



**CATHODE - RAY OSCILLOSCOPES**  
**AUXILIARY INSTRUMENTS AND ACCESSORIES**

AUGUST 1954



**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.***



TEKTRONIX INC.

## TEKTRONIX, INC.

*was organized as an Oregon Corporation in January 1946 for the purpose of developing and manufacturing cathode-ray oscilloscopes. The owners all had extensive wartime electronic experience, in either military or civilian capacities. All hold active supervisory or engineering positions in the organization.*

*In reviewing this backlog of experience, a large portion of which pertained to oscilloscopes, it was felt that a valuable contribution could be made in this field. This decision has been strengthened by the passage of time, and by the exceptional response of science and industry to the efforts that have been put forth.*

*The primary interest of Tektronix is the further development and improvement of the oscilloscope, not only as a "quality observation" device but, increasingly, as an accurate tool capable of precise quantitative measurements of time and amplitude. All present efforts are toward accomplishment of this goal, and all other Tektronix instruments have been developed for the purpose of supplementing and augmenting the operation of the oscilloscope.*

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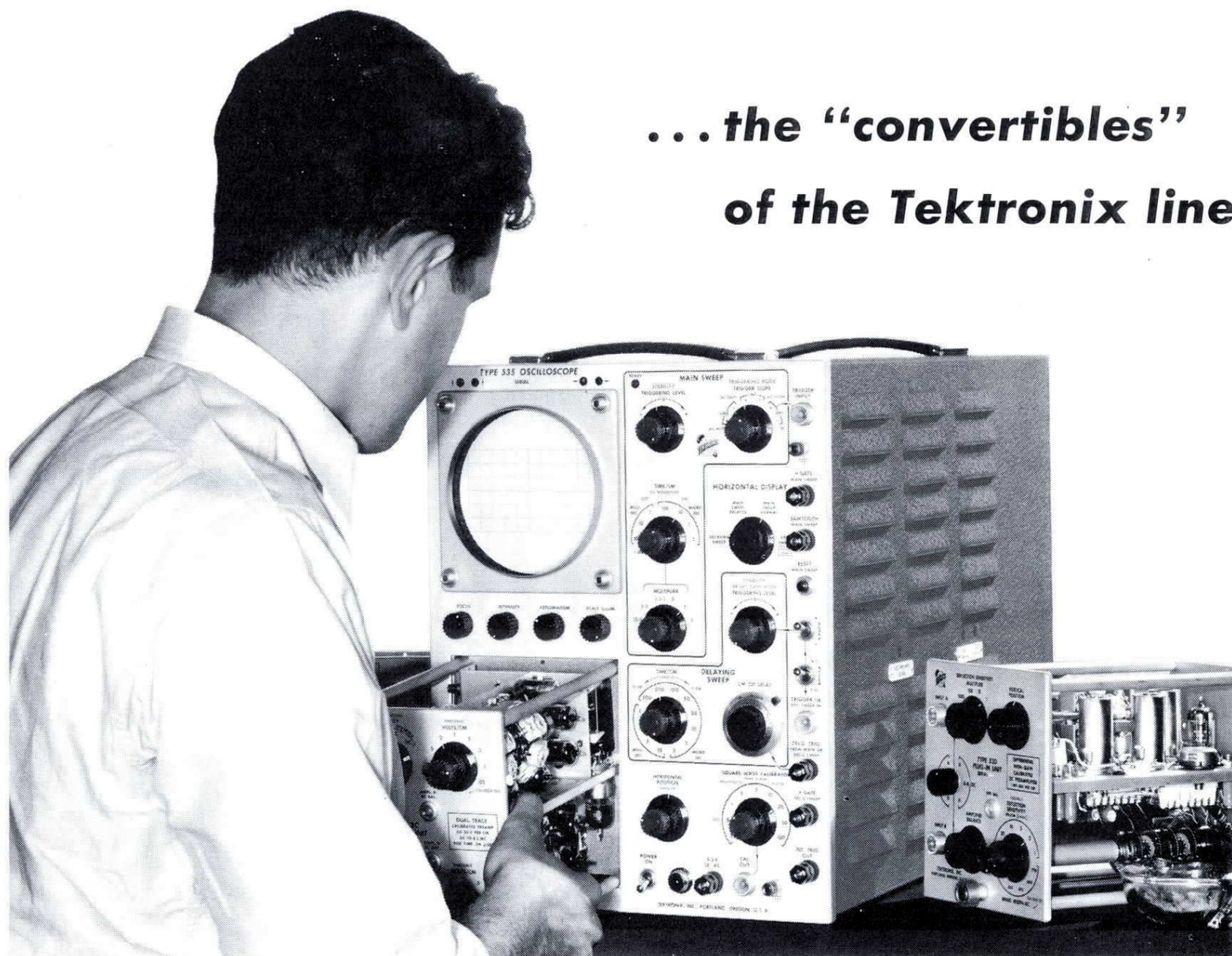
## NEW INSTRUMENTS

*Field reports relating to present and future instrumentation requirements influence the design of new Tektronix products. This section contains our interpretation of these reports in new instruments currently in production. Every effort is made to provide the greatest utility to the user, consistent with sound engineering and manufacturing practices.*

# Type 531 Type 535

## CATHODE-RAY OSCILLOSCOPES

... the "convertibles"  
of the Tektronix line



### ENGINEERED TO KEEP ABREAST OF THE INDUSTRY

Broad basic specifications of these oscilloscopes permit their conversion to widely differing applications by merely plugging in the appropriate vertical preamplifier. The oscilloscopes are designed to work through a far wider range than any previous models, and only by the use of interchangeable vertical preamplifiers can full advantage be taken of their capabilities. By designing the preamplifiers as plug-in units a new high in versatility and convenience is achieved.

As you examine the descriptions and specifications on the following pages, you'll be pleasantly surprised by the time-saving possibilities that will occur to you. Here is real, acceptable economy . . . definite savings in time and money combined with greater convenience and better performance.

The practical way for you to meet today's *and tomorrow's* oscilloscope requirements

# TYPE 530 SERIES OSCILLOSCOPES

## TYPE 531 CATHODE-RAY OSCILLOSCOPE

### 600,000,000 to 1 Sweep Range

0.02  $\mu\text{sec}/\text{cm}$  to 12  $\text{sec}/\text{cm}$ .

### 10-KV Accelerating Potential

Brighter display at low repetition rates.

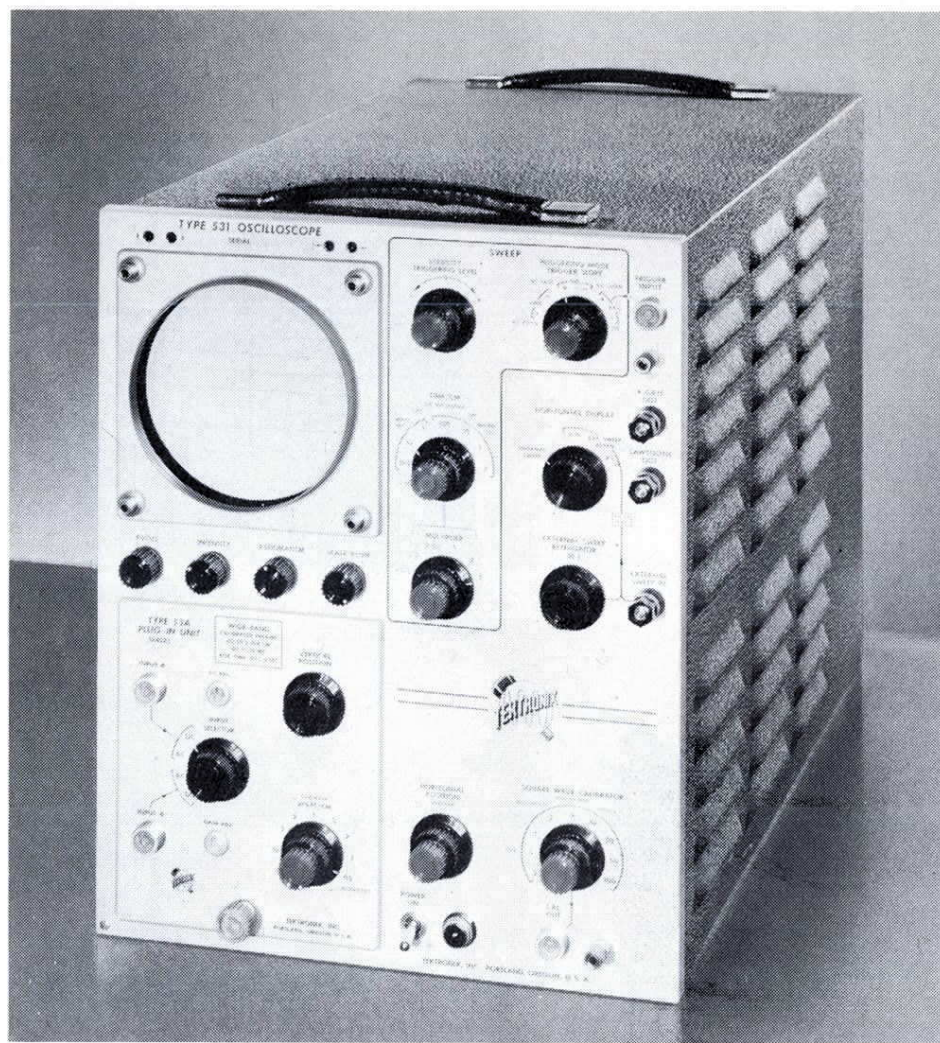
### Horizontal Input Amplifier

Sensitivity 0.2  $\text{v}/\text{cm}$  to 20  $\text{v}/\text{cm}$ , continuously variable.

### DC-Coupled Unblinking

### Balanced Delay Network

### Beam-Position Indicators



### GENERAL DESCRIPTION

The Type 531 basic oscilloscope unit is designed for general purpose laboratory use. With plug-in units, it is capable of handling most laboratory requirements. Many new features make this instrument easier to use than most conventional oscilloscopes. Exceptionally wide sweep range and high accelerating potential extend the working range beyond previous limits. Calibrated controls for accurate time and amplitude measurements, choice of automatic triggering or trigger amplitude selection, and beam position indicators add to the utility of this versatile new oscilloscope.

### VERTICAL DEFLECTION SYSTEM

**DC-Coupled Output Amplifier**—A wide-band dc-coupled output amplifier is used, factory adjusted for optimum transient response. Cathode followers are used to drive the cathode-ray tube deflection plates.

The Type 531 vertical deflection system is designed for use with any one of the Type 53 Plug-In Preamplifiers. In order to operate the Type 531, one of the Type 53 Series Preamplifiers must be plugged in.

**Balanced Delay Network**—A signal delay of 0.25  $\mu\text{sec}$  is provided by the new balanced (push-pull) delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

**Direct input to CRT**—An aperture in the side of the cabinet permits direct connection to the cathode-ray tube deflection plates.

### HORIZONTAL DEFLECTION SYSTEM

The new Miller runup type sweep generator is used in the Type 531. Inverse feedback in the timing circuitry assures excellent linearity. Characteristics of this new circuitry make possible the extremely wide sweep range of 0.02  $\mu\text{sec}/\text{cm}$  to 12  $\text{sec}/\text{cm}$ .

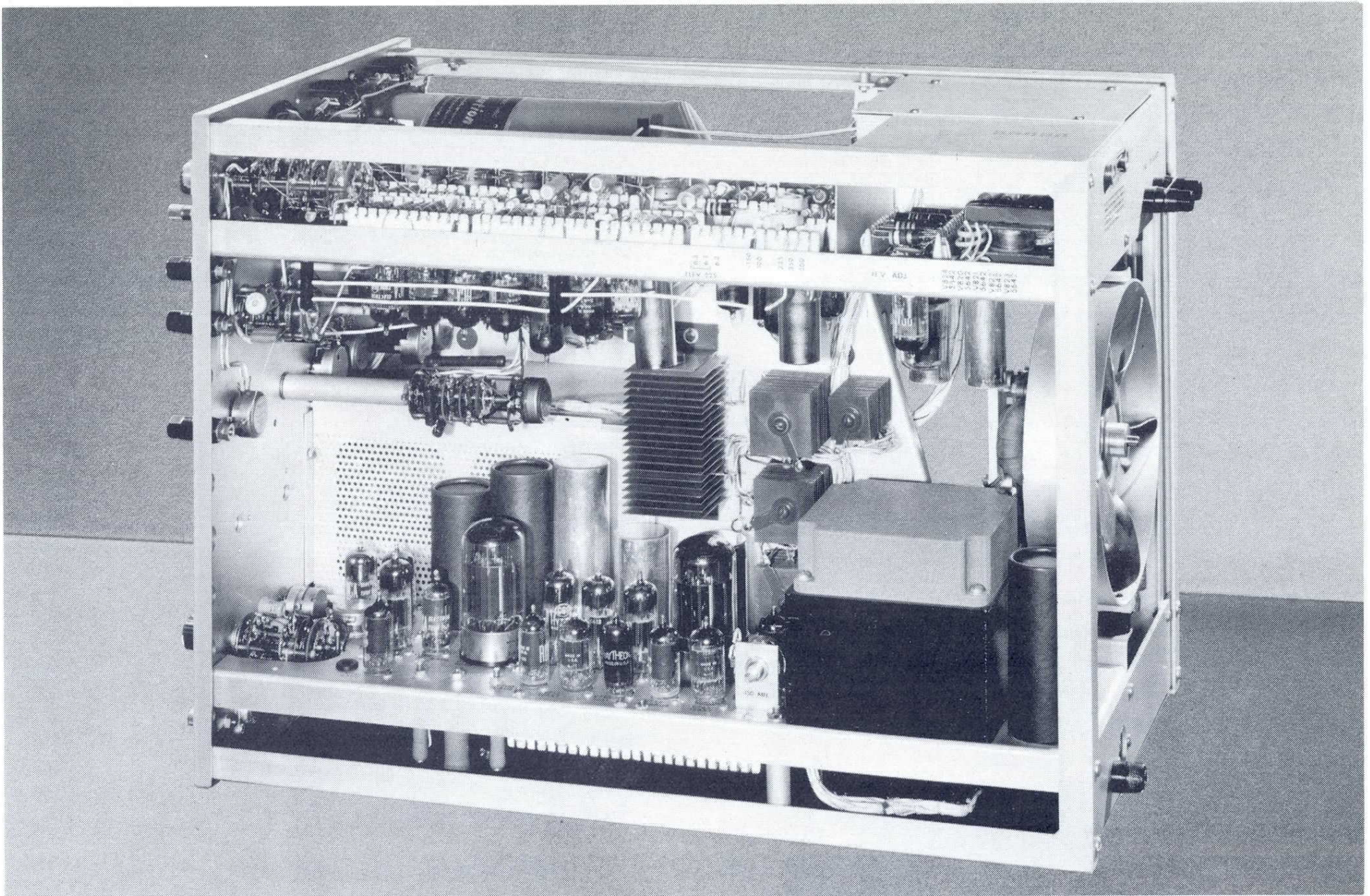
**Calibrated Sweeps**—Twenty-four calibrated sweeps, accurate within 3%, are available. Main sweep control has eight positions—0.1, 1, 10, 100  $\mu\text{sec}/\text{cm}$ , . . . 1, 10, 100  $\text{msec}/\text{cm}$ , . . . 1  $\text{sec}/\text{cm}$ . Multiplier positions of 1, 2 and 5 for each of the main sweep steps provide for a total of 24 calibrated sweeps. The remaining three positions on the multiplier switch are 2.5-to-1, 5-to-2, and 12-to-5 variable positions, making the sweep time continuously variable from 0.1  $\mu\text{sec}/\text{cm}$  to 12  $\text{sec}/\text{cm}$ . The 5-x magnifier applied to the 0.1- $\mu\text{sec}/\text{cm}$  sweep extends the calibrated sweep range to 0.02  $\mu\text{sec}/\text{cm}$ .

