

Topical

TEKTRONIX TIPS

MODIFICATION...

...PROGRESS





The Symbol of Excellence in Instrumentation

COMING EVENTS CAST THEIR SHADOWS

On the following pages we present a preview of new TEKTRONIX instruments and accessories available for shipment in the near future as standard TEKTRONIX catalog items. A thumbnail sketch of the proposed characteristics of each is included.

Where the Type number contains the prefix letters "XT", the instrument is tentatively scheduled to become a catalog item but experimental work is still being carried out to determine feasibility. Where an "X" only appears, production is reasonably well assured but final characteristics haven't been established. A Type number without prefix indicates completed development and availability from catalog.

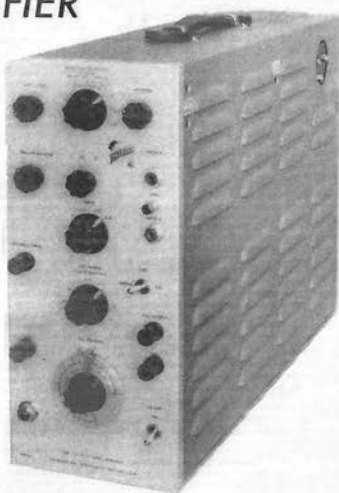
Suggestions as to desirable features which you would like to see included in TEKTRONIX instruments are always welcome and will receive consideration in full measure.

It is our sincere desire and intent to continue to supply our customers with instruments of maximum quality and usefulness as well as at minimum cost consistent with good business practices.



TEKTRONIX TYPE X-112

DC COUPLED AMPLIFIER



1. When used with a Cathode Ray Oscilloscope, whose Cathode Ray Tube has a basic deflection factor of 25 volts per centimeter, the deflection sensitivity (peak to peak) is 5 millivolts to 50 volts per centimeter. Expressed in terms of voltage gain, the range is .5 minimum to 5000 maximum, continuously variable by virtue of the range switch plus a fill-in potentiometer.

2. The input impedance is approximately 1 megohm — 45 mmfd. each side to ground for direct connection, but is approximately 10 megohms — 14 mmfd. each side to ground when using the two RC probes which are supplied as a part of the instrument. Either single ended or a differential input may be employed.

3. The maximum input voltage which may safely be applied is 600 volts.

4. Designed to work into a high impedance load (CRT plates), each output tube plate is connected to output terminals via 100 k. current limiting resistors and by-pass condensers. For other than design applications short circuiting the limiting components will provide an output impedance of 4000 ohms each plate to ground.



5. A maximum output voltage of approximately 150 volts (peak to peak) is available when working into high impedance load and approximately 75 volts (peak to peak) when used 4000 ohms to ground into matched load.

6. Band pass, DC — 2 mc. when voltage gain requirements are 150 or less, DC — 1 mc. when voltage gain requirements fall within the range of 150 to 5000.

7. By virtue of the compensation employed to provide optimum transient characteristics, the amplitude response curves are approximately 3 db. down at the high frequency points mentioned above. The rate of fall of the amplitude response curves, however, is quite gradual; appreciable and useful amplification existing considerably above the quoted points.

8. The front panel will mount the following controls and binding posts: deflection sensitivity control; amplifier attenuator control (range switch fill-in potentiometer); pre-amplifier balance control; position control; AC-DC switch (for insertion of coupling condensers, when desired); input-selector switch (for selecting single ended or differential input co-ax connectors or calibrating voltage of either polarity); calibrating voltage range switch (9 ranges, .5 millivolts to 50 volts); calibrating voltage control (fill-in potentiometer); calibrating voltage switch, normal-external; input "A" and input "B" co-ax connectors; calibrating output binding post; trigger output binding post; three ground binding posts; off-on switch and pilot light.

9. Output connections are from a right hand side access panel by means of banana jacks and plugs. Mounted at the rear of the scope, a co-ax connector permits the injection of time markers at a balanced point just ahead of the output stage without deleterious effect to other video signals present. Also, at the rear of the cabinet are two controls which determine the voltage point with respect to ground at which the output circuits (CRT deflection plates when so used) function.

