassy and Microphonic Tubes

a. Gas check: Center the trace vertically on the crt. Connect a jumper lead between a ground connector and the INPUT A connector on the plug-in unit, observing for any vertical shift in the trace as the input is grounded. It may be necessary to alternately remove and connect the jumper two or three times to determine the amount of shift, if any. The maximum permissible shift is 2.5 millimeters (1.25 minor divisions).

b. Microphonics check: Rap lightly on the front panel of the plug-in unit and observe the trace for any excessive ringing-type microphonics.

### 6. Gain Adjustment

Set the front-panel controls of the plug-in unit as follows:

| | |
|---|---|
| VOLTS/CM | .005 |
| VARIABLE | CALIBRATED (full right) |
| INPUT SELECTOR | INPUT A DC |

Set the oscilloscope SQUARE-WAVE CALIBRATOR controls as follows:

| | |
|---|---|
| Black knob | 20 |
| Red knob | MILLIVOLTS |

Connect a jumper from the CAL. OUT connector on the oscilloscope to the INPUT A connector on the plug-in unit. The vertical deflection on the crt should be **exactly** 4 centimeters. If not, adjust the GAIN ADJ. control until the vertical deflection is exactly 4 centimeters. Check the setting of the FOCUS and ASTIGMATISM controls to make sure this adjustment is made with the narrowest trace width.

### 7. Input Selector Switch

With the controls unchanged from the previous step, position the base line of the calibrator waveform to the center line of the graticule. Set the INPUT SELECTOR switch to INPUT A AC; the waveform should shift down so that the center graticule line is now through the approximate center of the display. Remove the signal from INPUT A and apply it to INPUT B; check both positions of the INPUT SELECTOR switch for INPUT B.

### 8. Volts/Cm Switch

With the calibrator signal applied to INPUT B and the INPUT SELECTOR switch set to INPUT B DC, check the vertical deflection for the switch settings listed in the following table. Make sure the red VARIABLE control on the plug-in unit is in the CALIBRATED position.

Volt/Cm Switch Calibration Check

| SQUARE-WAVE CALIBRATOR | | VOLTS/CM SWITCH | VERTICAL DEFLECTION |
|---|---|---|---|
| (red knob) | (black knob) | (black knob) | |
| MILLIVOLTS | 20 | .005 | 4 cm |
| MILLIVOLTS | 20 | .01 | 2 cm |
| MILLIVOLTS | 50 | .02 | 2.5 cm |
| VOLTS | .2 | .05 | 4 cm |
| VOLTS | .2 | .1 | 2 cm |
| VOLTS | .5 | .2 | 2.5 cm |
| VOLTS | 2 | .5 | 4 cm |
| VOLTS | 2 | 1 | 2 cm |
| VOLTS | 5 | 2 | 2.5 cm |
| VOLTS | 20 | 5 | 4 cm |
| VOLTS | 20 | 10 | 2 cm |
| VOLTS | 50 | 20 | 2.5 cm |

### 9. Input Capacitance and Attenuator Compensation

A 1-kc square wave from the Type 105 Square-Wave Generator is used to check the input capacitance and the Attenuator compensation of the Type H Unit. Turn the DC ON-OFF switch on the Type 105 to the OFF position (leave the AC ON-OFF switch in the ON position), and connect a 5:1 L Pad (B52-L5) to the OUTPUT connector of the Type 105. Connect a 52-ohm coaxial cable to the 5:1 L Pad, and connect the other end of the cable through a CS-47 Capacitance Standardizer to the INPUT A connector of the Type H Unit. Turn the DC ON-OFF switch on the Type 105 to the ON position, and adjust the RANGE and FREQUENCY controls for an output frequency of 1 kc. Set the INPUT SELECTOR switch on the plug-in unit to INPUT A DC.

The following table lists settings of the VOLTS/CM switch that will connect each Attenuator into the input circuit individually. The table also lists the capacitor(s) that will affect the waveshape for each setting of the VOLTS/CM switch and the effect of each capacitor. When the in-

HF-COMPENSATION ATTENUATOR ADJUSTMENTS

| VOLTS/CM SWITCH | AFFECTS CORNER OF SQUARE WAVE | AFFECTS TOP OF SQUARE WAVE |
|---|---|---|
| .005 | | C3809 |
| .01 | C3834 | C3833 |
| .02 | C3840 | C3839 |
| .05 | C3812 | C3811 |
| *.5 | C3818 | C3817 |
| 5 | C3824-C3828 | C3823 |

*Remove 5:1 L Pad from OUTPUT connector of Type 105.

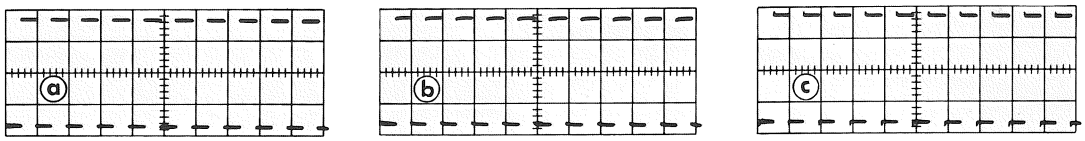



**Fig. 5-2. Checking the input capacitance and the Attenuator compensation of the Type H Plug-In Unit: (a) proper adjustment; (b) improper adjustment of input capacitance; (c) Attenuator overcompensated.**

put circuit is properly adjusted, the waveform will have a square corner and a flat top for each position of the VOLTS/CM switch, as shown in Fig. 5-2(a). The waveforms in (b) and (c) of Fig. 5-2 show two types of waveform distortion that may result from improperly adjusted capacitors.

Maintain approximately 3.5 centimeters of vertical deflection by adjusting the OUTPUT AMPLITUDE control of the Type 105 each time the VOLTS/CM switch is moved from one position to the next. In the last two positions of the switch (.5 and 5) it will be necessary to remove the 5:1 L Pad from the OUTPUT connector of the Type 105 and connect the cable directly to the OUTPUT connector. We suggest that you turn the DC ON-OFF switch to the OFF position while removing the 5:1 L Pad and reconnecting the cable directly to the Type 105.

## 10. High Frequency Compensation

The high-frequency compensation of the Type H Unit is checked by observing the leading edge and corner of a 450-kc square wave from the Type 105. It is very important that the output of the Type 105 is properly terminated and attenuated for this operation.

Connect a B52-R Terminating Resistor to the INPUT A connector of the plug-in unit, and connect a B52-T10 T Pad to the other end of the Terminating Resistor. Connect a 52-ohm coaxial cable to the T Pad, and connect the other end of the cable to the Type 105 OUTPUT connector through a B52-L10 L Pad. (See Fig. 5-3). Set the RANGE and FREQUENCY controls of the Type 105 for an output frequency of 450 kc.

Reset the following controls on the oscilloscope as indicated.

| | | |
|---|---|---|
| Type 541-545 | TIME/CM | .1 MICROSEC |
| | MULTIPLIER | 2 |
| Type 543 | TIME/CM | .2 MICROSEC |

Set up the Type H Unit as follows:

| | |
|---|---|
| VOLTS/CM | .005 |
| VARIABLE | CALIBRATED |
| INPUT SELECTOR | INPUT A DC |

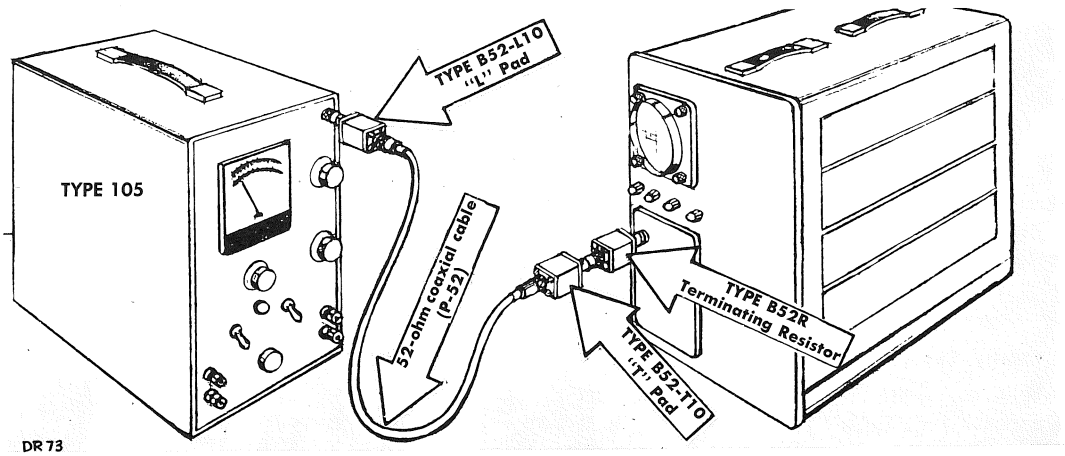



**Fig. 5-3 The manner in which the Type 105 Square-Wave Generator should be connected to the Type H Plug-In Unit to check the high-frequency compensation.**

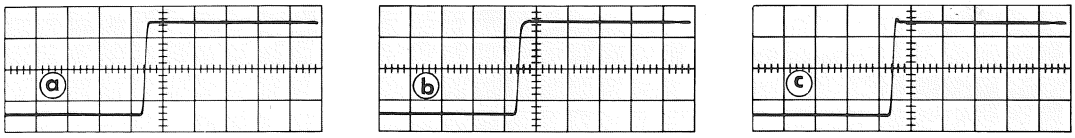



**Fig. 5-4. Checking the high-frequency compensation of the Type H Plug-In Unit: (a) proper adjustment; (b) rolloff, and (c) overshoot, caused by improper adjustment.**

Adjust the OUTPUT AMPLITUDE control on the Type 105 for a vertical deflection of about 3 centimeters.

If the high-frequency compensating circuits in the Type H Unit are in proper adjustment, these control settings should result in a display of the Type 105 waveform similar to that shown in Fig. 5-4(a). However, if there is any rolloff at the corner, as shown accentuated in Fig. 5-4(b), or overshoot (with or without ringing) as shown in Fig. 5-4(c), the high-frequency compensating circuits are in need of adjustment.

The following table lists each control that affects the high-frequency response of the plug-in unit, and the relative time constant of each control. Each of these controls will affect the leading corner of the square wave, however, the duration of the time constant will determine the degree to which the effect can be noticed. For example, the controls having a relatively short time constant will have their action confined more nearly to the vertex of the corner, while the longer time-constant controls will affect a wider portion of the corner. The plug-in unit is adjusted for optimum high-frequency response when the corner is square and there are no aberrations in the top of the waveform immediately following the corner.

## EFFECT OF HF ADJUSTMENT

| CONTROL | RELATIVE TIME CONSTANT |
|---|---|
| R3856 | Very long |
| C3873-C4873 | Long |
| *L3874-L4874 | Medium |
| **L3853-L4853 | Short |
| R3897 (H.F. PEAKING) | Very short |

*When properly adjusted, the tuning slug should be on the top side of the center tap (the side farthest from the chassis).