**Sweep Magnifier**—Sweep magnification is obtained by increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the trace is expanded to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accurate 5-x magnification is obtained on all ranges.

**DC-Coupled Unblinking**—DC coupling is provided for the unblinking waveform. This assures uniform bias on cathode-ray tube for all sweep times and repetition rates.

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# TYPE 530 SERIES OSCILLOSCOPES



**Triggering Level**—The amplitude level where triggering occurs may be selected with the TRIGGERING LEVEL control. Permits triggering the sweep at a selected level on simple or complex waveforms.

**Automatic Triggering**—With the TRIGGER MODE switch in the AC AUTO position, the sweep will be triggered by any recurrent incoming signal from 60 cycles to 2 megacycles. Signals differing in frequency, amplitude, and shape can be observed without readjustment of the triggering controls. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the crt screen.

**Trigger Requirements**—Internal triggering—a signal large enough to cause 2-mm deflection. External triggering—a signal of 0.5 v to 100 v.

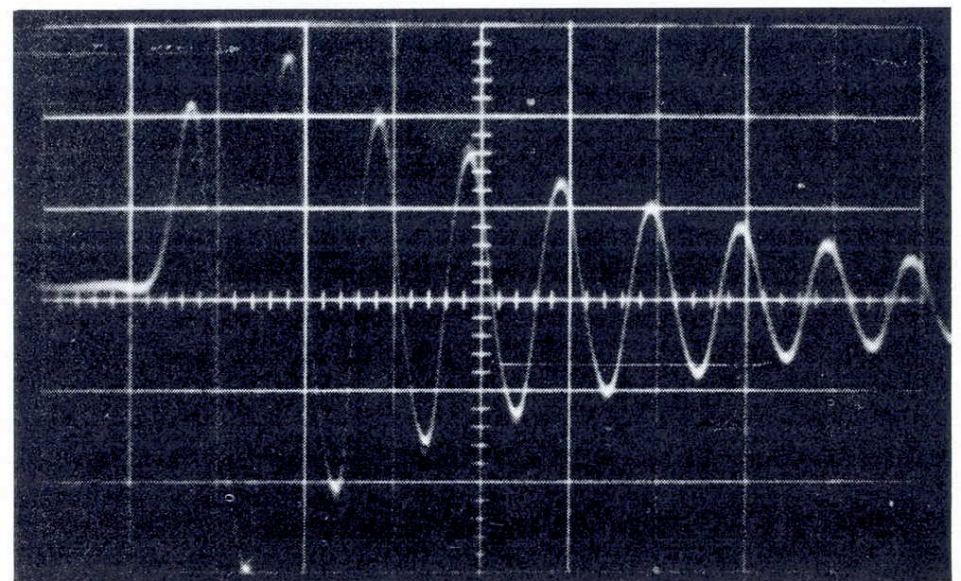
**Trigger Selection**—The TRIGGER SELECTOR is a coaxial control. Triggering from either the positive or negative slopes of internal, external, or line voltage signals is selected by the outer knob. The inner knob is used to select the triggering mode—ac, dc, or automatic triggering.

**Horizontal Input Amplifier**—DC-coupled external connection to the sweep-output amplifier is through a front-panel connector. Combination of a step attenuator and variable attenuator makes the horizontal input sensitivity continuously variable from 0.2 v/cm to 20 v/cm. Passband is dc to 400 kc.

## OTHER CHARACTERISTICS

**Accelerating Potential**—10-kv accelerating potential assures bright display when using fast sweeps at low repetition rates, and in single-sweep applications. The T51P, a new Tektronix cathode-ray tube, is used in the Type 531. The T51P is a 5" flat-faced metallized tube with a helical post-accelerating anode. Deflection-plate connec-

### Single-Sweep Recording



10-mc damped oscillation on a single 0.1- $\mu$ sec/cm sweep, photographed at f1.9 on 35-mm Linagraph Pan. Type 531 Oscilloscope with P11 crt screen. Recorded writing rate—175 cm/ $\mu$ sec.

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# TYPE 530 SERIES OSCILLOSCOPES

tions are brought out at the neck. For best results over the wide sweep range of the Type 531, a P2 phosphor is used.

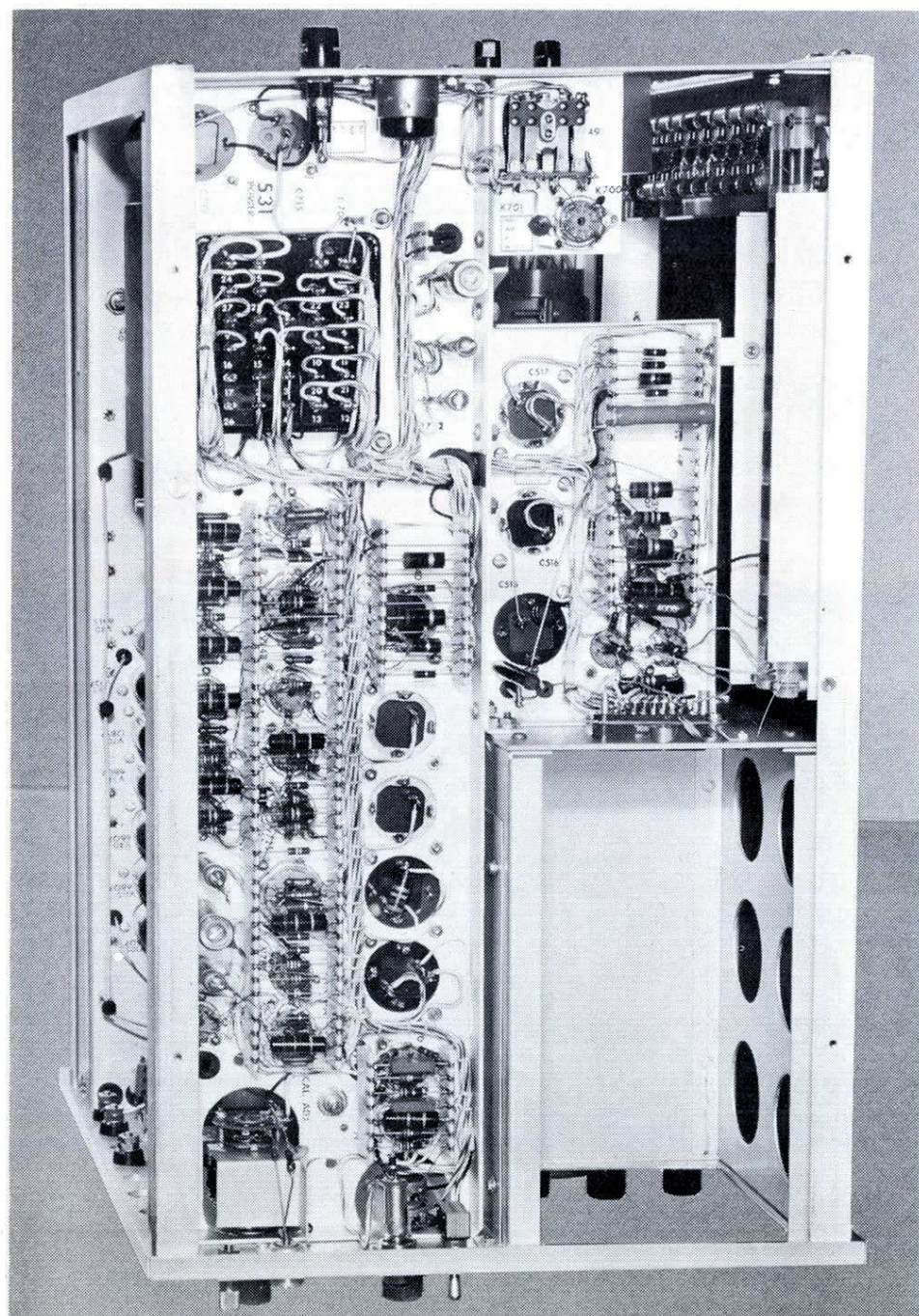
**Regulated Power Supply**—Electronic regulation compensates for line-voltage variations between 105 and 125 v, and for current-demand differences among the Type 53 Series Preamplifiers.

**Amplitude Calibrator**—A square-wave calibration voltage is available through a front-panel uhf connector. Eighteen fixed steps—0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 millivolts, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

**Output Waveforms**—A positive-gate voltage of the same duration as the sweep and the sweep-sawtooth waveform are available at front-panel binding posts via cathode followers.

**Beam Position Indicators**—Two pairs of indicator lights shows direction of the electron beam when it is not on the screen.

**Illuminated Graticule**—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.



## VACUUM TUBE COMPLEMENT

Vertical Amplifiers . . . . .	2	6BQ7A
Vertical Amplifier CF . . . . .	2	6BQ7A
Vertical Amplifiers . . . . .	2	12BY7
Sweep Generator . . . . .		6CL6
Sweep Generator CF . . . . .		6BQ7A
Unblank and Holdoff CF . . . . .		6BQ7A
Trigger Inverter . . . . .		6BQ7A
Horizontal Position and Cal Output CF . . . . .		6BQ7A
Horizontal Drive CF . . . . .		6BQ7A
Horizontal Amplifier . . . . .		6BQ7A
Horizontal Output CF . . . . .		6BQ7A
Positive Multivibrator and CF . . . . .		6BQ7A
Sawtooth and Gate CF . . . . .		6BQ7A
Multivibrator CF . . . . .		6BQ7A
Internal Trigger CF . . . . .		6BQ7A
External Horizontal Amplifier . . . . .		6BQ7A
Trigger Shaper Amplifier . . . . .		6U8
Internal Trigger Amplifier . . . . .		6U8
Cal Multivibrator . . . . .		6U8
External Horizontal Amplifier CF . . . . .		12AU7
Negative Multivibrator . . . . .		12BY7
Sweep Start Compensator . . . . .		12BY7
Dual-Trace Trigger Amplifier . . . . .		6AU6
Disconnect Diode . . . . .		6AL5
High-Voltage Oscillator . . . . .		6AU5
High-Voltage Rectifiers . . . . .	5	5642
Regulator . . . . .		12AU7
Voltage Reference . . . . .		5651
Series Regulators . . . . .	2	6080
Regulator Amplifiers . . . . .	5	6AU6
Comparator Amplifiers . . . . .	2	12AX7
Series Regulators . . . . .	4	12B4
Cathode-Ray Tube . . . . .		T51P2

## MECHANICAL SPECIFICATIONS

**Ventilation**—Safe operating temperature is maintained by filtered, forced-air ventilation.

**Construction**—Electrically-welded aluminum alloy cabinet and chassis.

**Finish**—Photo-etched anodized panel, gray wrinkle cabinet.

**Dimensions**—24" long, 13" wide, 16" high.

**Weight**—61½ lbs.

**Power Requirements**—117/234 v, 50-60 cycles, 475 watts with Type 53C unit plugged in.

**Price**—\$995 f.o.b. Portland (Beaverton), Oregon  
(Less Plug-In Preamplifiers)

Includes: 2—P510A probes  
2—A510 binding post adapters  
1—F510-5 green filter  
1—Instruction Manual

### Currently Available Extras

P2 crt phosphor normally furnished,  
P1, P7, P11 optional . . . . . No extra charge  
Several other phosphors can be furnished on special order.

### Recommended Additional Accessories

EP53 Plug-In Extension—for making attenuator and transient response adjustments . . . . . \$5

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# TYPE 530 SERIES OSCILLOSCOPES

## TYPE 535 CATHODE-RAY OSCILLOSCOPE with New Delayed Sweep

### GENERAL DESCRIPTION

The Type 535 Cathode-Ray Oscilloscope is actually the Type 531 plus the new Tektronix lockout-reset sweep-delay circuitry. All major specifications other than those pertaining to the sweep-delay circuitry are the same. Please refer to the Type 531 section for these specifications.

### WIDE-RANGE SWEEP DELAY

1  $\mu$ sec to 0.1 sec, continuously variable.

#### Conventional Operation

Time-jitter less than 1 part in 20,000.

#### Triggered Operation

Jitter-free at any magnification, even in the presence of actual signal jitter.

#### Accurate

Incremental accuracy within 0.2% of full scale.