10. Power requirement 105-125/210-250 volts 50-60 cycles, approximately 200 watts.

11. Self-contained unit, dimensions 15 1/2" high, 6 1/2" wide and 21 1/2" deep. Total weight approximately 30 pounds.

12. Price, \$495.00, f.o.b. Portland, Oregon.



TEKTRONIX TYPE X-121

WIDE BAND PRE-AMPLIFIER

The Type X-121 Wide Band Pre-Amplifier is a self-contained three-stage amplifier designed primarily to increase the sensitivity of the Type 511, 511-A, and 511-AD oscilloscopes. A maximum voltage gain of 100 is available, increasing the sensitivity of the oscilloscope to 2.5 mv. per cm. A combination of step and continuous attenuators on the Type X-121 provides a complete range of sensitivity from 2.5 mv./cm. to 25 v./cm. without the use of the attenuators on the oscilloscope. Connection between the Type X-121 and oscilloscope is via a matched 93 ohm co-axial cable so that the separation of the instruments may be 100 ft. or more. As in all Tektronix instruments, primary emphasis has been placed on transient response. A bandwidth in excess of 10 mc. preserves the excellent rise time of the oscilloscope.

Careful design results in a high input impedance of 1 meg. shunted by 20 mmf., maintained for all positions of the attenuators. When desired, conventional RC probes may be used to increase this impedance at the expense of a reduction of gain. DC plate and heater supplies are available on a front panel socket so that when both high input impedance and high gain are necessary a cathode follower probe or a special pre-amplifier stage mounted directly on the signal source may conveniently be used.

The self-contained power supply in the Type X-121 provides electronically regulated DC for the plates of the tubes and to minimize the hum level, rectified, filtered DC is supplied to the filaments of the first three tubes as well as the external panel socket.

The entire unit is approximately 5" wide by 10" high by 14" long.



TEKTRONIX TYPE X-513

CATHODE - RAY OSCILLOSCOPE

In response to many requests from present Tektronix instrument users and others for an oscilloscope which incorporates the widely accepted features of the Type 511-A and Type 511-AD, but which also includes the "high writing rate" capabilities inherent in the newer cathode ray tubes, development is now being carried forward on the Tektronix Type X-513 Cathode Ray Oscilloscope.

The Type X-513 is expected to have a video pass band of 5 cycles to approximately 20 megacycles; vertical sensitivity of 30 mv./cm.; continuously variable sweep speed range of .1 microsecond/cm. to .01 sec./cm.; triggered, recurrent or single sweeps; a 1 kc. square wave voltage calibrator; utilize the 5X CRT with P-1, P-2, P-7 or P-11 screen optional; have a self-contained power supply providing approximately 12.5 kv. accelerating potential.

Dimensions of the X-513 are not expected to exceed 15 1/2" x 12 1/2" x 21 1/2", nor to exceed 60 pounds in weight.

Availability approximately January 1, 1950. Price approximately \$1,695.00.



VIDEO SIGNAL DELAY NETWORKS

TEKTRONIX TYPE 511 AND 511-A CATHODE RAY OSCILLOSCOPE

The type **1-AD-25** Video Delay Network is designed for use in the video amplifier of the Tektronix Type 511-A Oscilloscope. It provides a signal delay of .25 microsecond, thus permitting the CRT to be unblanked and the sweep to be operating linearly, before the initiating signal reaches the vertical deflection plates. By this method, random pulses may be observed.

The Type 511-AD Oscilloscope includes a factory installed Type **1-AD-25** Delay Network.

The Type **1-AD-25** consists of 23 *M*-derived sections. By using $M=1.27$, very uniform time delay is obtained for frequencies well above the cut-off of the Type 511-A output amplifier. To obtain smooth impedance matching between sections of the network, trimming capacitors are provided. These are adjusted at the factory and should not require resetting in the field.

The output termination consists of the **Vert. Ampl. Atten.** potentiometer, shunted by R2 to match the characteristic impedance of the network. To make this termination less critical, the network is partially matched at the input by the 270 ohm resistor R1 in series with the internal impedance of the cathode follower V17. This input matching produces an insertion loss of 3 db., but is necessary since the impedance of the output termination varies slightly with the setting of the **Vert. Ampl. Atten.** potentiometer.

When the delay network is not needed, it may be removed from the circuit by means of a rotary switch operated from the front panel.

The **1-D-25** Video Delay Network differs only in that it is physically suited for use with the Tektronix Type 511 Oscilloscope.

Either delay Network is suitably engineered for simple field installation and full instructions are provided.