**When properly adjusted, the tuning slug should be on the bottom side of the center tap (the side nearest the chassis).

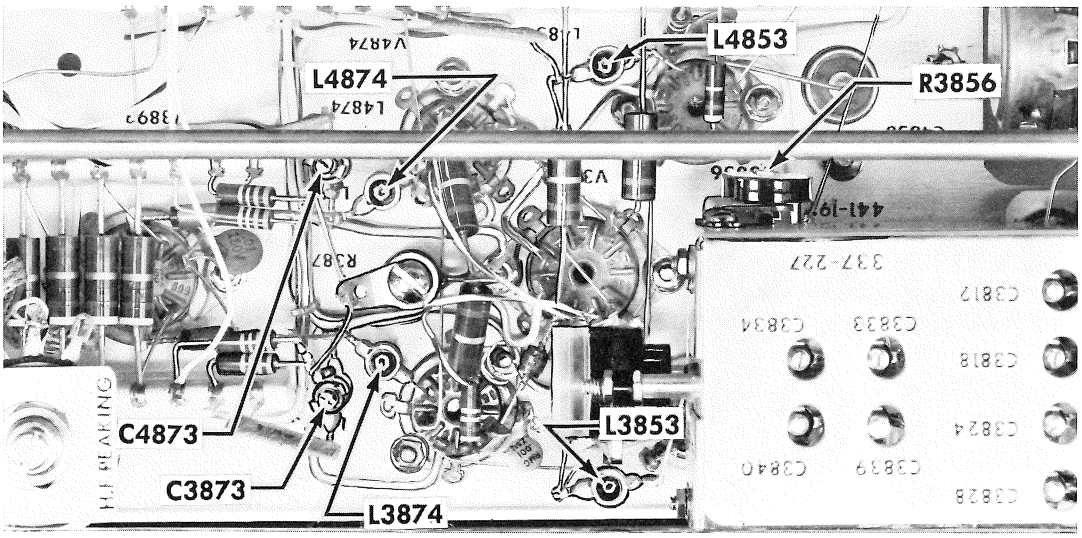



**Fig. 5-5. Bottom view of Type H Unit showing location of the high-frequency compensation adjustments.**

## 11. Frequency Response Measurement

The frequency response of the plug-in-oscilloscope combination is checked by applying a 500-kc sine wave from the Type 190 or Type 190A Constant-Amplitude Signal Generator to the Type H Unit, and adjusting the output amplitude from the signal generator for a reference amount of deflection on the crt. The frequency of the output signal is then increased, while maintaining the same output amplitude, until the deflection on the crt has decreased 3 db from the reference deflection; the frequency of the output signal then represents the upper 3-db frequency of the plug-in-oscilloscope combination.

To make this check, set the plug-in controls as explained in Step 10 and reset the following controls on the oscilloscope:

| | | |
|---|---|---|
| Type 541-545 | TIME/CM | 100 MICROSEC |
| | MULTIPLIER | 1 |
| Type 543 | TIME/CM | .1 MILLISEC |
| all scopes | TRIGGERING MODE | AC SLOW |
| | STABILITY | full right (cw) |

Connect the ATTENUATOR box of the Type 190 or 190A to the INPUT A connector of the plug-in unit through a 5:1 L Pad (B52-L5), and adjust the controls on the signal generator as follows:

| | |
|---|---|
| RANGE SELECTOR | .35-.75 |
| RANGE IN MEGACYCLES | .50 (on the .35-.75 scale) |

Set the switch on the ATTENUATOR box to 1, and adjust the OUTPUT AMPLITUDE control of the signal generator for a vertical deflection of exactly 3 centimeters (make sure the VOLTS/CM and VARIABLE controls on the plug-in unit are set to .005 and CALIBRATED, respectively). Then, set the RANGE SELECTOR switch on the signal generator to 9-21, and adjust the RANGE IN MEGACYCLES control until the vertical deflection on the crt is exactly 2.1 centimeters. The VERTICAL POSITION control on the plug-in unit may be adjusted to make the measurements more convenient, but do not adjust any other controls on either the plug-in unit or the signal generator (with the exception of the RANGE IN MEGACYCLES control). A vertical deflection of exactly 2.1 centimeters represents the upper 3-db frequency of the circuit; this should be at least 15 megacycles.

# PARTS LIST

For an explanation of the abbreviations used in this parts list, see the indexed sheet marked **ABBREVIATIONS.**

## Capacitors

| | | | | | | Tektronix Part Number |
|---|---|---|---|---|---|---|
| C3804 | 0.1 μμf | PTM | Fixed | 600 v | 20% | 285-528 |
| C3808 | 3.3 μμf | Cer. | Fixed | | ±0.25 μμf | 281-534 |
| C3809 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3810 | 22 μμf | Cer. | Fixed | 500 v | ±10% | 281-511 |
| C3811 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3812 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3814 | 8 μμf | Cer. | Fixed | 500 v | ±0.5 μμf | 281-503 |
| C3816 | 22 μμf | Cer. | Fixed | 500 v | ±10% | 281-511 |
| C3817 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3818 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3820 | 220 μμf | Mica | Fixed | 500 v | 5% | 283-513 |
| C3822 | 22 μμf | Cer. | Fixed | 500 v | ±10% | 281-511 |
| C3823 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3824 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3826 | 100 μμf | Cer. | Fixed | 500 v | ±10 μμf | 281-530 |
| C3828 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3830 | 180 μμf | Mica | Fixed | 500 v | 5% | 283-510 |
| C3832 | 2.7 μμf | Cer. | Fixed | 500 v | ±10% | 281-547 |
| C3833 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3834 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3835 | 10 μμf | Cer. | Fixed | 500 v | ±1 μμf | 281-504 |
| C3838 | 6.8 μμf | Cer. | Fixed | 500 v | ±10% | 281-541 |
| C3839 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3840 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3850 | .005 μf | Cer. | Fixed | 500 v | | 283-001 |
| C3855 | .005 μf | Cer. | Fixed | 500 v | | 283-001 |
| C3873 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C3875 | .001 μf | Cer. | Fixed | 500 v | | 283-000 |
| C3894 | .001 μf | Cer. | Fixed | 500 v | | 283-000 |
| C4821 | .01 μf | Cer. | Fixed | 150 v | | 283-003 |
| C4823 | .01 μf | Cer. | Fixed | 150 v | | 283-003 |
| C4825 | .01 μf | Cer. | Fixed | 500 v | | 283-002 |
| C4827 | .005 μf | Cer. | Fixed | 500 v | | 283-001 |
| C4842 | .01 μf | Cer. | Fixed | 150 v | | 283-003 |
| C4858 | 6.25 μf | EMT | Fixed | 300 v | −20+50% | 290-000 |
| C4873 | .7-3 μμf | Tub. | Var. | | | 281-027 |
| C4875 | .001 μf | Cer. | Fixed | 500 v | | 283-000 |
| C4894 | .001 μf | Cer. | Fixed | 500 v | | 283-000 |

## Inductors

| | | | Tektronix Part Number |
|---|---|---|---|
| L3853 | 8.5-18 μh | Var. | 114-109 |
| L3861 | 2.5 μh | Fixed | 108-148 |
| L3871 | .45 μh | Fixed | 108-098 |
| L3873 | 8.4 μh | Fixed | 108-149 |
| L3874 | 11-23 μh | Var. | 114-110 |
| L3891 | 1.8 μh | Fixed | 108-105 |
| L3896 | .18 μh | Fixed | 108-009 |
| L4853 | 8.5-18 μh | Var. | 114-109 |
| L4861 | 2.5 μh | Fixed | 108-148 |
| L4871 | .45 μh | Fixed | 108-098 |
| L4873 | 8.4 μh | Fixed | 108-149 |
| L4874 | 11-23 μh | Var. | 114-110 |
| L4891 | 1.8 μh | Fixed | 108-105 |
| L4896 | .18 μh | Fixed | 108-009 |

## Resistors

| | | | | | | |
|---|---|---|---|---|---|---|
| R3801 | 27 Ω | ½ w | Fixed | Comp. | 10% | 302-270 |
| R3802 | 27 Ω | ½ w | Fixed | Comp. | 10% | 302-270 |
| R3812 | 900 k | ½ w | Fixed | Prec. | 1% | 309-142 |
| R3814 | 111 k | ½ w | Fixed | Prec. | 1% | 309-138 |
| R3818 | 990 k | ½ w | Fixed | Prec. | 1% | 309-145 |
| R3820 | 10.1 k | ½ w | Fixed | Prec. | 1% | 309-135 |
| R3824 | 970 k | ½ w | Fixed | Prec. | 1% | 309-012 |
| R3826 | 34.5 k | ½ w | Fixed | Prec. | 1% | 309-038 |
| R3828 | 300 k | ½ w | Fixed | Prec. | 1% | 309-125 |
| R3830 | 10.1 k | ½ w | Fixed | Prec. | 1% | 309-135 |
| R3834 | 500 k | ½ w | Fixed | Prec. | 1% | 309-140 |
| R3836 | 1 meg | ½ w | Fixed | Prec. | 1% | 309-148 |
| R3840 | 750 k | ½ w | Fixed | Prec. | 1% | 309-141 |
| R3842 | 333 k | ½ w | Fixed | Prec. | 1% | 309-139 |
| R3844 | 47 Ω | ½ w | Fixed | Comp. | 10% | 302-470 |
| R3846 | 1 meg | ½ w | Fixed | Prec. | 1% | 309-148 |
| R3850 | 100 k | ½ w | Fixed | Comp. | 10% | 302-104 |
| R3851 | 47 Ω | ½ w | Fixed | Comp. | 10% | 302-470 |
| R3852 | 6 k | 5 w | Fixed | WW | 5% | 308-052 |
| R3853 | 1.4 k | Mica Plate Manufactured by Tektronix | | | | 310-552 |
| R3855 | 12 Ω | ½ w | Fixed | Comp. | 10% | 302-120 |
| R3856 | 150 ~~500~~ Ω | .1 w | Var. | Comp. | 20% | 311-056 129 |
| R3857 | 22 k | 2 w | Fixed | Comp. | 10% | 306-223 |
| R3858 | 22 k | 2 w | Fixed | Comp. | 10% | 306-223 |
| R3865 | 6.8 k | 1 w | Fixed | Comp. | 10% | 304-682 |
| R3866 | 15 k | 2 w | Fixed | Comp. | 10% | 306-153 |
| R3873 | 3 k | 5 w | Fixed | WW | 5% | 308-062 |
| R3874 | 1.6 k | Mica Plate Manufactured by Tektronix | | | | 310-550 |
| R3875 | 470 k | ½ w | Fixed | Comp. | 10% | 302-474 |
| R3876 | 5.6 k | 1 w | Fixed | Comp. | 10% | 304-562 |

## Resistors *(continued)*

| | | | | | | Tektronix Part Number |
|---|---|---|---|---|---|---|
| R3878 | 660 Ω | Manufactured by Tektronix | | | | 311-140 |
| R3879 | 4.5 k | 5 w | Fixed | WW | 5% | 308-066 |
| R3880 | 10 k | 2 w | Var. | Comp. | | 311-016 |
| R3883 | 330 k | ½ w | Fixed | Comp. | 10% | 302-334 |
| R3885 | 2x100 k | 2 w | Var. | Comp. | | 311-028 |
| R3886 | 2x100 k | 2 w | Var. | Comp. | | 311-051 |
| R3887 | 330 k | ½ w | Fixed | Comp. | 10% | 302-334 |
| R3893 | 3.9 k | 2 w | Fixed | Comp. | 10% | 306-392 |
| R3894 | 9.1 k | 1 w | Fixed | Comp. | 5% | 303-912 |
| R3896 | 9.1 k | 1 w | Fixed | Comp. | 5% | 303-912 |
| R3897 | 2 k | 2 w | Var. | Comp. | | 311-008 |
| R4827 | 47 Ω | ½ w | Fixed | Comp. | 10% | 302-470 |
| R4831 | 100 k | 2 w | Var. | Comp. | | 311-026 |
| R4833 | 390 k | ½ w | Fixed | Comp. | 10% | 302-394 |
| R4835 | 100 k | 2 w | Var. | Comp. | | 311-026 |
| R4837 | 3.9 meg | ½ w | Fixed | Comp. | 10% | 302-395 |
| R4841 | 1.5 meg | ½ w | Fixed | Comp. | 10% | 302-155 |
| R4842 | 3.9 k | ½ w | Fixed | Comp. | 10% | 302-392 |
| R4851 | 47 Ω | ½ w | Fixed | Comp. | 10% | 302-470 |
| R4853 | 1.4 k | Mica plate Manufactured by Tektronix | | | | 310-552 |
| R4857 | 15 k | 2 w | Fixed | Comp. | 10% | 306-153 |
| R4858 | 33 k | ½ w | Fixed | Comp. | 10% | 302-333 |
| R4865 | 6.8 k | 1 w | Fixed | Comp. | 10% | 304-682 |
| R4866 | 15 k | 2 w | Fixed | Comp. | 10% | 306-153 |
| R4874 | 1.6 k | Mica plate Manufactured by Tektronix | | | | 310-550 |
| R4875 | 470 k | ½ w | Fixed | Comp. | 10% | 302-474 |
| R4876 | 5.6 k | 1 w | Fixed | Comp. | 10% | 304-562 |
| R4879 | 5.6 k | 1 w | Fixed | Comp. | 10% | 304-562 |
| R4880 | 33 k | ½ w | Fixed | Comp. | 10% | 302-333 |
| R4883 | 330 k | ½ w | Fixed | Comp. | 10% | 302-334 |
| R4887 | 330 k | ½ w | Fixed | Comp. | 10% | 302-334 |
| R4894 | 9.1 k | 1 w | Fixed | Comp. | 5% | 303-912 |
| R4896 | 9.1 k | 1 w | Fixed | Comp. | 5% | 303-912 |