#### Trigger-Rate Source

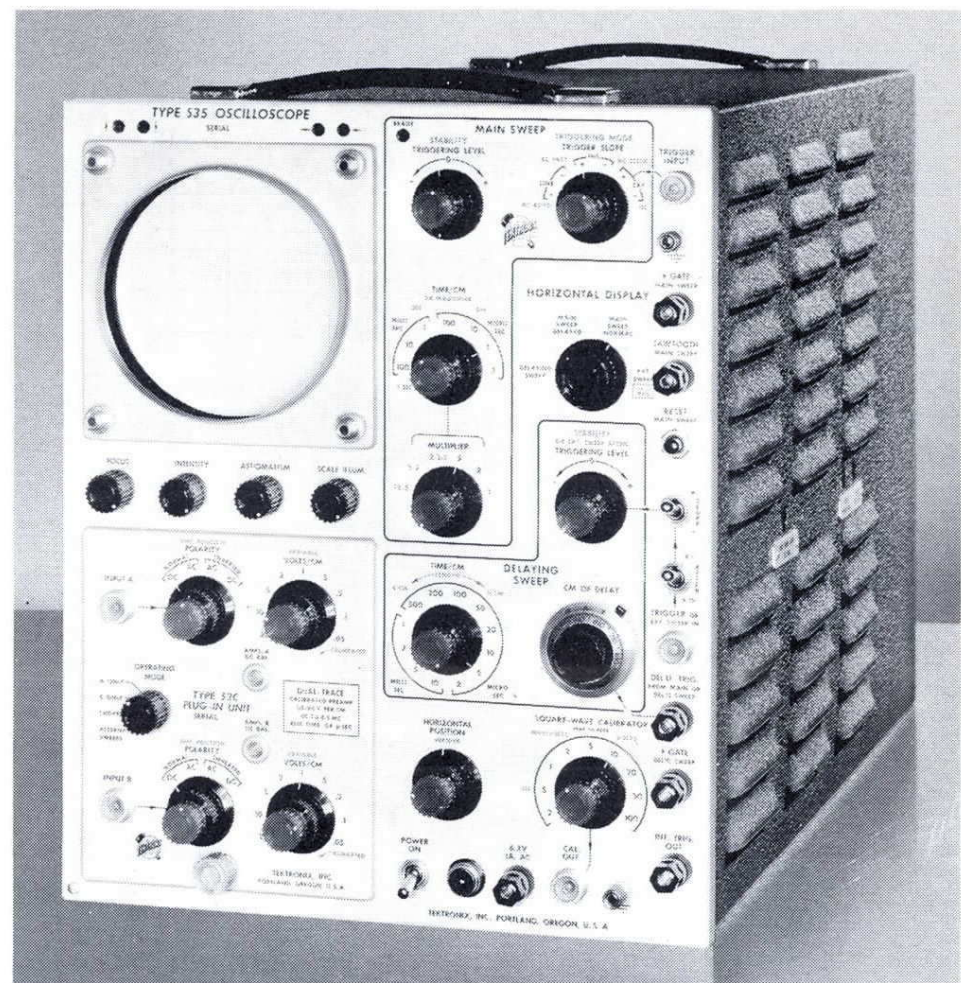
10 cycles to 50 kc, continuously variable.

**ALL OTHER MAJOR SPECIFICATIONS  
SAME AS TYPE 531**

### DELAYED SWEEP

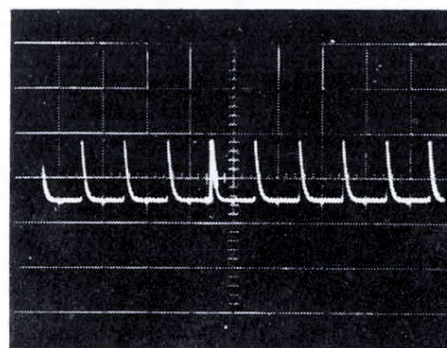
Two modes of operation permit use as a conventional delayed sweep, or as a triggered delayed sweep. In conventional operation the sweep starts immediately after the period of delay. In triggered operation the sweep does not start until it receives the first signal after the period of delay. Time-jitter is less than 1 part in 20,000 when the delayed sweep is operated in the conventional manner. Auxiliary equipment may be used to further stabilize delay, reducing time-jitter to less than one part per million. In triggered operation, jitter-free operation is obtained at any magnification, even in the presence of actual signal jitter.

Sweep delay is accomplished in the Type 535 by use of a second sweep called the DELAYING SWEEP. A position on the HORIZONTAL DISPLAY switch provides for displaying the delaying sweep on the cathode-ray tube screen. When the delaying sweep is displayed on the screen, the main sweep appears upon it as a section of increased brightness. With the signal applied to the delaying sweep, the main sweep may be ranged out or in, to position its start



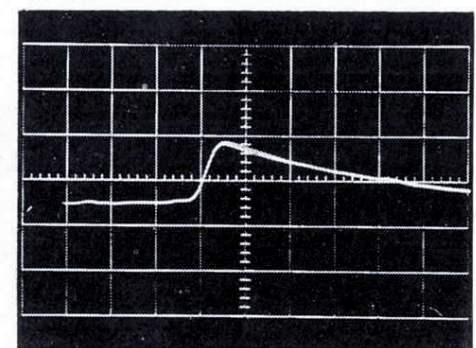
at the desired point. If the main sweep is adjusted to free-run, it will start exactly at this point. If it is adjusted for triggered operation, it will not start until the first trigger following this point is received. A turn of the HORIZONTAL DISPLAY switch returns the main sweep to the screen, delayed by the selected amount.

**Delaying Sweep**



10- $\mu$ sec/cm delaying sweep displayed on the screen. The 0.2- $\mu$ sec/cm main sweep appears as a bright area on the delaying sweep, and moves along the trace as the delay is adjusted to the desired amount.

**Main Sweep—delayed**



The main sweep returned to the screen, displaying the fifth pulse in the chain on the 0.2- $\mu$ sec/cm time base. The start of the main sweep was delayed 40  $\mu$ sec.

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# TYPE 530 SERIES OSCILLOSCOPES

**Calibration**—Delay is calibrated in time per centimeter. A twelve-position switch covers the range of 2  $\mu\text{sec}/\text{cm}$  to 10 msec/cm. A ten-turn precision potentiometer fills in between steps, making the delay period continuously variable from 1  $\mu\text{sec}$  to 0.1 sec. Range accuracy is within 2%. Incremental accuracy is within 0.2% of full scale on all ranges.

**Manual Reset**—Single sweeps may be initiated by a front-panel button. When the RESET button is pressed, a single sweep results if the main sweep has been adjusted to free-run. When the main sweep is adjusted for triggered operation, pressing the RESET button arms the sweep to fire on the next trigger received. After firing once, the sweep is locked out and will not fire again until rearmed by pressing the RESET button. A front-panel indicator lights when main sweep is reset and ready to accept a trigger.

**Trigger-Rate Source**—Triggered sweep rates of 10 cycles to 50 kc are obtained by adjusting the duration of the free-running delaying sweep, and using it to trigger the main sweep internally. The 10-cycle to 50-kc rate is continuously variable.

**Waveforms Available**—A positive gate from the delaying sweep, amplitude approximately 20 v, is available at a front-panel connector. A delayed trigger of approximately 5-v amplitude is also available at the front panel, from either the main sweep or the delaying sweep. The trigger, generated internally by the vertical signal input to the oscilloscope to trigger the main sweep, is brought out to a front-panel connector for external use. For extra convenience, 6.3 v ac at 1 a is available at another front-panel connector.

**Trigger Requirements**—The delaying sweep requires a trigger of from 0.1 v to 100 v fed into its TRIGGER

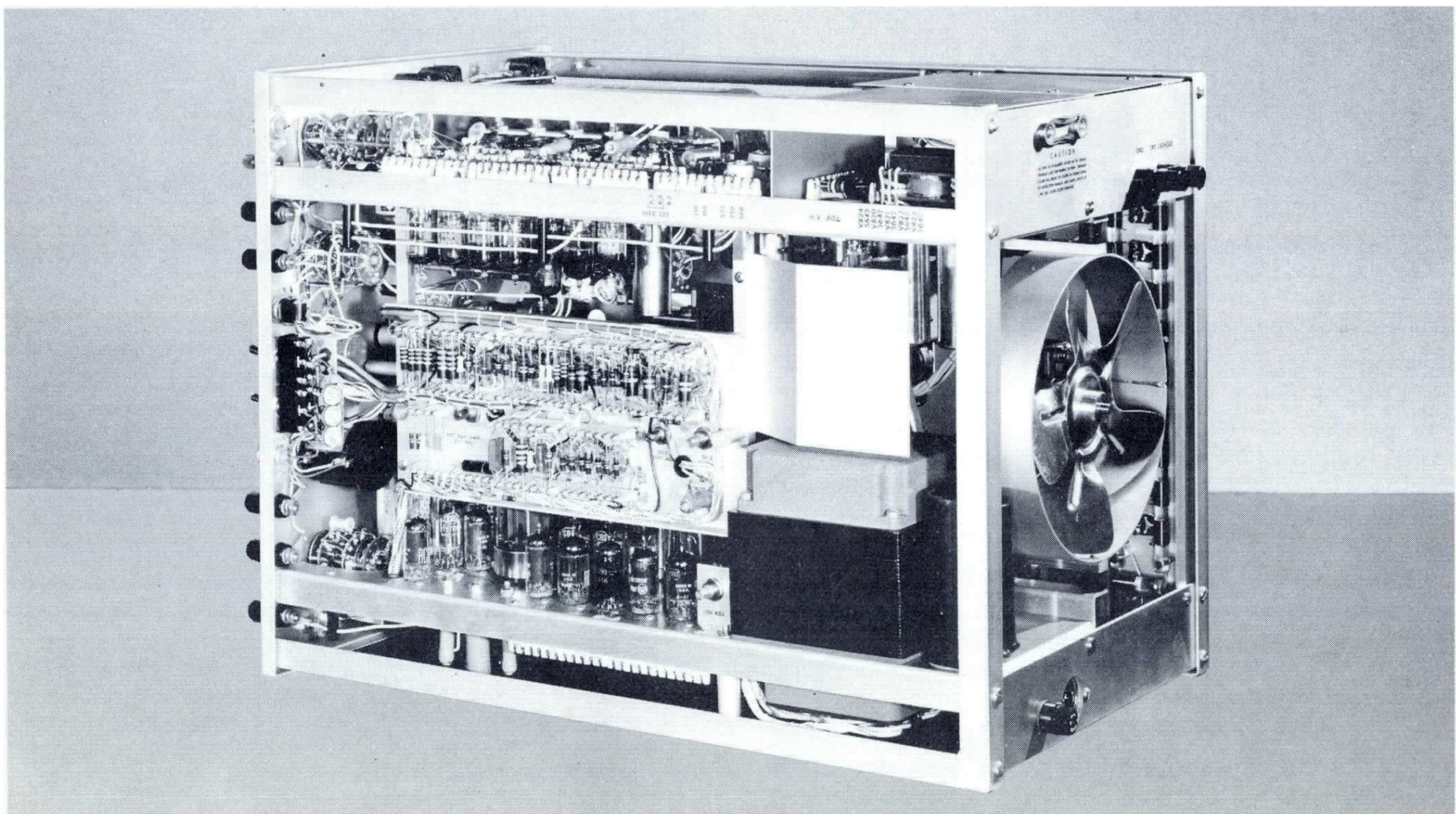
terminal. A switch permits selection of 1-x or 10-x attenuation and another switch provides for positive or negative-trigger polarity.

## OTHER CHARACTERISTICS

Horizontal input amplifier passband is dc to 800 kc. All other characteristics are identical to those of the Tektronix Type 531 Cathode-Ray Oscilloscope described in the first part of this Type 530 Series section.

## VACUUM TUBE COMPLEMENT

Vertical Amplifiers . . . . .	2	6BQ7A
Vertical Amplifier CF . . . . .	2	6BQ7A
Vertical Amplifiers . . . . .	2	12BY7
Internal Trigger Amplifier . . . . .		6U8
Internal Trigger CF . . . . .		6BQ7A
Cal Multivibrator . . . . .		6U8
Horizontal Position and Cal Output CF . . . . .		6BQ7A
Trigger Amplifier . . . . .		6BQ7A
Trigger Shaper . . . . .		6U8
Positive Multivibrator and Trigger Amplifier . . . . .		6U8
Negative Multivibrator and Clamp . . . . .		6U8
Holdoff CF . . . . .		6BQ7A
Positive Multivibrator and CF . . . . .		6BQ7A
Negative Multivibrator . . . . .		12BY7
Sawtooth and Gate CF . . . . .		6BQ7A
Dual-Trace Trigger Amplifier . . . . .		6AU6
Disconnect Diodes . . . . .		6AL5
Sweep Generator . . . . .		6CL6
Sweep Generator CF . . . . .		6BQ7A
Delaying Sweep Generator . . . . .		12AU6
Disconnect Diodes . . . . .		12AL5
Trigger Amplifier . . . . .		6BQ7A
Trigger Amplifier CF . . . . .		12AU7
Trigger Shaper . . . . .		6U8
Multivibrator and Gate CF . . . . .		6BQ7A
Multivibrator . . . . .		6U8



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# TYPE 530 SERIES OSCILLOSCOPES

Sweep Generator and Holdoff CF.....	6BQ7A
Comparator.....	6BQ7A
Trigger CF and Constant Current.....	6U8
Delay Multivibrator.....	6U8
Comparator.....	6U8
Horizontal Drive CF.....	6BQ7A
Horizontal Amplifier.....	6BQ7A
Horizontal Output CF.....	6BQ7A
Sweep Start Compensator.....	12BY7
Unblanking Mixer.....	6BQ7A
High-Voltage Oscillator.....	6AU5
Regulator.....	12AU7
High-Voltage Rectifiers.....	5 5642
Voltage Reference.....	5651
Series Regulators.....	2 6080
Regulator Amplifiers.....	5 6AU6
Series Regulators.....	4 12B4
Comparator Amplifiers.....	2 12AX7
Cathode-Ray Tube.....	T51P2

## MECHANICAL SPECIFICATIONS

Ventilation—Safe operating temperature is maintained by filtered, forced-air ventilation.

Construction—Electrically-welded aluminum-alloy cabinet and chassis.

Finish—Photo-etched anodized panel, gray wrinkle cabinet.

Dimensions—24" long, 13" wide, 16" high.

Weight—65 lbs.

Power Requirements—117/234 v, 50-60 cycles, 535 watts with Type 53C unit plugged in.

**Price—\$1300 f.o.b. Portland (Beaverton), Oregon**  
(Less Plug-In Preamplifiers)

Includes: 2—P510A probes  
2—A510 binding post adapters  
1—F510-5 green filter  
1—Instruction Manual

## Currently Available Extras

P2 crt phosphor normally furnished,  
P1, P7, P11 optional..... No extra charge  
Several other phosphors can be furnished on special order.