VERTICAL DEFLECTION POLARITY SWITCH - MODIFIKATION KIT

FOR TEKTRONIX TYPE 511-A AND TYPE 511-AD
CATHODE RAY OSCILLOSCOPE

To increase the undistorted deflection when observing pulses of a particular polarity, provision is made to move the operating point of the push-pull output amplifier from its normal position to one which allows almost the entire output swing to be utilized in either one direction or the other.

A three-position lever-type switch mounted at the rear of the Type 511-A and 511-AD permits the operating bias on grid No. 1 of V19 to be varied. With the switch set at the center (normal) position, the bias applied to V19 is equal to the bias of V18, resulting in balanced operation and equal upward and downward undistorted deflection of the trace.

If it is desired to observe pulses, the switch should be set in either the upward or downward position, corresponding to the deflection of the image on the cathode ray tube. In the upward position, the bias of V19 is increased, resulting in decreased output of V19 and increased output of V18, thus permitting greater undistorted upward deflection. These conditions are reversed when the deflection polarity switch is in the downward position.

Available through the Tektronix Field Sales Engineer for your area or direct from factory. Please mention Type 511-A or Type 511-AD serial number.



TEKTRONIX

TYPE X R-500

"SCOPE-MOBILE"



The "SCOPE-MOBILE" has been especially designed to accommodate the Tektronix Type 511-A, 511-AD, 512, X513 and XT517 Cathode Ray Oscilloscopes. It provides a mobile and therefore highly useful support for the oscilloscope. Convenient and easy observation of the CRT face is achieved by a 20° tilt back which is given to the front panel of the instrument used.

A blank panel, 10" x 16", fronting a mounting space of approximately 1 1/2 cubic feet allows for auxiliary built-in equipment to aid in meeting specialized requirements. This space is fully ventilated by means of louvres.

Convenient provision is made for the storage of cords, probes, instruction books, small tools, etc., in the form of a drawer 15" x 15" x 3" deep. An open shelf 16" x 24" is located at the bottom of the unit.

The "SCOPE-MOBILE" is mounted on 4" rubber-tired wheels, two fixed and two castering. The entire unit is constructed of aluminum alloy materials and is finished in bright aluminum and baked grey crackle to match other Tektronix products.

Total "dry" weight of the "SCOPE-MOBILE" is 42 pounds and clearance dimensions are 18 1/2" wide x 39" high x 30" deep.



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TEKTRONIX, INC.

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All price revision and design modification privileges reserved.



This booklet is presented for the primary purpose of passing along information to our customers which will tend to materially enhance the usefulness of their TEKTRONIX instruments.

The service notes and modification information contained herein include suggestions from TEKTRONIX instrument users (possibly yourself) and TEKTRONIX Field Engineers, gratefully acknowledged herewith, as well as improvements which have come to light in our own development laboratory and production test activity.



TEKTRONIX SERVICE NOTES

SERVICE NOTE NO. 1

SWEEP SPEED, SLOW

This item pertains to the 30k, 10-watt, sweep amplifier plate load resistors R59 and R63 in the Tektronix Type 511 instruments, Serial Nos. 236 through 280.

After a period of use, some of the above mentioned resistors used in this position have been found to decrease seriously in resistance. This defect will cause reduced sweep speeds and a positive change in the average DC potential of the horizontal deflection plates. The sweep speed may be checked with an accurate oscillator and the average DC potential to ground on the horizontal deflection plates may be measured at the side access panel with the sweep off. This average potential should be between minus 40 and plus 40 volts and the tests must be made at 117 line volts.

SERVICE NOTE NO. 2

LEAD DRESS, CRT SOCKET TO SIDE ACCESS PANEL

Whenever replacement of the cathode ray tube in a Tektronix oscilloscope is necessary, the deflection plate leads from the side access panel to the CRT socket should be very carefully dressed apart from each other and away from the metal framework or other wires. Excessive capacity at this point will decrease the high frequency response.

SERVICE NOTE NO. 3

REPLACEMENT OF FIRST VIDEO AMPLIFIER TUBE, 6AG7 - V16

Whenever it is necessary to replace the first video amplifier tube in either the Type 511 or the Type 511-A Oscilloscope, the adjustment of C44 should be checked in accordance with the instruction book which accompanied each individual instrument. If the proper wave shape cannot be obtained by readjustment of C44 (the lower trimmer on the input channel selector switch) another 6AG7 should be tried, since occasionally a 6AG7 is found which is completely unsuitable for this circuit.