## Switches

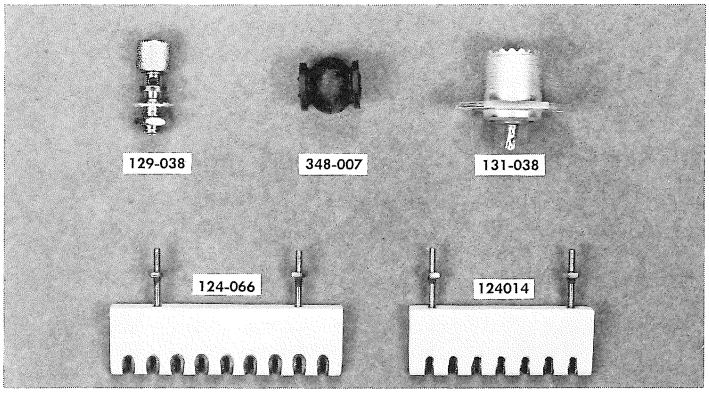
| | | unwired | wired |
|---|---|---|---|
| SW3800 | Input Selector | 260-081 | 262-155 |
| SW3810 | Volts/CM | 260-213 | 262-154 |

## Vacuum Tubes

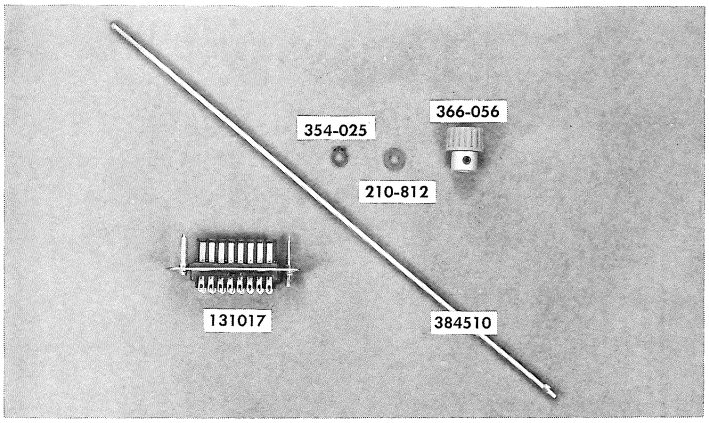
| | | | |
|---|---|---|---|
| V3854 | 12AU6 | Input Amplifier | 157-050 |
| V3863 | 12AT7 | Cathode Follower | 154-039 |
| V3874 | 12AU6 | Output Amplifier | 157-038 |
| V3893 | 12AT7 | Output Cathode Follower | 154-039 |
| V4854 | 12AU6 | Input Amplifier | 157-050 |
| V4874 | 12AU6 | Output Amplifier | 157-038 |

## Miscellaneous Parts

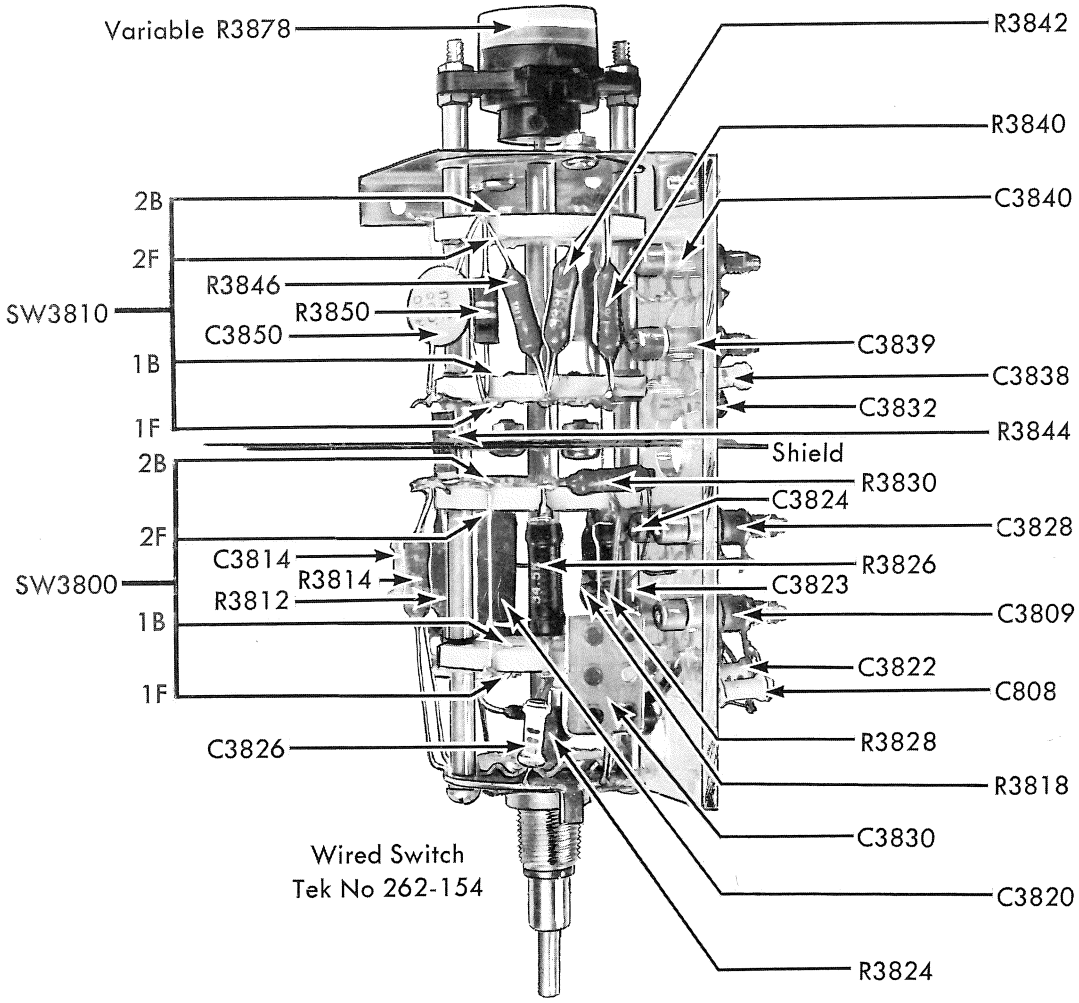
| | |
|---|---|
| Binding post, metal plated (ground) | 129-038 |
| Ceramic strip, 3/4" by 7 notches, 3/8" spacing | 124-014 |
| Ceramic strip, 3/4" by 9 notches, 3/8" spacing | 124-066 |
| Connector, chassis mounting | 131-017 |
| Knob, small red: VARIABLE VOLTS/CM | 366-038 |
| Knob, large black: VOLTS/CM | 366-040 |
| Knob, large black: INPUT SELECTOR, VERTICAL POSITION | 366-042 |
| Knob, small grey for retaining rod | 366-056 |
| Receptacle, coax, Type UHF: INPUT A and B | 131-038 |
| Ring, retaining | 354-025 |
| Rod, securing | 384-510 |
| Shockmount, rubber | 384-007 |
| Washer, fiber, for coax mounting | 210-812 |




Ground Post, Shockmount, Coax Receptacle and Ceramic Strips.

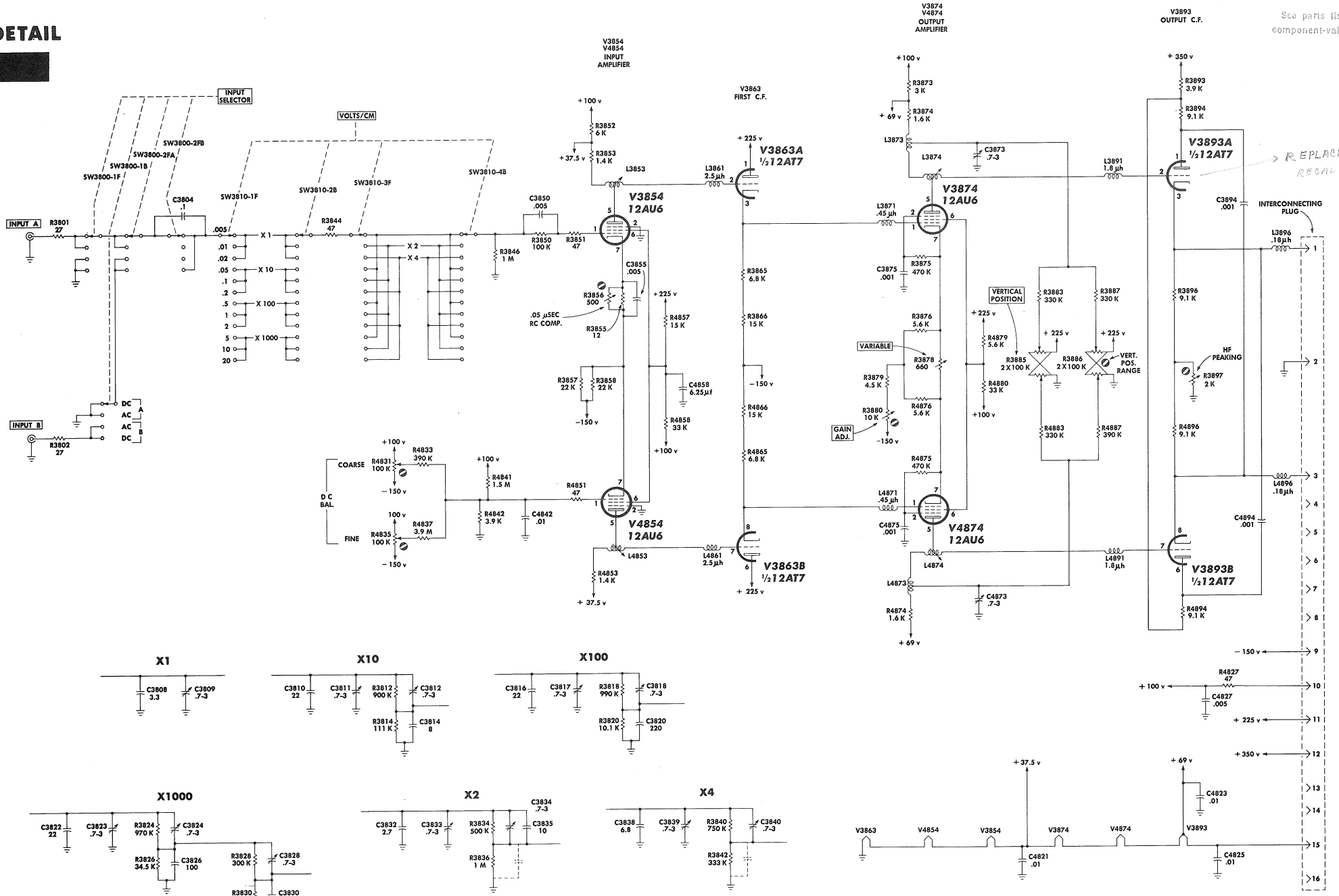



Retaining-Rod Assembly and Interconnecting Plug.