## Recommended Additional Accessories

EP53 Plug-In Extension—for making attenuator and transient response adjustments..... \$5

# TYPE 53 SERIES PLUG-IN PREAMPLIFIERS

Characteristics of Type 53 Series Preamplifiers apply only when plugged into Type 530 Series Oscilloscopes. Vertical sensitivity is calibrated to permit amplitude readings directly from the screen. When accurately set on one range, all others will fall within 3% of this accuracy.

## TYPE 53A PLUG-IN UNIT Wide-Band DC Preamplifier

### Transient Response

Risetime—0.035  $\mu$ sec.

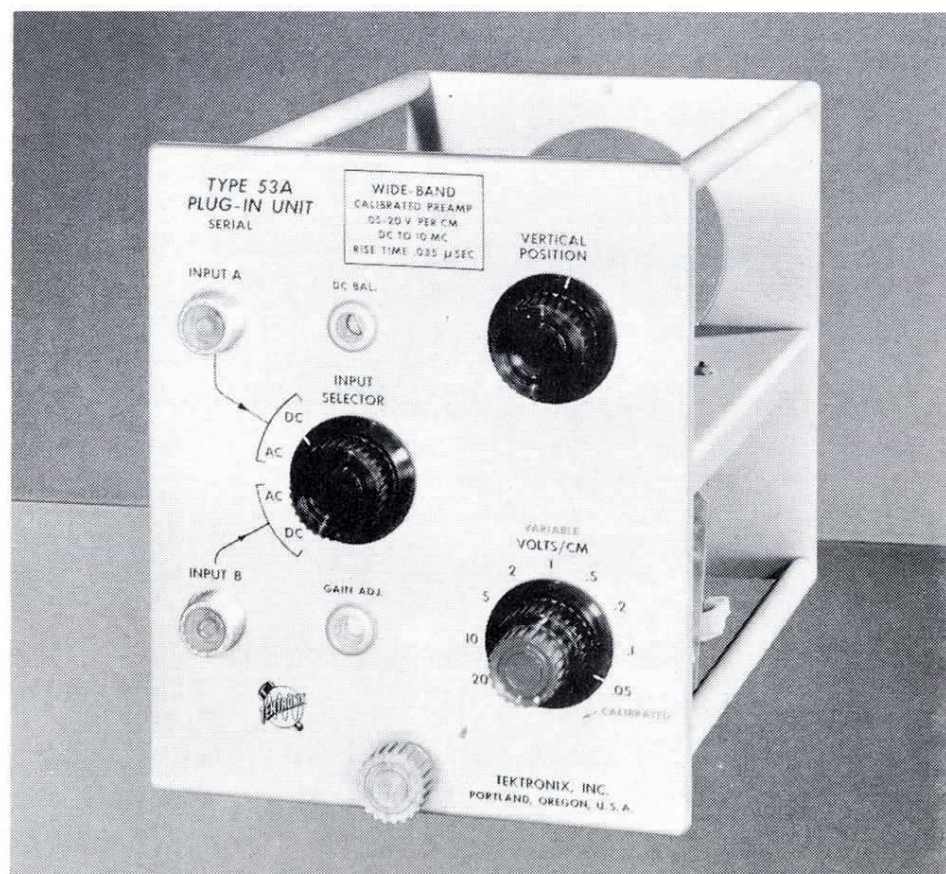
### Frequency Response

Passband—DC to 10 mc.

### Sensitivity

Calibrated—0.05 v/cm to 20 v/cm.

Continuously Variable—0.05 v/cm to 50 v/cm.



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# TYPE 530 SERIES OSCILLOSCOPES

## GENERAL DESCRIPTION

The Type 53A Plug-In Preampifier meets the requirements of most wide-band applications. Wide passband, excellent transient response, dc-coupling, and calibrated sensitivity are qualities most users require in an oscilloscope vertical amplifier. The Type 53A gives all of these qualities to Type 530 Series Oscilloscopes.

## OTHER CHARACTERISTICS

**Calibrated Sensitivity**—Nine calibrated sensitivity steps are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/cm. A variable attenuator fills in between steps, making the sensitivity continuously variable from 0.05 v/cm to 50 v/cm.

**Two Signal Inputs**—Two signal input connectors with more than 60-db isolation are controlled by a four-position switch. The INPUT SELECTOR provides for ac-coupling or dc-coupling through either input. A blocking capacitor is inserted in the AC positions, limiting the low-frequency response to 2 cycles.

**Input Impedance**—45  $\mu\text{mf}$  paralleled by 1 megohm.

## VACUUM TUBE COMPLEMENT

Amplifiers . . . . . 2 12AU6  
Output CF . . . . . 6BQ7A

## MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.

Finish—Photo-etched anodized panel.

Weight—3½ lbs.

**Price—\$85 f.o.b. Portland (Beaverton), Oregon.**

## TYPE 53B PLUG-IN UNIT Wide-Band High-Gain Preampifier

### Sensitivity

AC-Coupled Only—0.005 v/cm to 0.05 v/cm.

AC or DC-Coupled—0.05 v/cm to 50 v/cm.

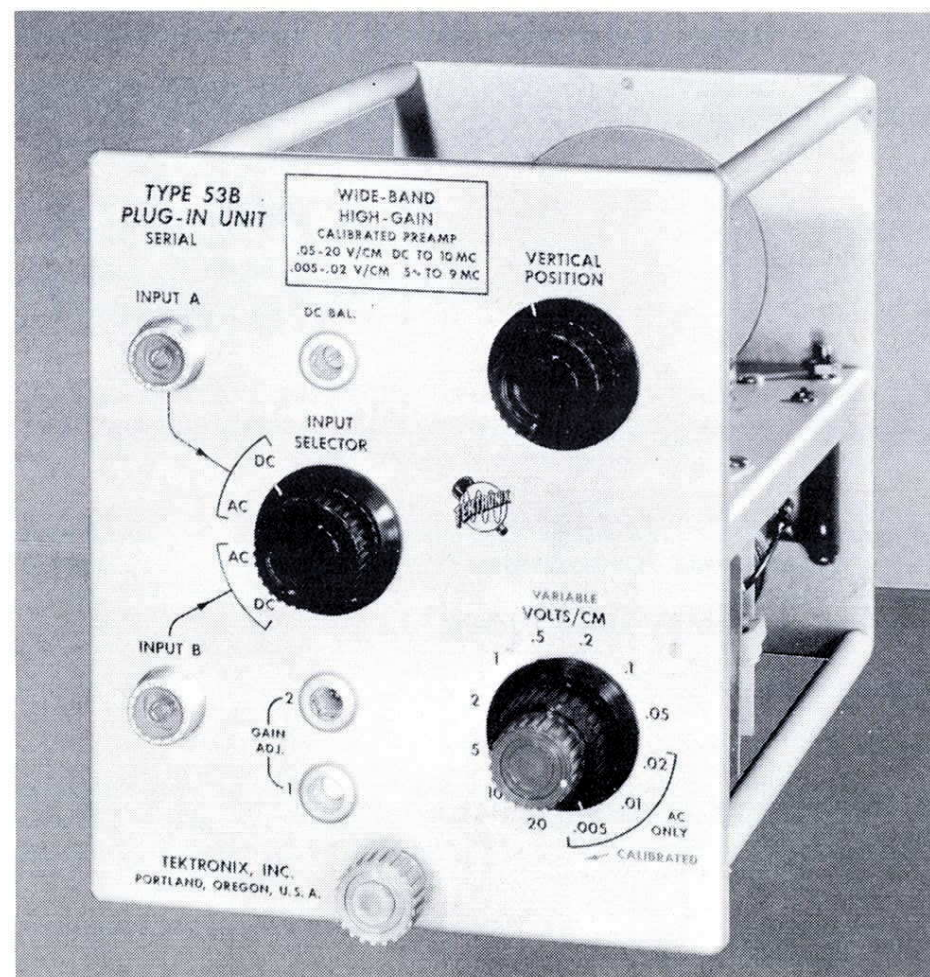
Calibrated—0.005 v/cm to 20 v/cm.

Continuously Variable—0.005 v/cm to 50 v/cm.

### Frequency Response

0.05 v/cm to 50 v/cm, DC to 10 mc.

0.005 v/cm to 0.05 v/cm, 5 cycles to 9 mc.



## GENERAL DESCRIPTION

The Type 53B Plug-In Unit is actually the Type 53A with a preampifier stage added. Three additional calibrated sensitivity steps, 0.005, 0.01, and 0.02 v/cm are

available at slightly reduced frequency response and risetime . . . 5-cycle to 9-mc passband, 0.04- $\mu\text{sec}$  risetime. In all other respects the Type 53B is identical to the Type 53A.

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# TYPE 530 SERIES OSCILLOSCOPES

## VACUUM TUBE COMPLEMENT

Preamplifier . . . . .	6AK5
Cathode Follower . . . . .	6BQ7A
Amplifiers . . . . .	2 12AU6
Output CF . . . . .	6BQ7A

## MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.  
 Finish—Photo-etched anodized panel.  
 Weight—3½ lbs.

Price—\$125 f.o.b. Portland (Beaverton), Oregon.

## TYPE 53C PLUG-IN UNIT Dual-Trace Preamplifier

### Two Identical Channels

### Electronic Switching

Triggered—switches on alternate sweeps.  
 Free-running—at approximately 100 kc.

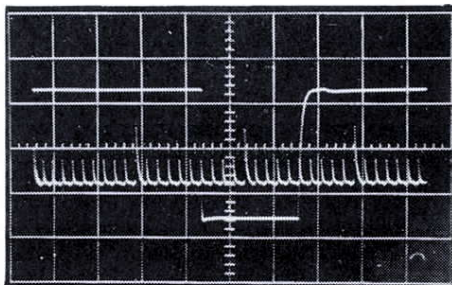
**Calibrated Sensitivity**—0.05 v/cm to 20 v/cm.

**Frequency Response**—DC to 8.5 mc.

**Risetime**—0.04  $\mu$ sec.

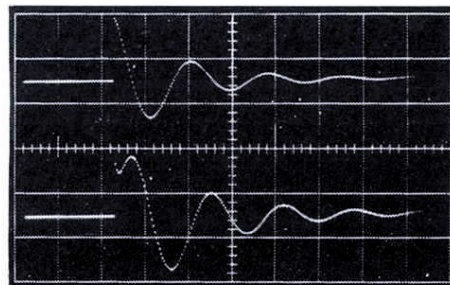
Two operating modes of the Type 53C with a Type 530 Series Oscilloscope are illustrated by the photographs below.

### Alternate-Sweep Presentation



Accurate measurement of pulse interval by comparison with timing comb shows alternate-sweep operation. Timing comb consists of 5- $\mu$ sec and 50- $\mu$ sec markers of the Tektronix Type 180 Time-Mark Generator.

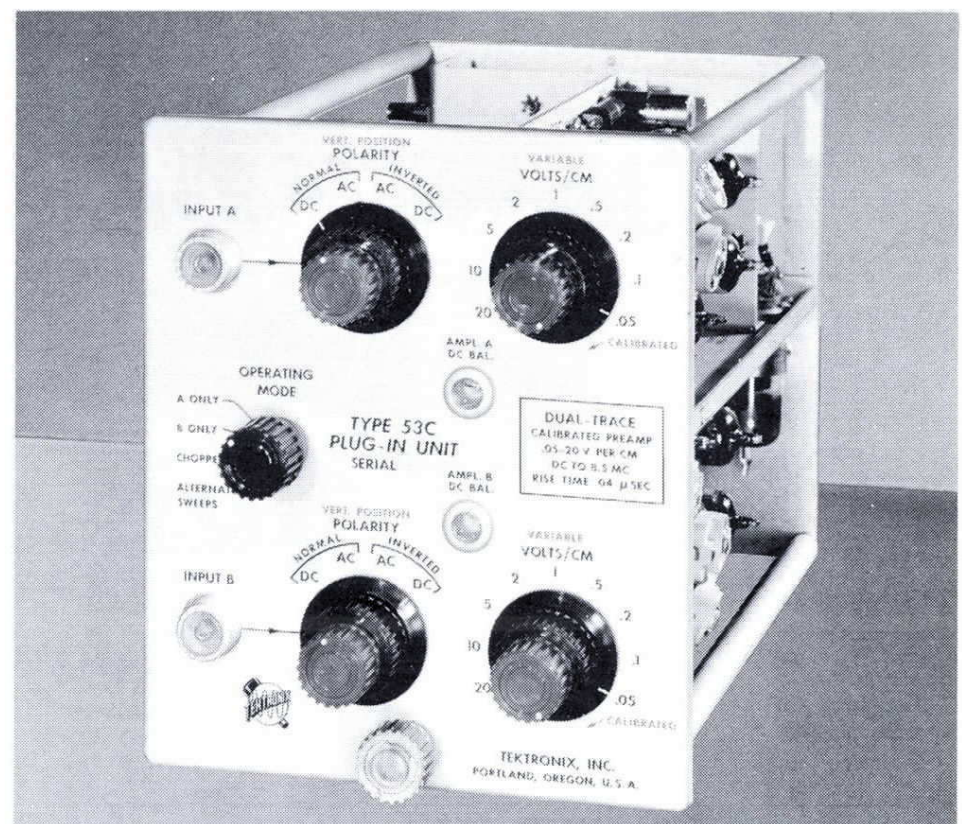
### Single-Sweep Presentation



Response of two networks excited by a single pulse shows free-running operation in a one-shot application. A single 200- $\mu$ sec/cm sweep is used for this display.

## GENERAL DESCRIPTION

The Type 53C Dual-Trace Unit contains two identical amplifier channels that can be electronically switched either by the oscilloscope sweep or at a free-running rate of approximately 100 kc. When amplifier switching is triggered by the oscilloscope sweep, the two signals to be compared appear on alternate sweeps. Because the sweeps are identical, and time-delay characteristics of the



two amplifier channels are held to within 1  $\mu$ sec, time comparisons can be made with a high degree of accuracy.

Stationary display of two signals unrelated in frequency is accomplished by internal triggering of the sweep alternately by the two signals. In free-running operation, switching occurs at a rate of approximately 100 kc, making it possible to view two simultaneous transients. Transients of as little as one millisecond duration are well delineated, having about one hundred elements in each trace. For many purposes, shorter transients may be adequately observed. Either amplifier channel can be used separately without electronic switching, making the Type 53C also useful in all single-trace applications within its frequency-response and sensitivity capabilities. Maximum flexibility is obtained by providing separate positioning, sensitivity, and polarity inverting controls for each channel.