SERVICE NOTE NO. 4

JITTER, SWEEP, AT LINE FREQUENCY

Trouble of this nature in Type 511 or Type 511-A Oscilloscope is usually traceable to V12, the 6AL5 DC restorer, and is usually caused by a heater-cathode leakage in V12 which, of course, may be corrected by replacement.

SERVICE NOTE NO. 5

UNSTABLE TRACE, TYPE 511

Erratic shifting of the trace, usually at a low rate, is often found to be due to a defective VR105 voltage reference tube, V28. This trouble may be checked visually, inasmuch as the drift in the trace position will coincide with the fluctuation of the glow in the VR105 tube. After replacing V28, the regulated supply voltage should be checked with an accurate voltmeter and readjusted to 225 volts with R167 if necessary.

SERVICE NOTE NO. 6

ERRATIC SYNCHRONIZATION, ANY SWEEP SPEED

There is a possibility of erratic operation in some Type 511 oscilloscopes, evidenced by the loss of synchronization at random intervals due to an arc to ground from some portion of the minus 1500 volt circuit. In some units below Serial No. 320, the cause may be lack of sufficient spacing between the supporting clamp for condenser C60 (located on the intensity-focus assembly board) and the safety cover shield which is used as a protection against the high voltage. The cover should be bent or a portion of the clamp cut off in order that a minimum spacing of $\frac{1}{8}$ inch exists between clamp and cover.

In some instruments between Serial Nos. 330 and 390, the intensity and focus controls were supplied with bakelite insulated flexible couplings. It is possible for an arc of sufficient magnitude to cause erratic synchronization to develop due to leakage in the coupling. This trouble may be remedied by the installation of a ceramic insulated coupling (Bud No. FC-795) in place of the original.



SERVICE NOTE NO. 7

ERRATIC SYNCHRONIZATION, ANY SWEEP SPEED, TYPE 511-A OSCILLOSCOPE

This effect, as indicated by a random shifting of the observed wave form may be caused by an internal arcing in the 1B3GT rectifier tubes between the unused base pins and internal leads. This difficulty may be eliminated by strapping together terminals 1, 3, 5, 6, 7 and 8 on each 1B3GT socket. Be sure that adequate spacing is provided from other terminals. This modification has been made on all Type 511-A scopes shipped since January 1, 1949, and began with serial No. 572.

SERVICE NOTE NO. 8

SYNCHRONIZATION POOR AT HIGH FREQUENCIES

If synchronization is poor when observing signals in the 10 megacycle region, and the trigger amplifier and trigger circuits appear normal, it is quite likely that the 6AG7 multi-vibrator, V5, is at fault. If this feature is particularly important, extra care should be exercised in the selection of V5, inasmuch as the 6AG7 tubes vary considerably in this characteristic.

SERVICE NOTE NO. 9

SHIELD, CATHODE RAY TUBE

The cathode ray tube shields which are used in Tektronix oscilloscopes are made of hydrogen annealed MU-metal. They should be treated with extreme care, as machining, drilling or careless handling may result in a large scale reduction of their magnetic shielding properties.

SERVICE NOTE NO. 10

TYPE 511-A OSCILLOSCOPE ONLY

Improved linearity of sweep and greater accuracy in the indication of sweep speed in the 1 to 10 microsecond range may be obtained by changing values of the sweep generator and sweep amplifier circuit components as follows:



R44 from 1.5 k, 1/2 w to 4.7 k, 1/2 w
C15_{aa} from 35 uuf to 20 uuf
R59 from 30k, 10w to 25 k, 10w
R63 from 30k, 10w to 25k, 10w
R62 from 4.7k, 2w to 1.2 k, 1w

After these changes have been made, it will be necessary to readjust the sweep speed calibration as explained in section 4 of the Type 511-A instruction manual. All type 511-A instruments shipped after December 7, 1948, beginning with serial No. 516, include the above improvement.

SERVICE NOTE NO. 11

INTENSITY MODULATION, TYPE 511-A OSCILLOSCOPE

Intensity modulation of the electron beam at the high voltage power supply frequency may be observed when using the instrument at low spot intensity. If this effect becomes objectionable, it may be eliminated by the addition of a filter condenser and resistor to the negative high voltage supply as follows: Remove R173, 50 megohm positive supply bleeder resistor and re-install it between high voltage transformer terminal No. 4 and ground terminal on mounting board adjacent to 6AQ5 socket. Install a 27k, 1/2 w resistor between V33, 1B3, pin 4 (plate tie point) and C77, .5 mfd., 2000 v. condenser. Connect a 2000 v., .01 to .05 condenser from V33, 1B3, pin 4 to ground. This modification has been made in all 511-A instruments shipped since December 18, 1948, and began with serial No. 530.