**VOLTS/CM SWITCH AND VARIABLE CONTROL**

# SWITCH DETAIL




See parts list for late component-value changes

→ REPLACED 3-29-60 HLB RECALIBRATED

## ATTENUATOR DETAILS

## *ABBREVIATIONS USED IN OUR PARTS LISTS*

| | | | |
|---|---|---|---|
| Cer. | ceramic | m | milli |
| Comp. | composition | Ω | ohm |
| EMC | electrolytic, metal cased | Poly. | polystyrene |
| EMT | electrolytic, metal tubular | Prec. | precision |
| f | farad | PT | paper tubular |
| h | henry | Tub. | tubular |
| k | thousands of ohms | v | working volts dc |
| meg | megohms | Var. | variable |
| μ | micro | w | watt |
| μμ | micromicro | WW | wire wound |
| | GMV guaranteed minimum value | | |

## *ABBREVIATIONS USED IN OUR CIRCUIT DIAGRAMS*

Resistance values are in ohms. The symbol k stands for thousands. A resistor marked 2.7 k has a resistance of 2,700 ohms. The symbol M stands for million. For example, a resistor marked 5.6 M has a resistance of 5.6 megohms.

Unless otherwise specified on the circuit diagram, capacitance values marked with the number 1 and numbers greater than 1 are in μμf. For example, a capacitor marked 3.3 would have a capacitance of 3.3 micromicrofarads. Capacitance values marked with a number less than 1 are in μf. For example, a capacitor marked .47 would have a capacitance of .47 microfarads.

Inductance values marked in mh are in millihenrys. Inductance values marked in μh are in microhenrys.

**Your instrument WARRANTY appears on the reverse side of this sheet.**

SERIAL NO. 1102

## IMPORTANT

Include the INSTRUMENT TYPE and the above SERIAL NUMBER in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your questions or fill your order with the least delay possible.

## WARRANTY

All Tektronix instruments are fully guaranteed against defective materials and workmanship for one year. Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them prepaid (via air if requested) as soon as possible, usually within 24 hours.

Tektronix transformers, manufactured in our own plant, carry an indefinite warranty.

# Accessories

## 5 INCH INSTRUMENTS

## *SCOPE-MOBILES . . .*

The Tektronix Type 500/53A Scope-Mobile is a sturdy, mobile support for Tektronix 5" Oscilloscopes. Convenient observation of the crt face is achieved by a 20-degree backward tilt of the top surface. The front-panel has two supporting cradles to accommodate Plug-In Units. A drawer, felt-lined and operating on roller bearings, provides handy storage for probes, cables, manuals, etc. An open shelf, topped with tough linoleum, is located at the bottom. Power input and three convenience outlets are mounted at the rear.

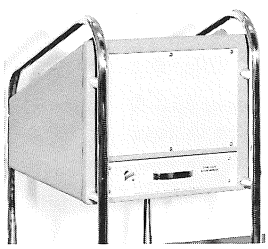
The Type 500/53A Scope-Mobile weighs 35 pounds. The outside dimensions are 18½" wide, 39" high and 30" deep.
Type 500/53A ..... $110.00

Type 53A Scope-Mobile Panel. For Type 500A Scope-Mobiles. Converts the Type 500A to a Type 500/53A by replacing the standard blank panel. Part No. 014-005 ..... $10.50

Type 53 Scope-Mobile Panel. For Type 500 Scope-Mobiles only. Converts the earlier Type 500 model to a Type 500/53 by replacing the standard blank panel.
Part No. 014-004 ..... $10.50

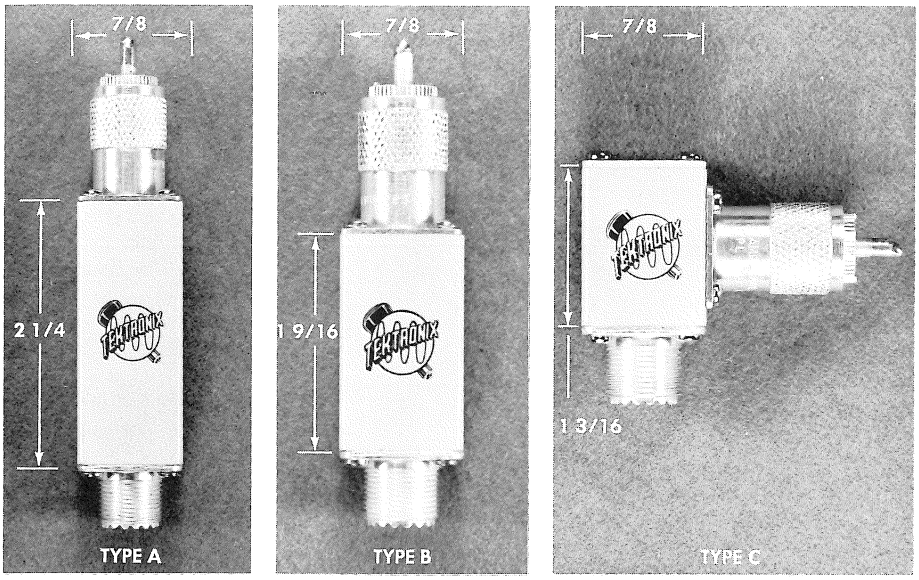
Scope-Mobile Fan Kit. For forced-air ventilation of the equipment compartment of the Type 500A Scope-Mobile. Contains motor, 5"-blade, filter, and mounting hardware.
Part No. 040-161 ..... $15.00

Scope-Mobile three-wire power receptacle. Installation of this kit allows a three-wire receptacle assembly to be added to the 500 or 500/53 scope-mobile. Part No. 040-186 ..... $8.50



The Tektronix Type 500A Scope-Mobile is identical to the Type 500/53A, except for the front panel. Auxiliary equipment can be mounted behind the blank front panel, but it will usually be necessary to provide forced-air ventilation for the equipment compartment. A fan kit, 040-161, is recommended for this purpose. Type 500A ..... $100.00

# CABLE TERMINATORS...




**Type B52-R** 52-ohm terminating resistor, 1.5 w, Type A case. Part No. 011-001 ..... $8.50

**Type B52-L5** 52-ohm 'L' pad, 5 to 1 voltage ratio, 1.5 w, Type A case.
Part No. 011-002 ..... $8.50

**Type B52-L10** 52-ohm 'L' pad, 10 to 1 voltage ratio, 1.5 w, Type A case.
Part No. 011-003 ..... $8.50

**Type B52-75L** Minimum-loss pad, 52 ohms to 75 ohms, Type A case.
Part No. 011-004 ..... $11.50

**Type B52-170L** Minimum-loss pad, 52 ohms to 170 ohms, Type B case.
Part No. 011-005 ..... $11.50

**Type B52-T10** 52-ohm 'T' pad, 10 to 1 voltage ratio, 1.5 w, Type B case.
Part No. 011-006 ..... $11.50

**Type B75-R** 75-ohm terminating resistor, 1.5 w, Type A case. Part No. 011-007 ..... $8.50

**Type B75-L5** 75-ohm 'L' pad, 50 to 1 voltage ratio, 1.5 w, Type A case.
Part No. 011-008 ..... $8.50

**Type B75-L10** 75-ohm 'L' pad, 10 to 1 voltage ratio, 1.5 w, Type A case.
Part No. 011-009 ..... $8.50

**Type B75-T10** 75-ohm 'T' pad, 10 to 1 voltage ratio, 1.5 w, Type B case.
Part No. 011-010 ..... $11.50

**Type B93-R** 93-ohm terminating resistor, 1.5 w, Type A case. Part No. 011-011 ..... $8.50

**Type B93-L5** 93-ohm 'L' pad, 5 to 1 voltage ratio, 1.5 w, Type A case.
Part No. 011-012 ..... $8.50

**Type B93-L10** 93-ohm 'L' pad, 10 to 1 voltage ratio, 1.5 w, Type A case.
Part No. 011-013 ..... $8.50

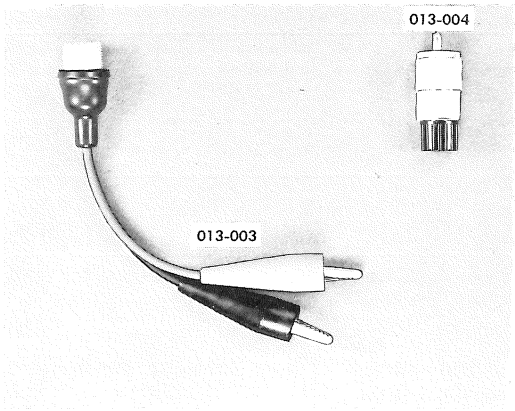
**Type B93-52L** Minimum-loss pad, 93 ohms to 52 ohms, 1.5 w, Type A case.
Part No. 011-014 ..... $11.50

**Type B93-T10** 93-ohm 'T' pad, 10 to 1 voltage ratio, 1.5 w, Type B case.
Part No. 011-015 ..... $11.50

**Type B170-R** 170-ohm terminating resistor, 1.5 w, Type C case. Part No. 011-016 .... $8.50

**Type B170-A** 170-ohm pi-attenuator, using 2% precision resistors, 1 to 64 db in 1-db steps, 0.25 w, not shown in photograph.
Part No. 011-017 ..... $45.00

# COAXIAL ADAPTERS...




**Cable-Connector Adapters**

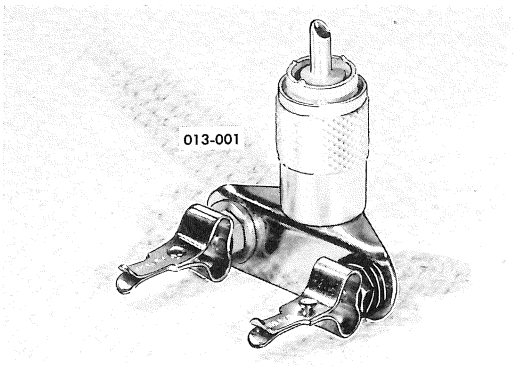
Type A100 Clip Lead Adapter. Provides clip lead connections for a coaxial cable.
Part No. 013-003 ..... $2.00

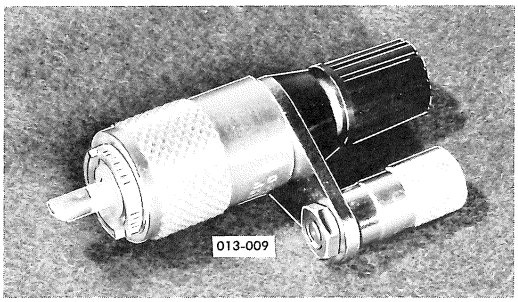
Type A510 Binding Post Adapter. Provides permanent connection for a single wire to the center conductor of a coaxial connector.
Part No. 013-004 ..... $2.00

**Binding Post Adapter.** Similar to Type A510 binding post adapter, but includes ground terminal. $\frac{3}{4}$" spacing between connector centers.
Part No. 013-009 ..... $3.00