## OTHER CHARACTERISTICS

**Calibrated Sensitivity**—Nine calibrated sensitivity steps are provided for each channel: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/cm. A variable attenuator fills in between steps, making the sensitivity continuously variable from 0.05 v/cm to 50 v/cm.

**Operating Mode Selection**—A four-position switch

**Tektronix, Inc.**

# TYPE 530 SERIES OSCILLOSCOPES

provides for electronic switch operation either triggered or free-running, and for separate use of either amplifier channel.

**Polarity Inversion**—Polarity may be inverted on either channel for greater accuracy in comparisons of signals 180 degrees out of phase. A four-position switch for each channel provides for ac or dc coupling, either normal, or polarity inverted. A blocking capacitor is inserted in the AC positions, limiting the low-frequency response to 2 cycles.

**Vertical Position Controls**—Separate positioning controls are provided for each channel.

**Input Impedance**—45  $\mu\text{mf}$  paralleled by 1 megohm.

## VACUUM TUBE COMPLEMENT

Input CF	2	12AU7
Amplifiers	2	6BQ7A
Amplifiers	4	12AU6
Output CF		6BQ7A
Coupling Diode		6AL5
Multivibrator		6BQ7A
Switching CF		6BQ7A

## MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.

Finish—Photo-etched anodized panel.

Weight—5½ lbs.

Price—\$275 f.o.b. Portland (Beaverton), Oregon.

## TYPE 53D PLUG-IN UNIT

### Differential High-Gain DC Preamplifier

#### Sensitivity

Calibrated—1 mv/cm to 50 v/cm.

Continuously Variable—1 mv/cm to 125 v/cm.

#### Frequency Response

DC to 350 kc at 1 mv/cm sensitivity . . . increasing to DC to 2 mc at 50 mv/cm and lower sensitivity.

#### Differential Input

10,000-to-1 rejection ratio at full gain for in-phase signals.

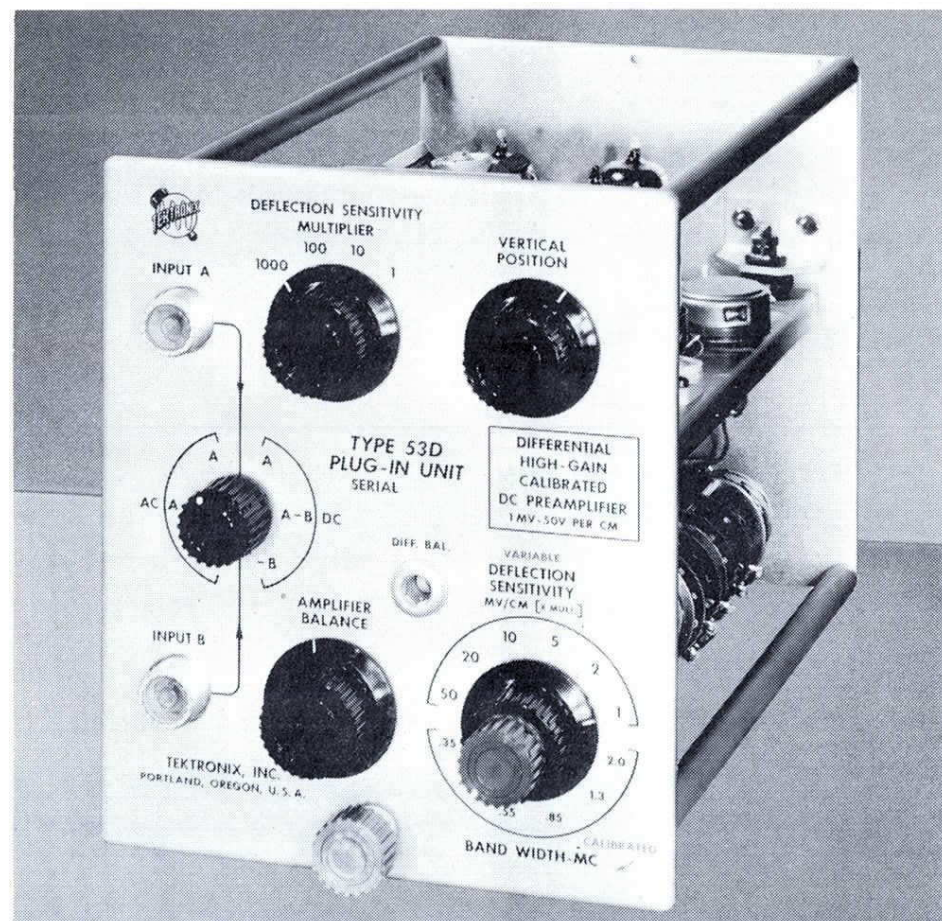
#### GENERAL DESCRIPTION

The Type 53D equips Type 530 Series Oscilloscopes for work requiring dc-coupling at sensitivities as high as 1 mv/cm. Differential input with high rejection ratio for in-phase signals permits cancellation of unwanted or interfering signals.

#### OTHER CHARACTERISTICS

**Input Selector**—A six-position switch provides for use of either input separately, or both together differentially, either ac-coupled or dc-coupled. In the AC positions a blocking capacitor is inserted, limiting the low-frequency response to 2 cycles.

**Deflection Sensitivity Controls**—The DEFLECTION SENSITIVITY switch has six calibrated positions: 1, 2, 5, 10, 20, and 50 mv/cm. Amplifier frequency response for each position is also indicated by this switch. A four-position calibrated DEFLECTION SENSITIVITY MULTIPLIER switch provides for multiplication by 1, 10, 100, and 1000 on each of the main switch steps. A variable attenuator control pro-



vides for continuously variable sensitivity from 1 mv/cm to 125 v/cm.

**Input Impedance**—45  $\mu\text{mf}$  paralleled by 1 megohm.

## VACUUM TUBE COMPLEMENT

Cascode Amplifiers	2	5814
Amplifiers	2	5879
Output CF		12AU7
Voltage Regulator		12AU7

## MECHANICAL SPECIFICATIONS

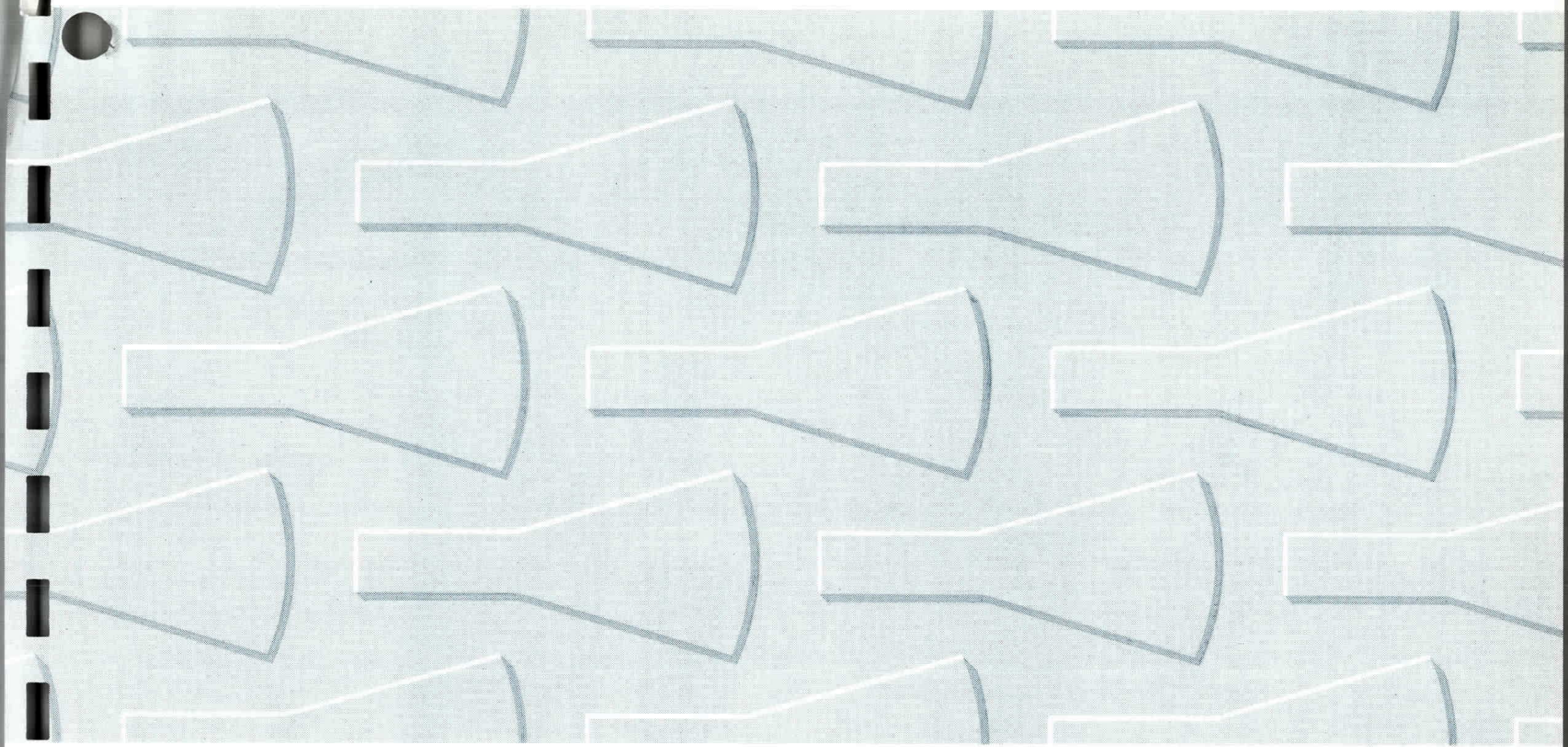
Construction—Aluminum-alloy chassis.

Finish—Photo-etched anodized panel.

Weight—4 lbs.

Price—\$145 f.o.b. Portland (Beaverton), Oregon.

**Tektronix, Inc.**



## CATHODE-RAY OSCILLOSCOPES

*Every Tektronix Oscilloscope is, from its inception, considered to be a specialized extension of the operator's senses. It is engineered to the highest standards of electronic circuit design, and arranged for maximum operator efficiency. Each instrument is built to conform to the distinctive Tektronix "look" as well as to strict standards of instrument design and layout.*



# TYPE 315-D OSCILLOSCOPE

## Portable Cathode-Ray Oscilloscope



**Sweep Range .01  $\mu$ sec/division to 10 sec/division**  
**Vertical Sensitivity . . . . . 0.01 v/division ac**  
**. . . . . 0.1 v/division dc**  
**Vertical Passband . . . . . dc to 5 mc**  
**Risetime . . . . . less than 0.07  $\mu$ sec**

### GENERAL DESCRIPTION

The TEKTRONIX **Type 315-D** is a portable, self-contained precision oscilloscope using a three-inch flat-faced cathode-ray tube. Design features include engineering and constructional innovations as well as small size and low weight.

The calibrated sweep range of 0.1  $\mu$ sec/division to 5 sec/division is among the widest offered in a commercial oscilloscope. Twelve calibrated vertical-sensitivity positions

cover the range of 0.01 v/division to 50 v/division. Vertical amplifier bandwidth is dc to 5 mc with the low frequency 3 db point at 5 cycles in the ac position. Risetime is less than 0.07  $\mu$ sec.

Calibrated vertical sensitivity controls permit direct reading of amplitude levels from the screen. Calibrated time base controls permit direct reading of time intervals from the screen in the same manner. Where ratios rather than absolute values are to be determined, uncalibrated continuously variable vertical amplitude and time base controls add to the convenience and ease of operation of the **Type 315-D**.

A direct-coupled trigger amplitude discriminator permits trigger phasing on complex waveforms. Square wave voltage calibrator is built-in for convenient checking of vertical amplifier calibration. Direct coupled unblanking, new 5x sweep magnifier, and 0.25  $\mu$ sec delay network are other features of the **Type 315-D**. All dc voltages are electronically regulated.

New mechanical design utilizes ceramic mounting strips and posts. This type construction makes possible a compact instrument that is not difficult to service. Forced ventilation is provided by a cooling fan mounted at the rear of the instrument. An efficient filter removes dust and foreign matter from the cooling air.

### VERTICAL DEFLECTION SYSTEM

Twelve calibrated vertical sensitivity positions are available.

**Vertical Sensitivity**—The seven position vertical input switch covers the calibrated ranges 0.01, 0.1, 1, 10 v/division ac and 0.1, 1, 10 v/division dc. A four position switch is used to select the multiplier—1, 2, 5, or 10 to 1. In the 10 to 1 position the multiplier is continuously variable to approximately ten times but is not calibrated.