SERVICE NOTE NO. 12

TRIGGER MODIFICATION

This note applies to all Type 511 or Type 511-A Oscilloscopes shipped on or before February 14, 1949. Instruments shipped after this date beginning with serial No. 634 were modified at the factory.

Changing from positive to negative internal trigger may cause a small variation in the observed wave form of high speed transients, especially in the two stages position. This condition may be overcome by additional by-passing at the screen of the 6AG7 cathode follower, V17. Connect a .01, 400-volt condenser between V17, pin 6, and the nearest ground lug of electrolytic condenser C39. A paper tubular unit is satisfactory.



SERVICE NOTE NO. 13

L. F. RESPONSE MODIFICATION

This note applies to all Type 511 and Type 511-A Oscilloscopes shipped prior to January 25, 1949. Beginning with serial No. 613, this modification was factory installed.

Coupling of the signal through the video amplifier, via the vertical positioning circuit, introduces a slight increase in gain at frequencies below 10 cycles per second. This effect may be objectionable when observing square wave signals of 50 cycles or less when the input channel selector is in the direct or via condenser position. It may be eliminated by rewiring the third (from front) section of the input channel selector switch, as follows:

Remove the 1 meg. resistor R118, and connect it between the rotor (11 o'clock) contact and the dummy (8 o'clock) lug. Remove the insulated wires from the 12 o'clock and 1 o'clock contacts and connect them to the dummy (8 o'clock) lug. Connect a jumper between the dummy (8 o'clock) lug, and the direct position (12 o'clock) contact.

SERVICE NOTE NO. 14

SWEEP MAGNIFIER MODIFICATION, TYPE 511 AND TYPE 511-A OSCILLOSCOPES

Improved stability of the Sweep Magnifier may be obtained by providing a D.C. restorer circuit, utilizing the unused section of V6, 6A15, by the following sweep circuit changes:

| REMOVE | BETWEEN | AND |
|-------------------|---------------------------------|-----------------------|
| 1 R48, 10k, 1w | Vert. board term. 12a | Vert. board term. 12b |
| 2 R49, 10k, 1w | Vert. board term. 11a | Vert. board term. 11b |
| * 3 Bare strap | Vert. board term. 2b, 4a, 5b | |
| 4 Bare strap | Vert. board term. 3b | V6, 6A15, pin 7 |
| 5 Bare strap | Vert. board term. 12b | V11, 6J6, pin 7 |
| 6 Bare strap | V11, 6J6, pin 6 | V10, 6C4, pin 6 |
| MOVE | FROM | TO |
| 7 Insulated strap | V6 6A15, pin 1 | V6, 6A15, pin 5 |
| 8 Insulated strap | V11, 6J6, pin 6 | V10, 6C4, pin 6 |
| 9 Bare strap | V11, 6J6, pin 6 | V10, 6C4, pin 6 |

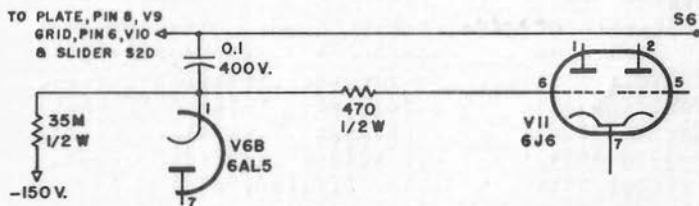


| CONNECT | BETWEEN | AND |
|--------------------------------|--------------------------------------|--------------------------------------|
| *10 Insulated strap | Vert. board term. 4b | Vert. board term. 12b |
| *11 Insulated strap | Vert. board term. 2b | Vert. board term. 5b |
| 12 Bare strap | Vert. board term. 3a | Vert. board term. 4a |
| 13 .1 mf, 400v. solite | Vert. board term. 12a (back side) | Vert. board term. 12b (back side) |
| *14 35 meg., 1/2 w | Vert. board term. 4a | Vert. board term. 4b |
| 15 18k, 2w, or par. 39k, 1w | Vert. board term. 11a | Vert. board term. 11b |
| 16 470 ohm, 1/2 w | Vert. board term. 12b | V11, 6J6, pin 6 |
| 17 Insulated strap | Vert. board term. 11a | V11, 6J6, pin 7 |
| 18 Bare strap | Vert. board term. 3b | V6, 6AL5, pin 2 |
| *19 Bare strap | Vert. board term. 4b | V6, 6AL5, pin 1 |
| *20 Bare strap | Vert. board term. 12a | V9, 6AG7, pin 8 |
| 21 Bare strap | V6, 6AL5, pin 4 | V6, 6AL5, pin 7 |