**Type F30 Production Test Fixture**

This fixture was designed for use with the Type 130 L, C Meter in production line sorting and testing. It may be used to terminate the output of any standard coaxial connector.
Part No. 013-001 ..... $3.00




# INTERCONNECTING CABLES...

**Type W130B** Black, 30" flexible output lead with banana-type connector at one end and alligator clip at other. Part No. 012-014 .... $1.00

**Type W130R** Same as Type W130B except colored red. Part No. 012-015 ..... $1.00

**Type PC-6B** Black, 6" flexible cord terminated in combination male and female banana-type connectors. The combination type connectors permit "stacking." Part No. 012-023 ..... $1.25

**Type PC-6R** Similiar to Type PC-6B except colored red. Part No. 012-024 ..... $1.25

**Type PC-18R** Similar to Type PC-6B except 18" long and colored red.
Part No. 012-031 ..... $1.50

**Type W-531B** Black, 6" flexible cord terminated in male banana-type connectors.
Part No. 012-028 ..... $1.00

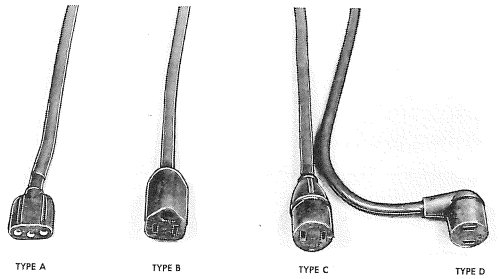
**Type W531R** Similiar to Type W-531B except colored red. Part No. 012-029 ..... $1.00

**Suppressor cord for Type 570.** Similiar to Type W-531 cords but includes 100 Ω resistor.
Part No. 012-025 ..... $1.50

**Suppressor cord for Type 570.** Similar to Type W-531 cords except includes 300 Ω resistor.
Part No. 012-026 ..... $1.50

**Suppressor cord for Type 570.** Similar to Type W-531 cords except includes 1 k resistor.
Part No. 012-027 ..... $1.50

# POWER CORDS...




**2-conductor,** 8′ rubber-covered power cord with Type C connector. No. 18 wire.
Part No. 161-001 ..... $1.25

**2-conductor,** 8′ rubber-covered power cord with no female connector. (For permanent connection to instrument).
Part No. 161-002 ..... $1.10

**2-conductor,** 1′ rubber-covered power cord with Type C connector. No. 18 wire.
Part No. 161-003 ..... $ .85

**2-conductor,** 8′ rubber-covered power cord with Type C connector. No. 16 wire.
Part No. 161-004 ..... $1.75

**3-conductor,** 8′ rubber-covered power cord with Type A connector. No. 16 wire.
Part No. 161-005 ..... $2.00

**3-conductor,** 10′ rubber-covered power cord with no female connector. (For permanent connection to instrument). No. 16 wire.
Part No. 161-006 ..... $3.00

**2-conductor,** 8′ rubber covered power cord with Type D connector. No. 18 wire.
Part No. 161-007 ..... .$1.25

**3-conductor,** 8′ rubber-covered power cord with Type B connector. No. 18 wire.
Part No. 161-008 ..... $1.50

**3-conductor,** 8′ rubber covered power cord with Type B connector. No. 18 wire.
Part No. 161-010 ..... $1.75

**3-conductor,** 1′ rubber covered power cord with Type B connector. No. 18 wire.
Part No. 161-011 ..... $1.25

**3-conductor,** 8′ rubber-covered power cord with no female connection. (For permanent connection to instrument). No. 18 wire.
Part No. 161-012 ..... $1.25

**Power-cord adapter** for connecting a 3-wire power cord to a 2-wire receptacle.
Part No. 103-013 ..... $ .65

# COAXIAL CABLES...

**Type P52** Coaxial cable, 52 ohms nominal impedance, 42″ long. Part No. 012-001 .... $4.00

**Type P75** Coaxial cable, 75 ohms nominal impedance, 42″ long. Part No. 012-002 .... $4.00

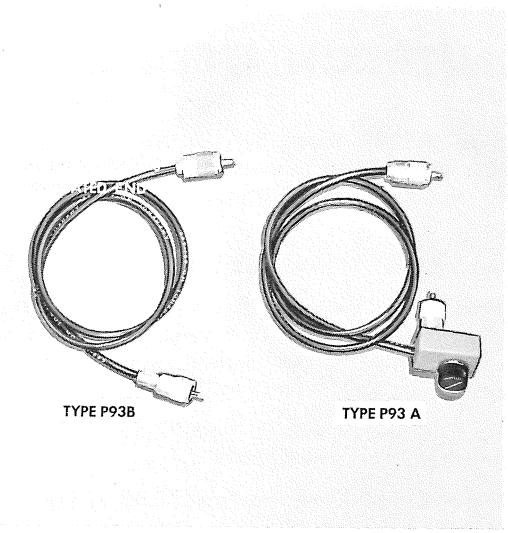
**Type P93** Coaxial cable, 93 ohms nominal impedance, 42″ long. Part No. 012-003 .... $4.00

**Type P93A** Coaxial output cable, 93 ohms, terminated with variable attenuator, 42″ long. (See photo). Part No. 012-004 ..... $13.50

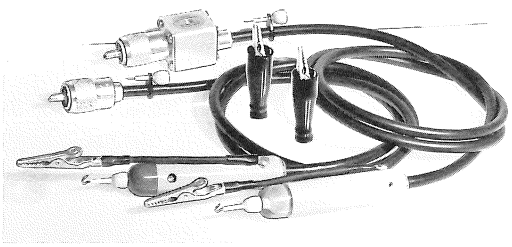
**Type P93B** Coaxial output cable, 93 ohms, terminated with ½-watt 93-ohm resistor, 42″ long. (See photo). Part No. 012-005 ..... $5.00

**Type P170** Coaxial cable, 170 ohms nominal impedance, 42″ long. Part No. 012-006 .. $9.50

**Coaxial cable,** 170 ohms nominal impedance, 5′ long. Part No. 012-034 ..... $4.00



# P400-SERIES PROBES . . .



P400-Series Low-Capacitance Probes. This series of low-capacitance probes preserves the transient response of Tektronix fast-rise instruments. The P400-Series probes are free of overshoot and ringing and have relatively uniform high-frequency response. Input capacitance and insertion loss are affected by cable length. With cables up to 12′ in length, insertion loss is less than 3 db at 20 mc, and overshoot is less than 1%. With exception of the P450-L, these probes can be used on those instruments having input capacitances from 20 to 50 $\mu\mu$f.

General physical characteristics of the P400-Series probes are identical to the P510A probe. Color-coding of the plastic nose indicates attenuation ratio. Two interchangeable Tektips—a straight tip and a hooked tip—each adding less than 0.5 $\mu\mu$f to the input capacitance, and an alligator clip assembly are supplied with each probe.

| PROBE | CABLE LENGTH | PART NO. | PRICE |
|---|---|---|---|
| P405 (green nose) | 42″<br>8′ | 010-006<br>010-013 | $10.50<br>12.50 |
| P410 (brown nose) | 42″<br>8′ | 010-007<br>010-014 | 10.50<br>12.50 |
| P420 (red nose) | 42″<br>8′ | 010-008<br>010-015 | 10.50<br>12.50 |
| P450 (clear nose, green inside) | 42″<br>8′ | 010-009<br>010-016 | 12.50<br>14.50 |
| P450-L (clear nose, green inside) | 42″<br>8′ | 010-010<br>010-017 | 12.50<br>14.50 |
| P4100 (clear nose) | 42″<br>8′ | 010-002<br>010-018 | 12.50<br>14.50 |

## P400-SERIES PROBE SPECIFICATIONS

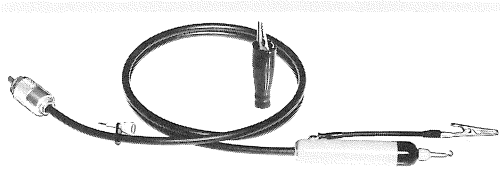
| PROBE TYPE | ATTEN. RATIO | INPUT CHARACTERISTICS | | | DB Loss at 30 MC | Maximum Voltage Rating |
|---|---|---|---|---|---|---|
| | | Resist. (MegΩ) | Capacitance Minimum* | Capacitance Maximum† | | |
| P405 | 5:1 | 5 | 12 $\mu\mu$f<br>21 $\mu\mu$f** | 19 $\mu\mu$f<br>30 $\mu\mu$f** | 1-2 | 600 |
| P410 | 10:1 | 10 | 8 $\mu\mu$f<br>12 $\mu\mu$f** | 11 $\mu\mu$f<br>15 $\mu\mu$f** | 1 | 600 |
| P420 | 20:1 | 10 | 5.5 $\mu\mu$f<br>8 $\mu\mu$f** | 7 $\mu\mu$f<br>9 $\mu\mu$f** | 1 | 600 |
| P450 | 50:1 | 10 | 3.5 $\mu\mu$f<br>4 $\mu\mu$f** | 3.5 $\mu\mu$f<br>4 $\mu\mu$f** | 1 | 1000 |
| P450-L | 50:1 | 10 | 2.5 $\mu\mu$f<br>3 $\mu\mu$f** | | 1 | 1000 |
| P4100 | 100:1 | 10 | 2.5 $\mu\mu$f<br>3 $\mu\mu$f** | 2.5 $\mu\mu$f<br>3 $\mu\mu$f** | 1 | 1000 |

***When connected to instruments with 20-$\mu\mu$f input capacitance.**

**†When connected to instruments with input capacitances up to 50 $\mu\mu$f.**

****With 8-foot cable.**

# P510A PROBES...



**P510A Attenuator Probe** provides an attenuation of ten times when used with Tektronix oscilloscopes and amplifiers. The P510A is small and streamlined, and presents an input impedance of 10 megohms paralleled by 14 $\mu\mu$f. The probe is completely insulated—made of high-impact-strength fiberglass-reinforced alkyd—and has an internal brass shield. Two interchangeable Tektips—a straight tip and a hooked tip—and an alligator clip assembly are furnished. Probe has a 42" cable with coaxial connector, and is rated at 600 v maximum.

Part No. 010-001 ..... $8.50

### P510A PROBES WITH LONG CABLES

P510A probe cables ring at a period that depends on the cable length and, to a lesser degree, on the input capacitance of the oscilloscope used. Each particular cable length will be satisfactory only when zero transmission of the oscilloscope does not extend to a frequency that includes the resonant frequency of the probe. This difficulty has been eliminated in the P400-Series Probes.

P510A with 6' cable, Part No. 010-004 .. $9.00

P510A with 8' cable, Part No. 010-005 .. $9.50

Prices for P510A Probes with other cable lengths available on request.