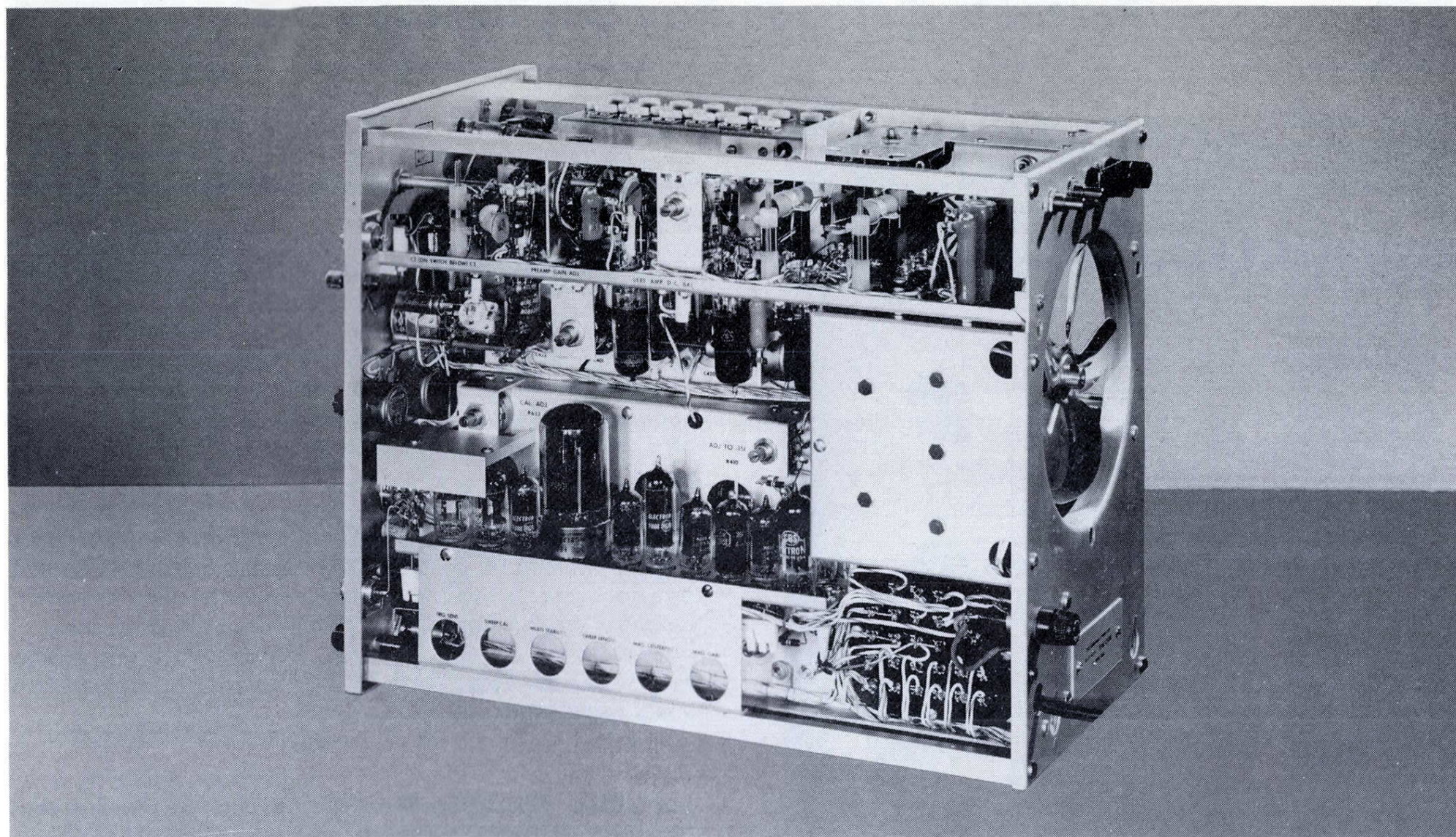
The calibrated vertical sensitivity is extended to 500 v/division by use of the small, insulated 10x probe furnished with the instrument. The probe presents an input impedance of ten megohms paralleled by approximately fourteen micro-microfarads.

The vertical amplifier presents an input impedance of one megohm paralleled by approximately thirty-five micro-microfarads.

**Signal Delay**—A 0.25  $\mu$ sec signal delay is provided by a delay network between the first and second stages of the main amplifier. The second stage is a cathode-coupled parallel stage providing a push-pull output. The pre-amplifier is capacitively coupled to the main amplifier in the 0.01 v/division range.

**Tektronix, Inc.**

# TYPE 315-D OSCILLOSCOPE



## HORIZONTAL DEFLECTION SYSTEM

An entirely new horizontal deflection system is used in the **Type 315-D**. The time base is generated in a Miller runup circuit. Sawtooth linearity is improved by a constant current charging source to the timing capacitor.

**Wide Range**—An 8-position range switch and a 1, 2, 5, and 10 to 1 multiplier switch provide 24 calibrated time bases, 3 per decade, from 0.1  $\mu\text{sec}/\text{division}$  to 5 sec/division. The 10 to 1 position of the multiplier switch provides a continuously variable uncalibrated time base from approximately 0.1  $\mu\text{sec}/\text{division}$  to 10 sec/division.

**Sweep Magnifier**—The 5x magnifier expands the time base to right and left of center. When the magnifier switch is turned on, a degenerative network in the output amplifier circuit is opened increasing the gain by a factor of five. The HORIZONTAL POSITION control precedes the magnifier circuits and therefore positions for both the magnified and the normal time bases. By means of a screwdriver adjustment the magnification can be accurately set to 5 times, except at sweep times of less than 0.1  $\mu\text{sec}/\text{division}$ .

• **Direct Coupled Unblanking**—Separate power supplies controlled by a common regulator are provided for the grid and cathode voltages of the cathode-ray tube. The cathode supply maintains a fixed potential. The grid supply is floating and has its positive end connected to the unblanking cathode followers. This provides a dc coupling for the unblanking waveform and assures that when the cathode-ray tube is unblanked its grid bias is uniform regardless of sweep time and repetition rate.

## Direct Coupled Trigger Amplitude Discriminator

—The amplitude level on a waveform where triggering occurs may be selected by the TRIGGER AMPLITUDE DISCRIMINATOR control. This permits triggering the sweep at various levels on simple or complex waveforms. The degree of flexibility of this system is indicated by the fact that the sweep may be initiated at any point on the positive or negative portion of the negative going slope of a sine wave, as well as any point on the positive going slope.

**Trigger Selector**—A ten position switch permits selection of the positive or negative going portion of the waveform to trigger the sweep, either internally or by providing the trigger from an external source, and use of either a fast or slow risetime waveform for a trigger. Selection of either the positive or negative going portion of the line voltage waveform is also provided.

## OTHER FEATURES

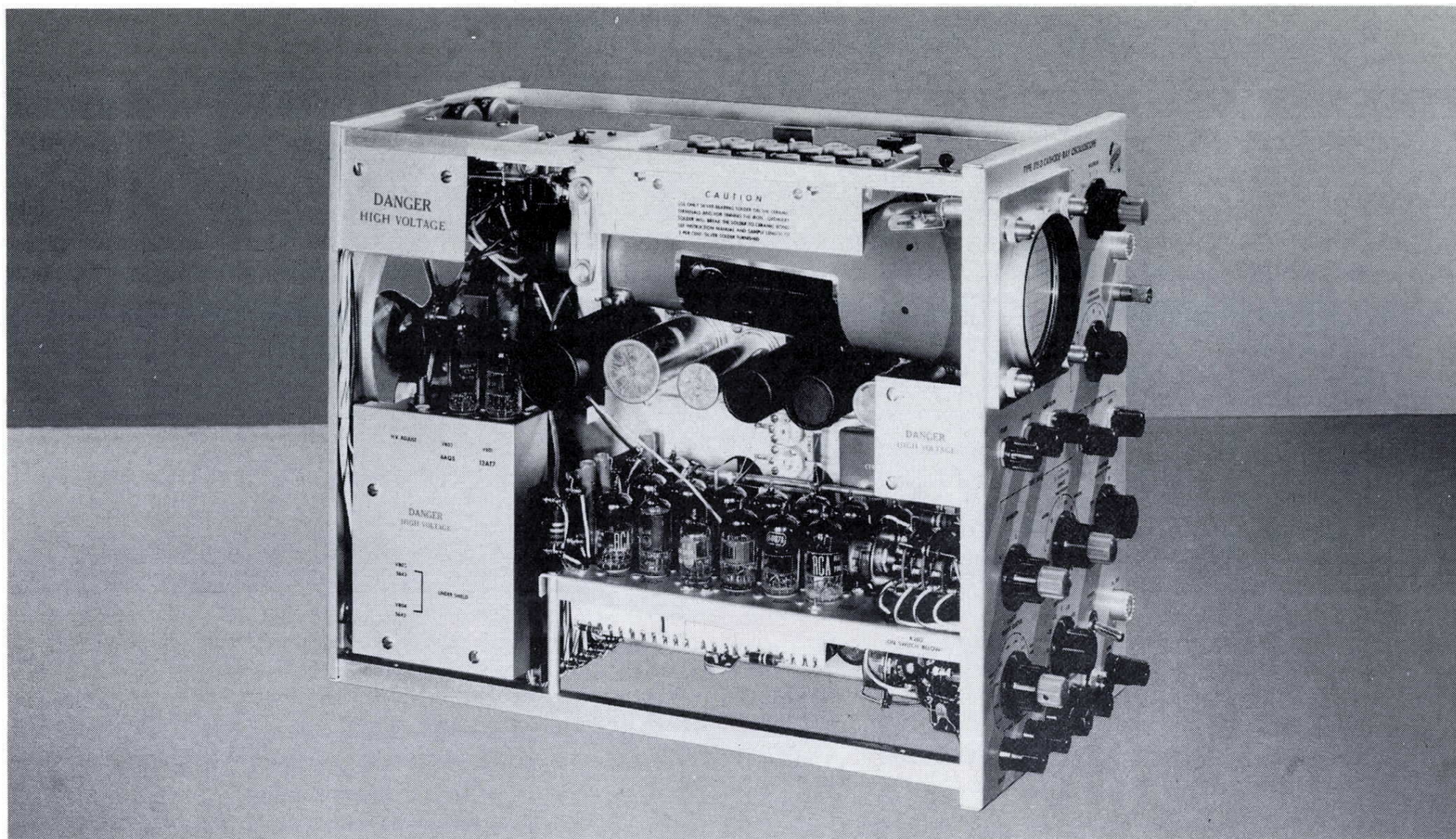
**Voltage Calibrator**—A square wave voltage is available at four accurate levels—0.1, 1, 10, and 100 volts, peak to peak. The calibrator operates at a frequency of about one kilocycle. This square wave is also useful for aligning the vertical amplifier, attenuator, and probe. It is a suitable signal for checking many types of amplifiers and other equipment.

**Output Waveforms**—A +GATE voltage of the same duration as the sweep, and the sweep sawtooth waveform are available at the front panel via cathode followers.

**Accelerating Potential**—A flat-faced cathode-ray tube with 1.8 kv accelerating potential is used in the **Type 315-D**.

**Tektronix, Inc.**

# TYPE 315-D OSCILLOSCOPE



**Illuminated Graticule**—An edge-lighted graticule marked in quarter inch divisions is provided. Illumination is controlled by a front panel knob. An appropriate color filter is provided to increase contrast when viewing in a brightly lighted room.

**Regulated Power Supply**—All dc voltages are electronically regulated to insure stable operation over the supply range of 105 v to 125 v. Selenium rectifiers are used throughout the main power supply.

## CHARACTERISTICS

**Time Base Circuit**—Wide range Miller runup type, triggered or recurrent as desired.

**Time Bases**—24 calibrated: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500 microseconds/division, 1, 2, 5, 10, 20, 50, 100, 200, 500 milliseconds/division, 1, 2, 5 seconds/division. Calibration accuracy 3% or better except on 0.1, 0.2, 0.5  $\mu$ sec and 1, 2, 5 sec time bases where calibration accuracy is within 5%. Uncalibrated time base continuously variable from approximately 0.1  $\mu$ sec/division to 10 sec/division.

**Sweep Magnification** — 5x magnifier expands the sweep to right and left of center.

**Vertical Amplifier**—Three stage, push-pull output, response dc to 5 mc, 5 cycles to 5 mc when capacitively coupled. Risettime less than 0.07  $\mu$ sec.

**Vertical Deflection Sensitivity**—12 calibrated sensitivity ranges: 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 volts/division. A front panel screwdriver adjust-

ment is provided for setting the vertical amplitude calibration. When set on any one range, all others will fall within 3% of this accuracy. The 0.01, 0.02, 0.05 volts/division ranges capacitively coupled only. Sensitivity continuously variable but uncalibrated from approximately 0.01v/division to 100 v/division.

**Calibrating Voltage**—Square wave, approximately 1 kc. Four fixed levels: 0.1, 1, 10, 100 volts peak to peak. Calibration accuracy 3% or better.

**Construction**—Self-contained, cabinet and chassis made of aluminum alloy, removable sub-chassis. Photo-etched front panel.

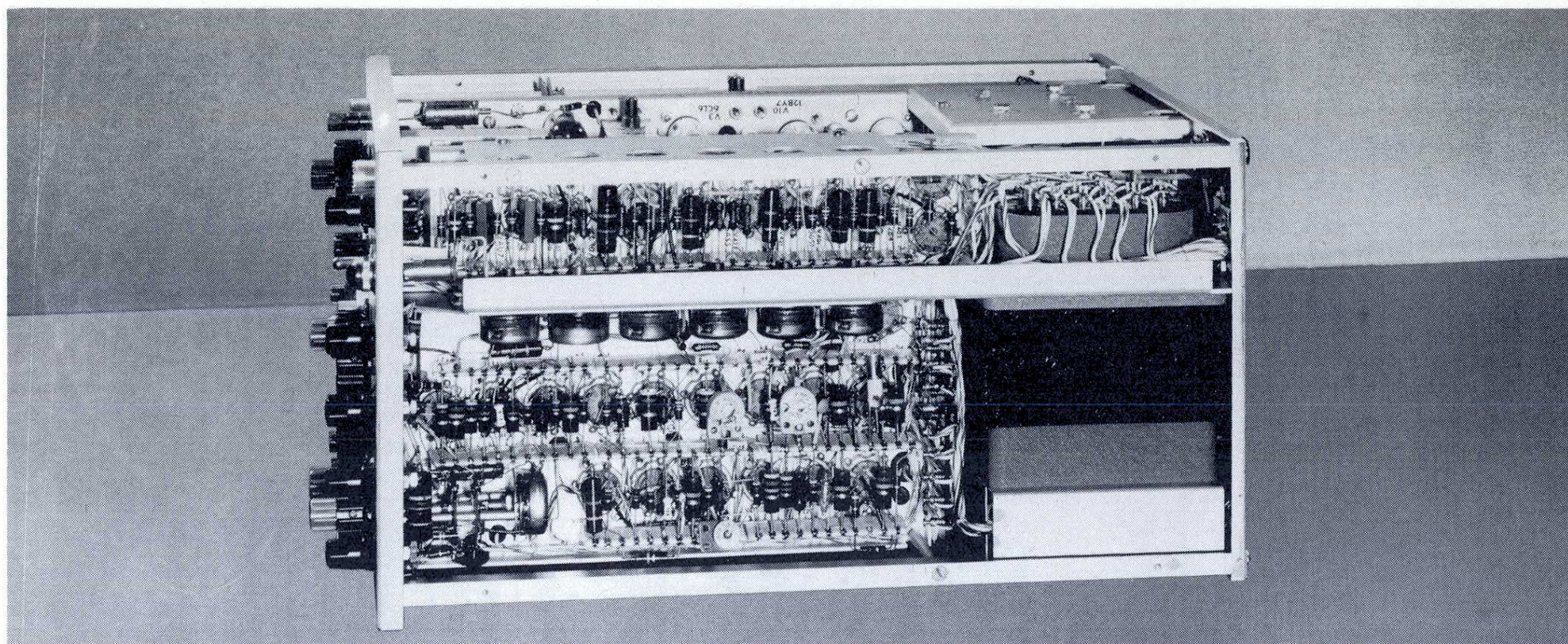
**Dimensions**—12  $\frac{3}{8}$ " high, 8  $\frac{5}{8}$ " wide, 15  $\frac{7}{8}$ " deep. Maximum depth including knobs and air filter, 18  $\frac{1}{4}$ ".