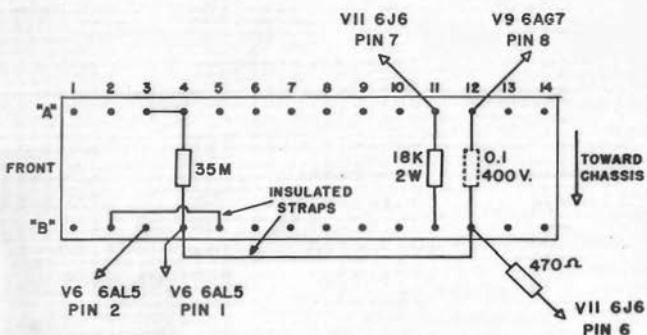
***SPECIAL NOTES FOR TYPE 511 OSCILLOSCOPE ONLY**

- Step 3. Omit this step in Type 511 Oscilloscope. See Step 11 note.
- Step 10. In some Type 511 Oscilloscopes which have a resistor mounted on vertical board terminals 4a and 4b, connect the front end of this jumper directly to V6, pin 1.
- Step 11. Omit this step in Type 511 Oscilloscopes as this jumper is already in place, factory installed.
- Step 14. Omit this step if note for Step 10 applies.
- Step 19. If note for Step 10 applies, this resistor connects between 3a and V6, pin 1.
- Step 20. If note for Step 10 applies, omit Step 20.

CIRCUIT AS MODIFIED



TYPE 511-A OR 511-AD OSCILLOSCOPE VERTICAL TERMINAL BOARD AS MODIFIED



With the sweep magnifier out, set the sweep range switch at the 1 microsecond position and adjust C15a for correct sweep speed, using an accurate oscillator. This is necessary because of added circuit capacity.

This modification was made at the factory on all oscilloscopes with serial No. 581 or higher and on No. 550 in addition.

SERVICE NOTE NO. 15

TEKTRONIX TYPE 104 SQUARE WAVE GENERATOR

On occasion, an undesirable 50-60 cycle frequency modulation of high frequency signals from the Type 104 may be noticed. This effect is evidenced, on the scope being used in observation, as a trace which begins in normal fashion, but develops increased width of vertical lines with an increase in horizontal deflection. This unwanted modulation is introduced by the heaters of some 6AG7 tubes when used in the V-1 and/or V-2 high frequency multivibrator positions. In making correction, it may be necessary to try several 6AG7's inasmuch as some brand new tubes exhibit this characteristic. When used in position V-3 or V-4, a 6AG7 of this sort will introduce amplitude modulation at line frequency, especially noticeable at the trigger output.



SERVICE NOTE NO. 16

TEKTRONIX TYPE 104 SQUARE WAVE GENERATOR

Improved low frequency rise time may be obtained by the addition of a 2.2 meg. $\frac{1}{2}$ -watt resistor connected between the low frequency +200 volt line and the junction of C21, R65 and R66. This permits the limiting of the multivibrator output by the diode section of V7 to occur at a lower point. To preserve the waveform in the 50-cycle position, C22 must be increased. (1mf. is recommended.)

This modification has been factory made on all production Type 104 units except Serial Nos. 102, 103, 106, 108 and 109. Component parts for modification of the previously mentioned instruments will be furnished at no charge upon request.

SERVICE NOTE NO. 17

TEKTRONIX TYPE 104 SQUARE WAVE GENERATOR

Increased amplitude of the trigger output (from both low and high frequency sources) may be accomplished by the addition of a 22 meg-ohm $\frac{1}{2}$ -watt resistor, R39, between the +200 volt bus and pin 6 of V5 in the high frequency section, and changing R70 from 10k to 18k in the low frequency section of the circuit. The above changes have been factory made in all units with serial No. 122 and above, as well as numbers 104 and 116 in addition. Resistors for modification will be furnished at no charge upon request.



OUR CONTINUING CREED

is that of serving Tektronix customers with products and policies that are unexcelled in the electronics industry and limited only by the current state of the art.