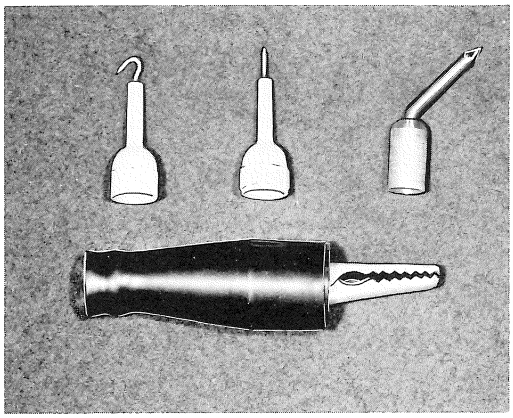
### PROBE TIPS

Tek tip, Hook Shank, Part No. 206-008 ... $ .25

Tek tip, Straight Shank, Part No. 206-009 . $ .25

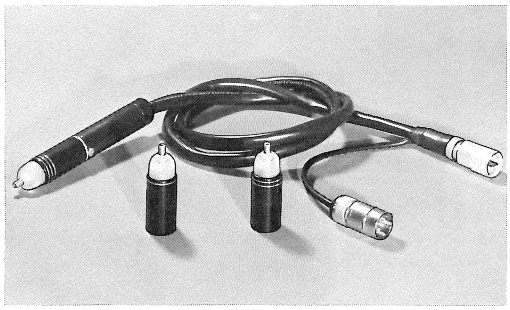
Pin Jack Probe Tip, Bent Shank (fits 0.082" pin jacks). Part No. 206-011 ..... $ .25

Alligator Clip Assembly. Part No. 344-005 $ .40



# CF PROBES...

### TYPE P170CF



**The P170CF Cathode Follower Probe** was developed for use with the Type 517 Oscilloscope. The cathode-follower is a 5718 triode with the 170-ohm termination of the preamplifier grid line in the Type 517 as a cathode load. Plate and heater voltages for this tube are provided at a four-terminal socket on the panel of the oscilloscope. The signal is attenuated by 2 times when using the P170CF. The input impedance of the probe will depend on the attenuator head being used, and because of the transit time in the cathode-follower, it will decrease appreciably at the higher frequencies. When the probe is used without an attenuator head, the input characteristic is 12 megohms shunted by 5 $\mu\mu$f. The probe cable is 42" long. Probe comes complete with 3 attenuator heads.

Part No. 010-101 ..... $86.00

**PAX-1 Attenuator Head.** Attenuation can be varied between 4 times and 40 times.

Part No. 010-301 ..... $11.00

**PAX-II Attenuator Head.** Attenuation can be varied between 20 times and 200 times.

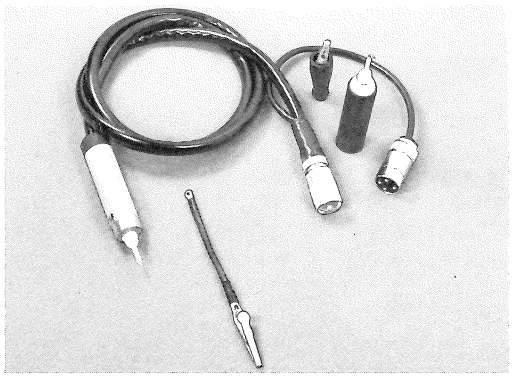
Part No. 010-302 ..... $11.00

**PAX-III Attenuator Head.** Attenuation can be varied between 200 times and 2000 times.
Part No. 010-303 ..... $11.00

## TYPE P500CF

**Type P500CF Cathode-Follower Probe.** For use with Type 524AD Oscilloscope. Presents low capacitance with minimum attenuation. Input characteristic is 40 megohms paralleled by 4 $\mu\mu$f. The gain is 0.8 to 0.85. Input to probe is ac-coupled, limiting its low-frequency response to 5 cycles. Amplitude distortion is less than 3% on unidirectional signals exceeding a few volts to minimize amplitude distortion. With the attenuator head attached, the probe input characteristic is approximately 10 megohms paralleled by 2 $\mu\mu$f. Probe output level is 11-v positive, making it necessary to use the AC-coupled position of the oscilloscope AC-DC switch. Probe cable is 42" long. Part No. 010-105 ..... $64.00

**A modification kit** is available to equip the Type 524AD Oscilloscope with a front-panel probe-power connector.
Modification Kit 040-059 ..... $5.00



**Probe Power-Cable Extension**—a 24" 3-conductor power-cable extension for Tektronix cathode-follower probes. Permits wider separation of the probe power source from the instrument signal input. Part No. 012-030 ..... $5.00

**Universal Probe Repair Kit.** This repair kit includes all of the necessary electrical and mechanical parts to repair badly damaged Type P410 and P510 Probes. Includes repair and assembly instructions. Part No. 040-180 ..... $8.50


## PROBE POWER SUPPLY

Type 128 Probe Power Supply. The Type 128 supplies the necessary plate and filament voltages for one or two probes, making it possible to use the Type P500CF and Type P170CF cathode-follower probes with oscilloscopes not equipped with a probe-power outlet.

DC Output Voltages:

+120 v regulated, at 25 ma
+6.3 v unregulated, at 150 ma
+6.3 v unregulated, at 150 ma

When a P170CF probe is to be used with an instrument other than the Tektronix Type 517, a 170-ohm terminating resistor is required. The Type B170-R Terminating Resistor is recommended for this purpose.

Ripple—Ripple on the 120 v supply is not more than 5 mv peak-to-peak, and not more than 75 mv peak-to-peak on the 6.3 v supplies.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 60 cycles, 25 watts using two P500CF probes.

Dimensions—4 3/4" wide, 7 3/4" high, 9" overall depth.

Weight—6 lbs.

Part No. 015-006 ..... $95.00

# CATHODE-RAY-TUBES . . .

The catalog description of each oscilloscope gives the kind of phosphor that is normally provided in the crt. In general, your oscilloscope can be provided, on order, with any commercially available phosphor.

Phosphors, other than those of short persistence may display an initial fluorescence of one color, followed by a phosphorescence of the same or another color. The following table describes some of the phosphors we can provide in your crt. Othed phosphors are available. We welcome your inquiries.

## PHOSPHOR CHARACTERISTICS

| PHOSPHOR | FLUORESCENCE | PHOSPHORESCENCE | PERSISTENCE |
|---|---|---|---|
| P1 | Green | Green | Medium |
| P2 | Blue-green | Green | Long |
| P7* | Blue-white | Yellow | Long |
| P11 | Blue | | Short |
| P16 | Violet and near ultra-violet | | Extremely short |
| P24 | Blue | | Extremely short |

***Double-layer type.**

## PRICE LIST

### Types 515A and RM15.

| | | |
|---|---|---|
| 5CBP1/T55P1 | 154-125 | $60.00 |
| 5CBP2/T55P2 | 154-120 | 60.00 |
| 5CBP7/T55P7 | 154-126 | 60.00 |
| 5CBP11/T55P11 | 154-127 | 60.00 |
| 5CBP16/T55P16 | 154-161 | 60.00 |
| 5CBP24/T55P24 | 154-177 | 60.00 |

### Type 536.

| | | |
|---|---|---|
| T536P1/T56P1 | 154-140 | $60.00 |
| T536P2/T56P2 | 154-133 | 60.00 |
| T536P7/T56P7 | 154-135 | 60.00 |
| T536P11/T56P11 | 154-136 | 60.00 |
| T536P16/T56P16 | 154-169 | 60.00 |

### Type 551.

| | | |
|---|---|---|
| T551P1/T57P1 | 154-186 | $150.00 |
| T551P2/T57P2 | 154-160 | 150.00 |
| T551P7/T57P7 | 154-189 | 150.00 |
| T551P11/T57P11 | 154-143 | 150.00 |

### Type 502.

| | | |
|---|---|---|
| T502P1/T60P1 | 154-172 | $150.00 |
| T502P2/T60P2 | 154-144 | 150.00 |
| T502P7/T60P7 | 154-170 | 150.00 |
| T502P11/T60P11 | 154-173 | 150.00 |

### Type 524AD.

| | | |
|---|---|---|
| 5ABP1 | 154-068 | $31.00 |
| 5ABP7 | 154-069 | 35.00 |
| 5ABP11 | 154-070 | 35.25 |

### Types 531, 535, RM31 and RM35.

| | | |
|---|---|---|
| 5BGP1/T51P1A | 154-080 | $75.00 |
| 5BGP2/T51P2A | 154-081 | 75.00 |
| 5BGP7/T51P7A | 154-082 | 75.00 |
| 5BGP11/T51P11A | 154-083 | 75.00 |
| 5BGP16/T51P16A | 154-092 | 75.00 |
| 5BGP24/T51P24A | 154-124 | 75.00 |

### Types 525, 532, RM32, 570 and 575.

| | | |
|---|---|---|
| 5CAP1/T52P1 | 154-093 | $50.00 |
| 5CAP2/T52P2 | 154-097 | 50.00 |
| 5CAP7/T52P7 | 154-102 | 50.00 |
| 5CAP11/T52P11 | 154-103 | 50.00 |
| 5CAP16/T52P16 | 154-162 | 50.00 |

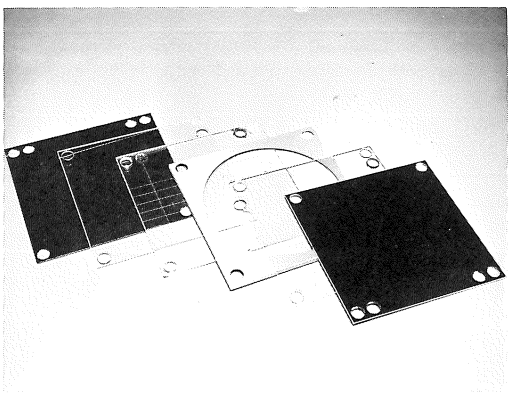
### Type 517A.

| | | |
|---|---|---|
| T517P1H/T54P1H | 154-107 | $110.00 |
| T517P2H/T54P2H | 154-109 | 110.00 |
| T517P7H/T54P7H | 154-108 | 110.00 |
| T517P11H/T54P11H | 154-105 | 110.00 |
| T517P16H/T54P16H | 154-128 | 110.00 |

### Types 541, 545, RM41 and RM45.

| | | |
|---|---|---|
| 5BHP1/T54P1 | 154-106 | $100.00 |
| 5BHP2/T54P2 | 154-098 | 100.00 |
| 5BHP7/T54P7 | 154-104 | 100.00 |
| 5BHP11/T54P11 | 154-099 | 100.00 |
| 5BHP16/T54P16 | 154-118 | 100.00 |
| 5BHP24/T54P24 | 154-152 | 100.00 |

## LIGHT FILTERS



These filters are useful for applications where it is desirable to select certain light frequencies from different color fluorescent and phosphorescent characteristics. Use the same color filter as the color or light frequency component you wish to view. For example, a color filter can be used to accentuate one of the two light outputs from a double-layer phosphor.

Under high ambient light conditions a filter of the same color as the trace is useful to increase the contrast between the trace and the face of the crt.