**Weight** — 36 pounds.

**Power Requirements**—105-125 or 210-250 volts, 50-60 cycles, 375 watts. The ability of the **Type 315-D** to use power line frequencies from 50 to 800 cycles is limited only by the type of ventilating fan used. Normally the **Type 315-D** is furnished with a shaded-pole ac ventilating fan motor, to be used on 50 to 60 cycle ac only. This fan motor has the advantages of being quieter and requiring very little maintenance. When the **Type 315-D** is ordered for use on power line frequencies from 50 to 800 cycles, it must be so designated on the order. When ordered for use on power line frequencies from 50 to 800 cycles the instrument is furnished with a dc ventilating fan motor and a selenium rectifier.

**Tektronix, Inc.**

# TYPE 315-D OSCILLOSCOPE



## VACUUM TUBE COMPLEMENT

Pre-amp input .....		6BQ7
Pre-amp amplifier .....	1/2	6BQ7
Pre-amp cathode follower .....	1/2	6BQ7
Amplifier input .....		6CL6
Amplifier, delay line driver .....		6CL6
Vertical position cathode follower .....	1/2	6BQ7
Driver cathode follower .....	1/2	6BQ7
Vertical output amplifier .....	4	12BY7
DC reference tube .....		5651
-150 regulator amplifier .....		6AU6
-150 v regulator series tube .....	2	12B4
+100 v regulator amplifier .....		6AU6
+100 v regulator series tube .....		6AS5
+225 v regulator amplifier .....		6AU6
+225 v regulator series tube .....	1/2	6080
+350 v regulator amplifier .....		6AU6
+350 v regulator series tube .....	1/2	6080
Cal. multivibrator .....		12AU7
Cal. clipper amplifier .....	1/2	12AT7
Cal. cathode follower .....	1/2	12AT7
High voltage oscillator .....		6AQ5
High voltage regulator .....		12AT7
High voltage rectifier .....		5642
Cathode-ray tube bias rectifier .....		5642
Trigger amplitude discriminator—phase inverter .....		12AT7
Trigger shaper multivibrator .....		6U8
Trigger amplifier .....		6BQ7
Hold-off cathode follower .....	1/2	6BQ7
Clamp diode .....	1/2	12AT7
Trigger cathode follower .....	1/2	6BQ7
Hold-off clamp .....	1/2	12AT7
Unblanking cathode follower .....	1/2	6BQ7
Buffer cathode follower .....	1/2	6BQ7
+ Gate out cathode follower .....	1/2	6U8
Cascode multivibrator .....	2	6BQ7
Multi reverting cathode follower .....	1/2	12AT7
Sawtooth out cathode follower .....	1/2	6BQ7
Sweep out cathode follower .....	1/2	6BQ7
DC feed back diode .....	1/2	6AL5
Sweep clamp cathode follower .....	1/2	6U8
Sweep clamp diode .....	1/2	6AL5
Constant current tube .....	1/2	12AT7
Miller sweep generator .....		6AK6
Sweep position cathode follower .....	1/2	6BQ7
Driver cathode follower .....	1/2	6BQ7
Sweep output amplifier (First side) .....	1/2	6BQ7
Sweep output cathode follower (First side) .....	1/2	6BQ7
Sweep output amplifier (Second side) .....	1/2	6BQ7
Sweep output cathode follower (Second side) .....	1/2	6BQ7
Cathode-ray Tube .....		3WP2

**Type 315-D**—For use on 105-125 v, 50-60 cycles only—Price \$770.

**Includes:** 1—P510A Attenuator probe  
2—A510 Binding-post adapters  
1—F310-5 Green filter  
1—Instruction Manual

**Type 315-D-S1** — for use on 105-125 or 210-250v, 50 to 800 cycles — Price \$785.

**Type 315-S2** — Includes a front panel controlled triggering circuit permitting direct, stable triggering from the sync pulse group of a complete pulse train in a PTM system with these general characteristics:

Rep rate ..... 9 to 17 kc (12 or 24 channels)

Sync group . . . 4 pulses, 0.5  $\mu$ sec wide, spaced 0.8  $\mu$ sec

Channel pulses . . . . . 0.5  $\mu$ sec wide, spaced 3.85  $\mu$ sec  
Price \$790

Your inquiries are invited about the availability of this instrument for use with PTM systems having general characteristics differing from the above.

### Currently Available Extras

Rack Mounting ..... Add \$25

P2 crt phosphor normally furnished.

P1, P7, P11 optional ..... No extra charge

### Recommended Additional Accessories

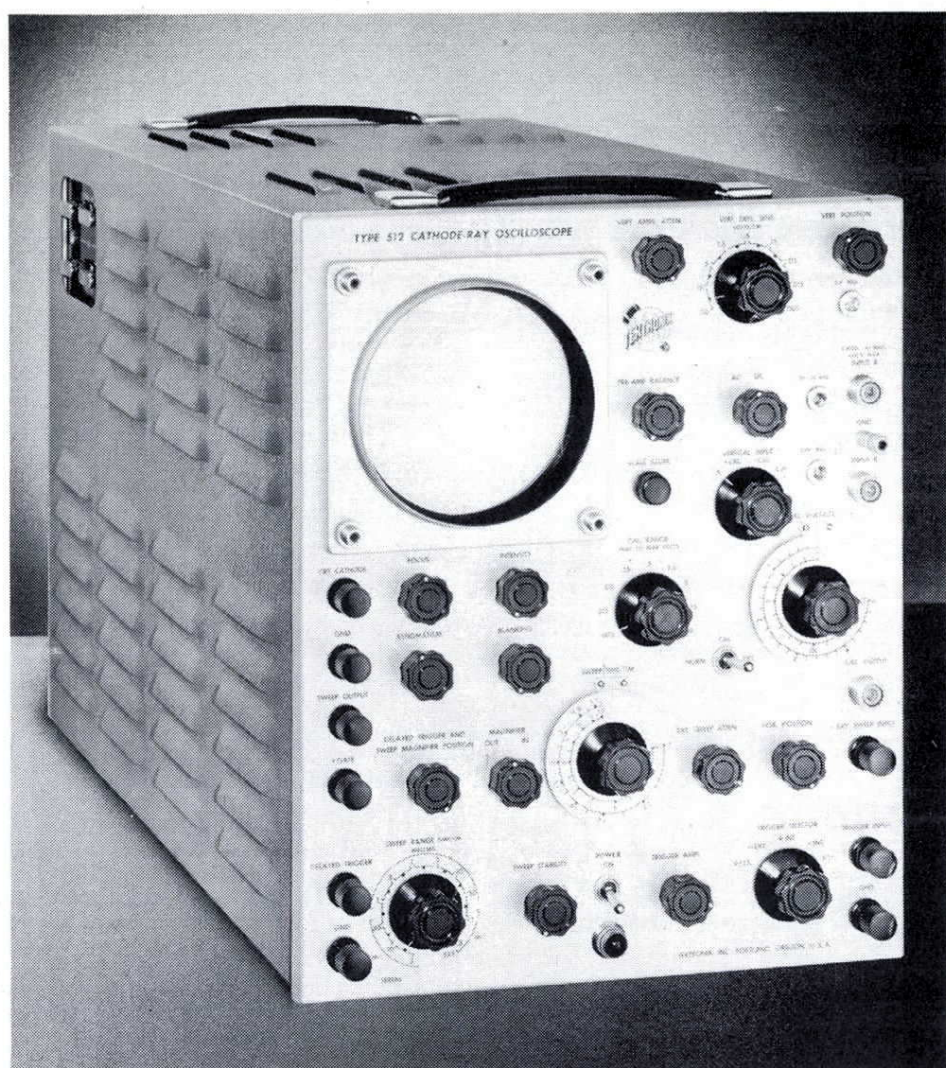
**MS 15 Fan Motor Kit** — For converting **Type 315-D-S1** for use on fixed supply voltage frequency (50-60 cycles only). Contains bracket, ac ventilating fan motor, and fan blade. Price \$7.50

**MU15 Fan Motor Kit**—For converting **Type 315-D** for use with various supply voltage frequencies (50-800 cycles). Contains bracket, selenium rectifier, dc ventilating fan motor, and fan blade. Price \$22.50.

Prices f.o.b. Portland (Beaverton), Oregon

**Tektronix, Inc.**

# TYPE 512 OSCILLOSCOPE



## GENERAL DESCRIPTION

The TEKTRONIX **Type 512** is a portable precision laboratory instrument incorporating direct coupled amplifiers throughout. Its sensitivity of 5 mv/cm DC and sweeps as slow as .3 sec/cm solve many problems confronting workers in the fields where comparatively slow phenomena must be observed. The vertical band width of 1 mc at maximum sensitivity (2 mc at lesser sensitivity) and sweeps as fast as 3 microsec./cm make it an excellent general purpose oscilloscope as well.

## VERTICAL DEFLECTION SYSTEM

**Direct Coupled Amplifier** — A high-gain direct-coupled wide-band vertical amplifier provides for observation of an extremely wide range of wave forms. The amplifier is divided into two sections, a pre-amplifier and an output amplifier, each having two push-pull stages. Both sections are used only in the three most sensitive positions of the vertical deflection sensitivity control, i.e. 5 to 150 mv/cm. In the first five positions, with only the output amplifier in use, a bandwidth of 2 mc is available. Because of the requirements of low drift, hum, grid current, etc., the bandwidth of the pre-amplifier is limited to 1 mc by the available tubes. As in all Tektronix instruments, primary emphasis is placed on obtaining excellent transient response rather than flat sine wave response. Each oscilloscope is adjusted for optimum transient response, with sine wave measurements made as an additional check. Since it is frequently desirable to observe only the AC components, a switch on the front panel permits optional insertion of coupling capacitors. To insure stability when operating as a DC amplifier, the heaters of the 1st, 2nd, cathode follower and 3rd stages are supplied by direct current from an electronically regulated power supply.

**Balanced Differential Input** — Extreme versatility of input is provided by a differential amplifier which permits optional single ended or push-pull input. In the push-pull connection the differential feature minimizes effects of the in-phase components. At full gain of the amplifier, one volt of in-phase signal will produce less deflection than 5 mv applied between the inputs. The differential input also provides a ready means of mixing two signals without interaction or frequency discrimination.

The **Type 512** Oscilloscope permits full cycle observation of frequencies as low as 1/3 cps or of pulses as long as 3 sec. It can be synchronized with frequencies of at least 1 mc or higher, and pulses of as short as 1  $\mu$ sec will trigger the sweep.

**Sensitivity Control** — Two controls are provided to enable the **Type 512** to display a wide range of signal amplitudes. The vertical deflection sensitivity control inserts RC compensated attenuators and simultaneously removes or inserts the pre-amplifier as necessary to provide eight degrees of sensitivity in steps of approximately three times. The second control is a low impedance potentiometer in a cathode follower circuit giving continuous attenuation to fill in the steps. All attenuators are in balanced pairs on both sides of the push-pull amplifier.

**Direct Connection to Deflection Plates** — Since it is often desirable to make a low capacity direct connection to the deflection plates, terminals are accessible externally through a side panel in the case. The terminals are of the banana jack type, being inter-connected with jumper plugs.

**Probes** — The **Type 512** is supplied complete with 2 probes on 42-inch cables. The probes have an attenuation of ten and an input impedance of 10 megohms with a capacity of approximately 14 mmf.

## HORIZONTAL DEFLECTION SYSTEM

**Sweep Generator** — The **Type 512** employs a screen-coupled phantastron as the basic sweep generator. An adaptation of a circuit developed in England during World War II, it is similar to the well known "bootstrap" circuit used in the United States in radar applications. One of the important differences is that the output is taken from the plate, rather than from the cathode circuit, doing away with the necessity for a floating power supply between the grid and cathode.

The circuit is capable of excellent inherent linearity, which makes it ideal for precision sweep generation. It is additionally useful because the positive screen pulse is available for operating the blanking circuits.

**Sweep Amplifier** — The direct-coupled sweep amplifier provides the voltage swing necessary to deflect the electron beam from one side of the CRT screen to the other. A constant average potential at the deflection plates is maintained — by the balanced output of the stages — to prevent defocusing the spot as it moves across the screen. The gain of the amplifier can be adjusted by an internal control to compensate for variations in cathode ray and sweep amplifier tubes.

# TYPE 512 OSCILLOSCOPE

**External Sweep Input** — A front panel binding post permits connection of external sweep generators to the **Type 512** via a continuously variable attenuator and the direct coupled push-pull sweep amplifier. The maximum sensitivity is 1 v/cm.

**Sweep Time Calibration** — To minimize the need for timing markers, the instrument is adjusted at the factory to provide an accuracy of sweep timing well within 5%. Two controls are provided, a ten position switch and a carefully calibrated potentiometer which provides approximately 9 inches of logarithmic scale per decade of sweep range. Convenient and accurate time determinations of observed phenomena are thus facilitated. This accuracy is made possible by the use of stable precision components and electronically regulating all DC voltages — including the CRT accelerating potentials—against line voltage variations.

**Sweep Magnification** — Frequently it is desirable to examine more closely a portion of a waveform which occurs at such a time on the trace that observation at a faster sweep rate is not feasible or possible. The sweep magnifier permits convenient 5X magnification of any desired 20% of the sweep. The accuracy and linearity of the main sweep is retained by the use of a separate sweep generator which consists of a modified "Miller rundown" circuit.

**Trigger Selector** — The trigger selector switch enables the sweep to be triggered from an external source or by the signal being observed. It thus permits the observation of a randomly occurring phenomenon or a single pulse. By a slight readjustment of the sweep stability control, a recurring sawtooth of extremely stable frequency characteristic is obtained. The sweep can also be synchronized with the power line frequency.

**Carrier Blanking** — Because of the slow sweeps and long waiting periods possible with the **Type 512**, conventional capacity coupled blanking of the CRT is unsatisfactory. To overcome this difficulty, the positive waveform from the screen of the sweep generator is used to control the operation of an RF carrier system which conveys the blanking voltage to the grid of the CRT during the flyback and waiting period of the sweep generator. Thus, when the CRT is unblanked, its grid bias is uniform regardless of the sweep time or repetition rate.