**Types 524AD, 531 and 535.** Amber, F510-3
Part No. 378-501 ..... $ .90

**Types 524AD, 531 and 535.** Yellow.
Part No. 378-502 ..... $ .90

**Types 507, 524AD, 525, 531, 532, 533, 535, 536, 545, 570, 575, RM31, RM32, RM35, RM41, and RM45.** Green, F510-5.
Part No. 378-503 ..... $ .90

**Types 524AD, 531 and 535.** Blue, F510-6.
Part No. 378-504 ..... $ .90

**Types 502, 515A, 517A, RM15, 533, 541, 543, 545, RM41, RM45 and 551.** Green.
Part No. 378-514 ..... $ .90

**Types 515A, RM15, 517A, 502, 533, 541, 545, RM41, RM45, 543 and 551.** Blue.
Part No. 378-515 ..... $ .90

**Types 502, 515A, 517A, 533, 541, 545, RM41, RM45, 551, RM15 and 543.** Amber.
Part No. 378-516 ..... $ .90

## GRATICULES

**Types 515A, RM15 and 533** graticule. 6 cm vertically, 10 cm horizontally.
Part No. 331-037 ..... $1.50

**Type 517A** adjustable reference graticule. 4 cm vertically, 8 horizontally.
Part No. 331-033 ..... $1.50

**Type 524AD** graticule. TV RMA style ruling for percentage measurements.
Part No. 331-009 ..... $1.50

**Type 524AD** graticule. Centimeter ruling, 5 cm vertically, 10 horizontally.
Part No. 331-006 ..... $1.50

**Types 532 and RM32** graticule. Centimeter ruling, 8 cm vertically, 10 horizontally.
Part No. 331-026 ..... $1.50

**Type 525** graticule. Ruling in percentages, —40 to +100. Part No. 331-035 ..... $1.50

**Types 531, 535, RM31, RM35 and 507** graticule. Centimeter ruling, 6 cm vertically, 10 horizontally. Part No. 331-016 ..... $1.50

**Types 541, 543, 545, RM41 and RM45** graticule. Centimeter ruling, 4 cm vertically, 10 horizontally. Part No. 331-034 ..... $1.50

**Types 536, 570 and 575** graticule. Division ruling, 10 divisions vertically, 10 horizontally.
Part No. 331-028 ..... $1.50

**Type 551** graticule. Centimeter ruling, 6 cm vertically, 10 horizontally.
Part No. 331-045 ..... $1.50

**Type 502** graticule. Centimeter ruling, 10 cm vertically, 10 horizontally.
Part No. 331-047 ..... $1.50

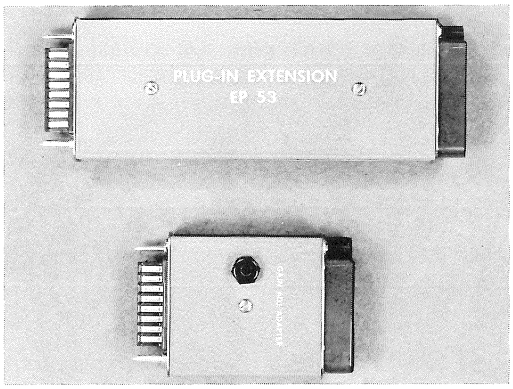
**Types 524AD and 525** graticule. Special colorburst TV. Part No. 331-040 ..... $4.50

**540-Series** graticule. 12 KV Special 3.4 x 8.5 cm.
Part No. 331-031 ..... $1.50

**Types 515A, 517A, 541 and 545** graticule. Unruled adjustable reference.
Part No. 386-451 ..... $1.00

**Types 524AD, 531 and 535** graticule. Unruled, plain. Part No. 386-326 ..... $1.00

# AUXILIARY DEVICES...




### TYPE EP53 PLUG-IN EXTENSION

Permits the operation of the plug-in unit partially extended out of its housing in a 530-, 540-, or 550-Series oscilloscope.
Part No. 013-002 ..... $5.00

### TYPE EP53A GAIN ADJ. ADAPTER

Permits the introduction of an external calibrating signal directly to the oscilloscope vertical amplifier input, by-passing the plug-in preamplifier. Useful for adjusting oscilloscope vertical amplifier gain in 530-, 540-, and 550-Series oscilloscopes. Part No. 013-005 ..... $5.00

### AIR FILTERS

Types 502, 524AD and 525. 8 x 8 x 1 aluminum filter. Part No. 378-003 ..... $2.00

Type 515A. 8 x 8 x 1 aluminum filter.
Part No. 378-010 ..... $2.25

Type RM15. 7 x 7 x 1 aluminum filter.
Part No. 378-016 ..... $2.25

Types 507 (Indicator Unit), 531, 532, 533, 535, 536, 541, 543, 545, 551 (Indicator Unit), 570 and 575. Part No. 378-011A ..... $2.25

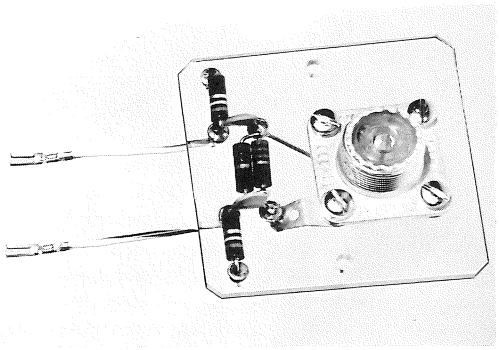
Type 530- and 540-Series instruments. Disposable 10 x 10 x 3/4 spun-glass filter with back-up screens. Part No. 378-009 ..... $1.75

Type 530- and 540-Series instruments. Disposable 10 x 10 x 3/4 spun-glass filter.
Part No. 378-012 ..... $1.00

Type 517. 11-7/8 x 11-7/8 x 2 aluminum filter.
Part No. 378-001 ..... $4.00

Types 507 and 551 (Power Supply Units). 7 x 7 x 1 aluminum filter. Part No. 378-015 .. $2.25

### DEFLECTION PLATE CONNECTOR



Type DP-52 Deflection-Plate Connector. This device provides a convenient means for making direct connections to the CRT vertical deflection plates in the 530- and 540-Series Oscilloscopes. With this device, front-panel control of the CRT beam position is retained. The connector is designed for use with a 52-ohm cable.

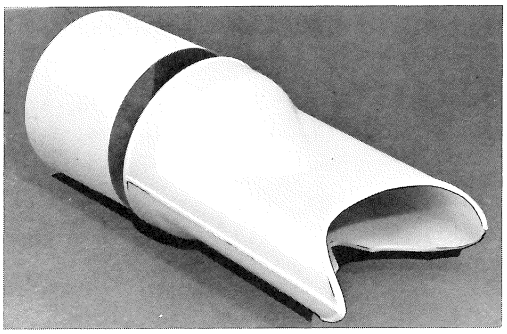
For 530- and 540-Series instruments with serial numbers below 5001 order Part No. 013-006. For 530-and 540-Series instruments with serial numbers 5001 and above order Part No. 013-007.
Price ..... $5.00

### H510 VIEWING HOOD

Type H510 Viewing Hood for Tektronix 5" Oscilloscopes. Includes molded rubber eye-piece and aluminum light shield. Part No. 016-001 .. $4.50

Molded rubber eye-piece.
Part No. 337-002 ..... $3.35

Aluminum light shield.
Part No. 354-004 ..... $1.15



## INSTRUCTION MANUALS

| | |
|---|---|
| 502 | $4.00 |
| 507 | 4.00 |
| 515A | 4.00 |
| RM15 | 4.50 |
| 517A | 4.50 |
| 524AD | 5.00 |
| 525 | 4.50 |
| 531 or RM31 | 4.50 |
| 532 or RM32 | 4.50 |
| 533 | 4.50 |
| 535 or RM35 | 5.00 |
| 536 | 4.50 |
| 541 or RM41 | 4.50 |
| 543 | 4.50 |
| 545 or RM45 | 5.00 |
| 551 | 4.50 |
| Type A | 1.50 |
| Type B | 1.50 |
| Type CA | 1.50 |
| Type D | 1.50 |
| Type E | 1.50 |
| Type G | 1.50 |
| Type H | 1.50 |
| Type K | 1.50 |
| Type L | 1.50 |
| Type P | 1.50 |
| Type T | 1.50 |
| 570 | 4.50 |
| 575 | 5.00 |

## TYPE P PLUG-IN

The Type P is a special-purpose test unit for Tektronix convertible oscilloscopes. You can use the step function generated by the Type P Unit to adjust an oscilloscope vertical amplifier and delay-line. By this procedure you can standardize the transient response of a number of like oscilloscopes. A plug-in preamplifier will exhibit identical transient-response characteristics in like oscilloscopes that have been standardized with the Type P.

Risetime of the step function generated by the Type P is less than 4 millimicroseconds. Polarity can be either positive or negative, and amplitude is continuously adjustable from 0 to 3 major graticule divisions. Repetition rate is 240/sec.

## MECHANICAL SPECIFICATIONS

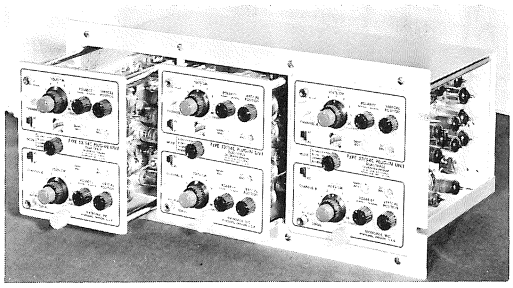
Construction—Aluminum-alloy chassis.

Finish—Photo-etched panel.

Weight—3½ pounds.

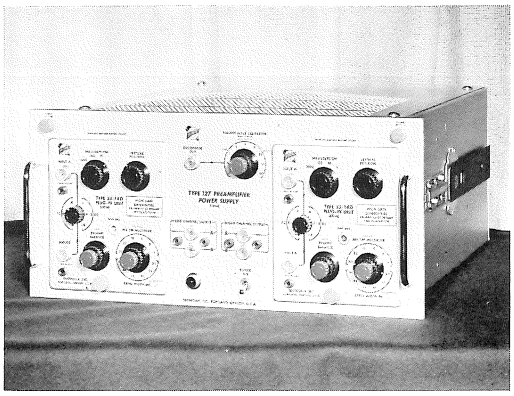
Price ..... $60.00


## PLUG-IN STORAGE CABINET



Plug-In Storage Cabinet. Mounts in standard rack, holds three Plug-In Units. Dimensions: 19" wide, 8 ¾" high, 9 ⅜" deep. Price without Plug-In Units. Part No. 437-031 ..... $25.00

## PLUG-IN POWER SUPPLY



The Tektronix Type 127 Preamplifier Power Supply supplies proper operating power to one or two Tektronix plug-in preamplifiers. Any plug-in units, powered by the Type 127, can be used to further increase the signal-handling versatility of Tektronix oscilloscopes employing plug-in preamplifiers. Double-differential dual-trace display may be obtained by employing 2 Type D, E, or G Differential Plug-In Preamplifier Units in the Type 127 in conjunction with an oscilloscope using a Type CA Dual-Trace Plug-In Unit. The Type 127 also facilitates the use of plug-in units in other applications.

The outputs of plug-in units powered by the Type 127 are fed through dc-coupled differential amplifier stages and cathode followers to provide a push-pull signal at the output terminals. Risetime of the unit is 0.018 $\mu$sec, permitting maximum utilization of the response of Tektronix 530-Series Oscilloscopes. Output swing is linear $\pm$3% over a range of $\pm$0.3 volt. Output dc operating levels are adjustable to ground potential.

The Type 127 has a gain of one, push-pull. With single-ended output, gain is one half.

Each channel has four output terminals, two on the front and two at the rear. Terminated 170-ohm output cables are furnished.
Price ..... $525.00

## CAPACITANCE STANDARDIZERS

**Type CS47 Input Capacitance Standardizer.** This device is used for standardizing the input capacitance of those plug-in units having a 47 $\mu\mu$f input capacitance. Standardization of plug-in input capacity permits interchanging probes from one plug-in to the other without the need for probe readjustment. The Type CS47 case is similar to the Type A attenuator case on Page A-2. Part No. 011-021 ..... $11.50

**Type CS20 Input Capacitance Standardizer.** Similar to the Type CS47 above but for standardizing 20 $\mu\mu$f input capacitances.
Part No. 011-022 ..... $11.50

## ADAPTER PLATES

Three quick-change adapter plates are available for the Type 570. These plates come complete with the tube socket mounted in the center of the plate and banana pin jacks connected to each pin connection in the socket. A fourth quick-change adapter plate is also available for assemblying your own special adapter plate. The fourth quick-change adapter plate with mounting holes only is available so that you may assemble your own test fixture. Patch cords to connect the adapter plates to Type 570 are listed under Interconnecting Cables. See Part Numbers 012-023 and 012-024.

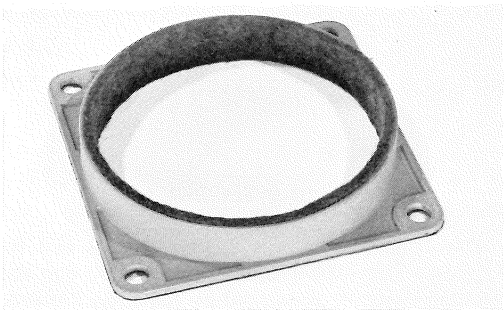
7 pin miniature socket adapter plate.
Part No. 016-004 ..... $4.00

8 pin octal socket adapter plate.
Part No. 016-005 ..... $4.00

9 pin miniature socket.
Part No. 016-006 ..... $4.00

Plain adapter plate with mounting holes.
Part No. 016-007 ..... $2.50

## TYPE BE510 BEZEL



Type BE510 Bezel for mounting camera on Tektronix 5" oscilloscopes. Dimensions: 5 7/8" square; ring 7/8" deep, diameter 5 5/8" outside, 5 1/8" inside. Die-cast construction, wrinkle finish, felt lined.
Part No. 014-001 ..... $4.50

# MODIFICATION KITS...

Frequently customers ask us to provide them with information and sometimes parts to modify their instruments for a special application. If there seems to be enough interest in a particular type of modification, we assemble a kit of materials and instructions and make it available as a regular catalog item. The list below is a partial list of some of the most common types of modifications. Your Tektronix Field Engineer has a more complete list. All such kits come complete with all of the necessary hardware and parts to effect the modification in your instrument and a detailed set of installation instructions are included also.

## SWEEP LOCKOUT MODIFICATION

The sweep lockout feature on an oscilloscope facilitates single-sweep operation for photographic purposes. With this feature an oscilloscope is adjusted to accept a single triggering impulse and at the completion of a single sweep of the crt beam the sweep circuits are rendered inoperative. This mode of operation is particularly useful for photographing transients which occur at random intervals.

Type K531 modification kit. Modifies standard Type 531 and Type 541 Oscilloscopes.
Part No. 040-118 ..... $25.00

Type K532 modification kit. Modifies conventional Type 532 Oscilloscope.
Part No. 040-147 ..... $25.00

## DC FAN MOTOR MODIFICATIONS

The power supplies of most Tektronix Oscilloscopes will operate over the range of power line frequencies from 50- to 800-cycles. However, the standard fan motor assembly will not operate over this range efficiently. Installation of a DC fan motor will permit the operation of the instrument over the wide range of power line frequencies without danger of the instrument overheating.

Type 515A fan motor kit. Includes mounting brackets, hardware, rectifier assembly and fan motor. Part No. 040-140 ..... $40.00

Type 531 and Type 535 fan motor kit. Permits operation on power line frequencies from 50- to 400-cycles. Part No. 040-128 ..... $47.50

Type 531 and Type 535 fan motor kit. Permits operation on power line frequencies from 400- to 1500-cycles (for serial numbers 5001 and up).
Part No. 040-129 ..... $89.00

Type 532 fan motor kit. Permits operation on power line frequencies from 50- to 400-cycles (for serial numbers 5001 and up).
Part No. 040-134 ..... $45.00

Type 541 and Type 545 fan motor kit. Permits operation on power line frequencies from 50- to 500-cycles (for serial numbers 5001 and up).
Part No. 040-130 ..... $47.50

Type 541 and Type 545 fan motor kit. Permits operation on power line frequencies from 400- to 1500-cycles (for serial numbers 5001 and up).
Part No. 040-131 ..... $89.00

Type 316 fan motor kit. Permits operation on power line frequencies from 50- to 800-cycles.
Part No. 040-141 ..... $40.00

## RACK-MOUNTING CRADLE ASSEMBLIES

To permit mounting conventional cabinet type oscilloscopes in relay racks, we provide in these kits all of the necessary hardware for most standard racks.

For Types 524, 531, 532, 535, 541, 545 and 570 above serial number 5000. Also for Types 533, 536, 543, and 575. Part No. 040-182 .... $45.00

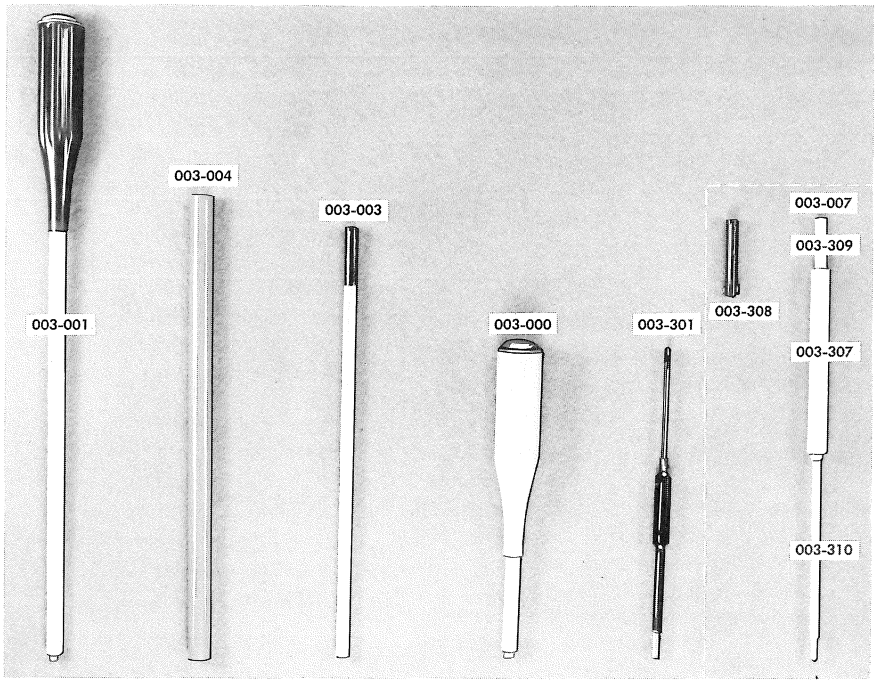
For Types 507 and 551. Part No. 040-183 $85.00

For Type RM15. This kit contains supporting cradles for supporting the rear of the slide assembly in a relay rack.
Part No. 426-063A ..... $7.50

## CRT MAXIMUM INTENSITY MODIFICATION

This modification replaces the conventional front-panel intensity control with two controls—one located inside the instrument, the other on the front panel. The internal adjustment can be set to prevent burning of the cathode-ray tube phosphor by inexperienced operators. This would be helpful, for example, where the instrument is used on a production line. Modifies Types 531, 535, 541 and 545.
Part No. 040-159 ..... $5.00

# RECALIBRATION TOOLS...




The tools shown above are handy—and in some cases, necessary—tools for the recalibration of Tektronix Instruments. All of the tools except the assembly at the right (003-007) are available through most radio parts suppliers.

003-000 Jaco No. 125 insulated screw driver. This tool is similar to 003-001 but has a 1 ½" shank ..... $ .75

003-001 Jaco No. 125 insulated screw driver with 7" shank and metal bit. This tool is useful for adjusting hard-to-reach adjustments on oscilloscopes ..... $1.25

003-003 Walsco No. 2519 insulated alignment tool. This double-ended tool is useful for adjusting variable inductors in Tektronix Instruments ..... $1.25

003-004 Walsco No. 2503 ¼" insulated hexagonal wrench. This tool is useful for tightening variable inductor lock nuts on older Tektronix Instruments. Current production instruments do not have lock nuts on coil assemblies .... $ .60

003-007 Tektronix recalibration tool assembly. This 4-unit tool assembly provides most of the necessary tools for adjusting variable inductors in Tektronix Instruments. The price for the entire assembly is ..... $2.50

Individual unit prices are as follows:

003-307 Handle ..... $ .75

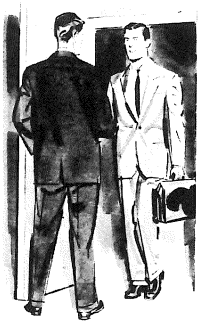
003-308 Red nylon insert with wire pin ... .50

003-309 White cymac insert with wire pin .50

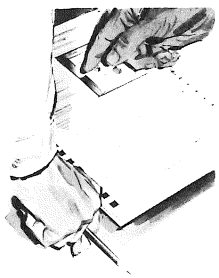
003-310 Hexagonal core insert ..... $ .75

003-301 Walsco No. 2543 double-ended 0.1" hexagonal wrench. This tool is useful for adjusting variable inductors with hexagonal cores. ..... $1.00

# TEKTRONIX FIELD SERVICES



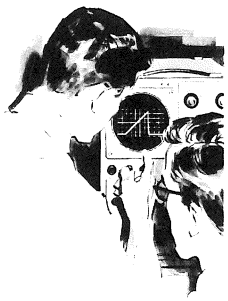
**Tektronix Customers are urged to take advantage of the many field services available to them through Tektronix Field-Engineering Offices, Engineering Representatives, and Overseas Engineering Organizations. Some of these services are described below.**



**Ordering**—There are many types of oscilloscopes, each designed for a specific application area. Your Field Engineer can help you select the one best suited to your present and future needs, and he will be happy to arrange a demonstration of the instrument.....in your application if you so desire.

If you are a Purchasing Agent or Buyer, your Field Engineer or his secretary can help you with information on prices, terms, shipping estimates, and best method of transportation on instruments, accessories, and replacement parts.

If you are responsible for the maintenance of a large quantity of Tektronix Instruments, ask your Field Engineer about the free factory training course in maintenance and calibration.

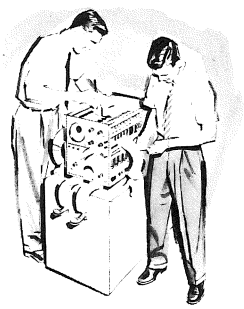


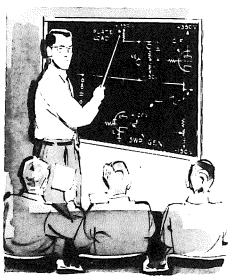
**Applications**—Perhaps the answers you need in a specific application can be obtained faster and easier through use of your Tektronix Oscilloscope. Your Field Engineer can help you find out, and if use of your oscilloscope is indicated, help you with procedures. He may also be able to suggest many time-saving uses for your oscilloscope in routine checks and measurements.

**Operation**—Your Tektronix Oscilloscope can be most useful to you when you are familiar with all control functions. Your Field Engineer will be glad to demonstrate the use of your instrument in various applications to help you become more familiar with its operation. If your instrument is to be used by several engineers, your Field Engineer will be happy to conduct informal classes on its operation in your laboratory.

**Instrument Reconditioning**—An older Tektronix Oscilloscope, properly reconditioned, can give you many additional years of service. Your Field Engineer will gladly explain the advantages and limitations of factory reconditioning, and make the necessary arrangements if you decide in favor of it.

Many major repair and recalibration jobs can be performed at a nearby Field Repair Station. Ask your Field Engineer about this at-cost service to Tektronix customers.





**Maintenance**—Tektronix willingly assumes much of the responsibility for continued efficient operation of the instruments it manufactures. If you should experience a stubborn maintenance problem, your Field Engineer will gladly help you isolate the cause. Often a telephone discussion with him will help you get your instrument back into operation with minimum delay. If yours is a large laboratory, your Field Engineer can be of service to your maintenance engineers by conducting informal classes on test and calibration procedures, trouble-shooting techniques, and general maintenance.

**Communications**—Your Field Engineer is a valuable communication link between you and the factory. He knows the exact person to contact in each circumstance, and he can reach that person fast and easily. Let him help speed your communications with the factory on any problem related to your Tektronix Instruments.

***Tektronix, Inc.***

# Tektronix, Inc., P. O. Box 831, Portland 7, Oregon

**Telephone: CYpress 2-2611 TWX—PD 311 Cable: TEKTRONIX**

**AN OREGON CORPORATION**

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