## ADDITIONAL FEATURES

**Amplitude Calibrator** — Amplitude calibration is accomplished by means of a comparison square wave whose amplitude is continuously variable in nine ranges, from 5 millivolts full scale to 50 volts full scale. Two scales, 0-5 and 0-15 are provided on the dial of the output potentiometer. When the **Type 512** is used direct coupled, the reference side of the square wave remains fixed as the amplitude is varied. A choice of upward or downward deflection is available. Besides performing its primary function of amplitude calibration for the oscilloscope, the square wave is also available for checking the adjustment of the RC attenuators and probes incorporated in the video

deflection system and for external use as a test signal for adjustment of other RC attenuators, measurement of amplifier gain, etc.

**Edge-Lighted Graticule** — The CR tube face is covered by a plastic edge-lighted graticule having scribed reference lines marked off in centimeters. These lines appear in a color complementary to that of the color filter which is used to improve the trace contrast under high ambient light conditions.

If the vertical amplifier is set to a known sensitivity, voltage readings of any portion of a waveform can be obtained directly from the illuminated reference lines. Time durations can be read in a like manner as the sweep time/cm is known from the setting of the sweep time dial.

**Delayed Trigger** — To provide a trigger for pulse generators, nerve stimulators, etc., whose effects are to be observed on the **Type 512**, a delayed trigger pulse can be made to occur at any point on the sweep. The position of the pulse on the sweep remains fixed as the sweep time is varied.

**Sweep Output** — To facilitate operation of external cathode ray or time delay equipment, the sweep waveform is made available at a front panel connection. The output is taken from a cathode follower circuit, in order that the sweep generator might be isolated from any effects caused by the external load.

**Positive Gate** — In the observation of certain phenomena which occur in a random manner, it frequently is desirable and necessary that auxiliary equipment operate only for the duration of the sweep. A positive gating voltage, which is obtained from the screen of the phantastron, is available for the control of this type of operation. Isolation circuits prevent the external load from interfering with the operation of the sweep generator.

**Intensity Modulation** — Frequently a waveform is of such complexity that timing or marking pulses cannot easily be observed when superimposed on it. An RC coupling network provides for introducing blanking or brightening pulses to the cathode of the CRT, thus permitting intensity modulation of the trace.

**Cathode Ray Tube** — A Type 5ABP tube is used with accelerating potential of 3 kv. A P-7 screen is normally supplied, with P-1 or P-11 screens optional at no additional cost.

**Time Marker Input** — For those applications where timing markers are needed, an over-biased amplifier provides for their introduction, via a coaxial input, without interaction with the observed waveform.

## CHARACTERISTICS

**Sweep Circuit** — Phantastron followed by push-pull linear amplifier. Triggered, recurrent or single sweeps as desired.

**Sweeps** — Continuously variable from .3 sec/cm to 3 microseconds/cm in ten calibrated ranges. Calibration

# TYPE 512 OSCILLOSCOPE

accuracy of  $\pm 5\%$ . 1 sec/cm and 3 sec/cm available on special order.

**Magnification** — Any desired 20% of the sweep can be spread over the entire trace.

**External Sweep Input** — Via 100 K potentiometer and DC coupled amplifier. 1 v/cm maximum sensitivity.

**Trigger Requirements** — Triggers from signals being observed which produce deflection of 5 mm. or greater. External triggers of either polarity, pulses or sine waves. 10 mv or larger.

**Vertical Deflection Sensitivity (peak to peak)** — Direct to plate—13 v/cm. Via amplifier 5 mv. to 50 v/cm. Sensitivity reduced by a factor of 10 when probe is used.

**Input Impedance** — 1 meg. shunted by 45 mmf. With probe 10 meg. and 14 mmf.

**Vertical Amplifier Response** — For sensitivities of .15 v/cm or lower: Bandwidth DC to 2 mc. Rise time .2 microsec. For sensitivities between 5 mv and .15 v/cm: Bandwidth DC to 1 mc. Rise time .4 microsecond.

**Calibrating Voltage** — Square wave, approximately 1-kc. Nine ranges, 5 mv to to 50 v full scale, continuously variable. Full scale calibrations accurate within 3%; control linear within 1% of full scale.

**Waveforms Available Externally** — Sweep saw-tooth, 100 volts peak. Delay trigger, 75 volts peak. Positive gate, 150 volts peak. The square wave calibrating signal, 0-50 volts peak.

**Connection to CRT Cathode** — Via .1 mfd. capacitor. RC=.01 sec.

**Accelerating Voltage on Cathode Ray Tube** — 3 KV.

**Time Marker Input** — Via isolating stage to video amplifier. Minimum marker amplitude 8 v.

**Regulated Power Supply** — All dc voltages are electronically regulated.

**Power Requirements** — 105-125 volts, or 210-250 volts, 50-60 cycles, 280 watts.

**Dimensions** — 16" high, 13" wide, 22 7/8" deep.

**Finish** — Panel, photo etched aluminum with black letters. Cabinet, gray wrinkle.

**Weight** — 56 pounds.

**Vacuum Tube Complement** —

Trigger Amplifier .....	2	6AU6
Trigger Amplitude Control .....		6AU6

Trigger Limiter and Clamp Diode .....		6J6
Phantastron Sweep Generator .....		6BH6
Phantastron and Sweep Output Cathode Followers .....		12AU7
Sweep Amplifier .....		12AT7
Delayed Trigger and Magnifier Selector .....		6J6
Delayed Trigger and Magnifier Shaper .....		6AU6
Magnifier Sweep Generator .....		6AU6
Magnifier Sweep and Delayed Trigger Cathode Followers .....		12AU7
Magnifier Sweep Voltage Regulator and Clamp Diode .....		12AU7
+ Gate Amplifier and Blanking Gate Inverter .....		12AU7
Blanking Oscillator .....		6AU6
Calibrator Multivibrator .....		12AU7
Calibrator Diode and Output Cathode Follower .....		12AU7
Blanking Bias Rectifier .....		6AL5
Vertical Pre-Amp. Inputs .....	2	5879
Vertical Pre-Amp. Outputs .....	2	12AU6
Vertical Gain Control Cathode Followers .....	2	12AU6
Vertical Main Amplifier Inputs .....	2	12AU6
Vertical Main Amplifier Outputs .....	2	6AG7
Vertical Amplifier Voltage Regulators .....	2	12AU7
Marker Input Amplifier .....		6AU6
Low Voltage Rectifiers .....	4	6W4GT
High Voltage Rectifiers .....	2	1V2
High Voltage Supply Oscillator .....		6AQ5
Voltage Reference .....		5651
Voltage Regulator Amplifiers .....	2	6AU6
Voltage Regulator Series Tube .....		6AS7G
Sweep Power Supply Rectifier .....		6X4
Sweep Power Supply Regulator .....		12AU7
Cathode Ray Tube .....		5ABP

**Price \$950.00**

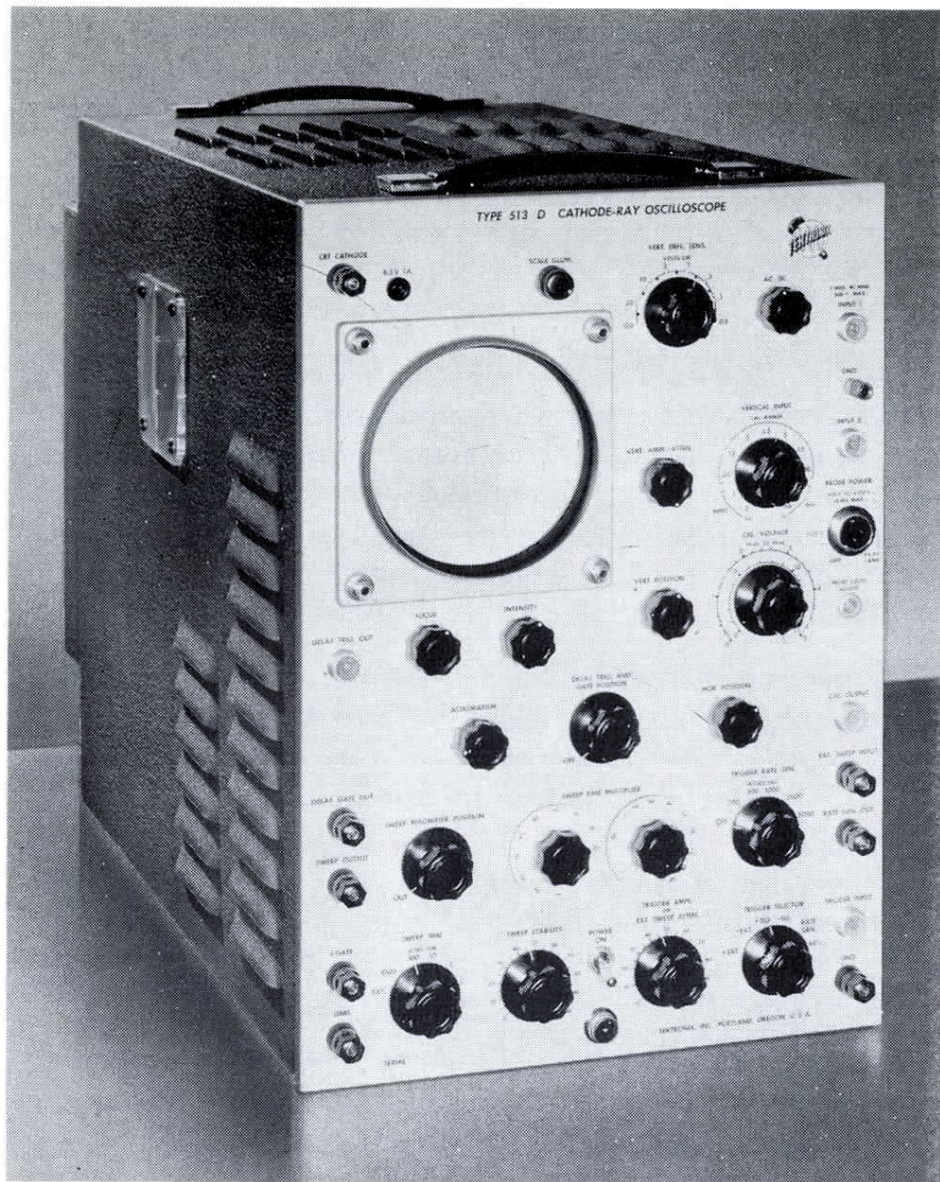
Includes: 2—P510A Probes  
2—A510 Binding-post adapters  
1—F510-3 Amber filter  
1—F510-6 Blue filter  
1—Instruction Manual

### Currently Available Extras

Rack mounting .....	\$25
CRT on right-hand side .....	100
10 $\mu$ sec/cm to 1 sec/cm sweep range .....	25
30 $\mu$ sec/cm to 3 sec/cm sweep range .....	25
P7 crt phosphor normally furnished;	
P1, P11 optional .....	no extra charge

**Prices f.o.b. Portland (Beaverton), Oregon**

# TYPE 513-D OSCILLOSCOPE



## GENERAL DESCRIPTION

The TEKTRONIX **Type 513-D** is a portable, self-contained, precision instrument specifically designed for the study of short duration pulses. It features a 5XP type cathode ray tube with an accelerating potential of 12 kv, making it particularly useful where a high writing rate is required, or when it is desired to photograph single high speed sweeps.

The direct coupled vertical amplifier, with its rise time of  $.025\mu\text{sec}$ , extends its usefulness beyond the limits of any previous cathode ray oscilloscope in general laboratory work.

Frequencies of 10 mc can be synchronized and clearly observed on this instrument. A pulse as short as  $.05\mu\text{sec}$  will serve to trigger the sweep generator, but pulses of .1 sec duration or full cycles of as low as 10 cps can be observed in their entirety.

## VERTICAL DEFLECTION SYSTEM

**Direct Coupled Amplifier** — A distributed type vertical amplifier is used which provides a sensitivity of .3 v/cm in the direct coupled position, or a maximum sensitivity of .03 v/cm when capacitively coupled. The vertical amplifier is adjusted for optimum transient response.

**Sensitivity Control** — Two controls are provided to enable the **Type 513-D** to display a wide range of signal amplitudes. The vertical deflection sensitivity control inserts RC compensated attenuators and also inserts the pre-amplifier stages in the two highest gain positions. It is variable in steps of approximately 3 to 1. The vertical

amplifier attenuator is a low impedance potentiometer providing a continuously variable attenuation of 3 to 1 to fill in the steps of the vertical deflection sensitivity control. The overall sensitivity of the vertical amplifier is continuously variable from .03 volts/centimeter to 100 volts/centimeter, peak to peak.

**A. C. - D. C. Switch** — When the direct coupled feature of the amplifier is not needed, or when it is desirable to observe only the ac components of the signal, this switch may be thrown to the ac position, inserting a coupling capacitor

**Input Selector** — The **513-D** is equipped with two signal input connections, either of which may be used, still retaining the full bandwidth. Selection is made by the vertical input selector switch. This feature offers a convenient method of making rapid comparison between two signals.

**Constant Input Impedance** — The input impedance of 1 megohm and  $40\mu\text{mf}$  is maintained at all sensitivity settings, permitting use of R-C input probes.

**Probe** — The **Type 513-D** is supplied complete with a high impedance probe on a 42" cable. The probe is R-C compensated and has an attenuation of 10X with an input impedance of 10 megohms and a capacity of approximately 14 mmf.

**Auxiliary Power** — A power supply socket is provided for a cathode follower probe or an auxiliary amplifier stage connected close to the circuit under observation. 6.3 volts ac at .5 amp and 15 to 150 volts regulated dc at 15 ma. is available. 6.3 volts ac is also available from a front panel pin jack.

**Signal Delay Network** — A .25 microsecond delay network provides a means of observing the front of a pulse which is being used to trigger the sweep, by delaying the appearance of the signal until the cathode ray tube is unblanked and the sweep operating linearly.

**Amplitude Calibrator** — Amplitude calibration is accomplished by means of a comparison square wave whose amplitude is continuously variable in 7 ranges from .05 volts full scale to 50 volts full scale. Accuracy of square wave amplitude exceeds  $\pm 3\%$  of full scale. The calibrator voltage is also brought out to a uhf connector so that it may be used for checking the adjustment of the probe or the R-C attenuators incorporated in the vertical amplifier, or used in conjunction with other equipment.

**Direct Connection to CRT Deflection Plates** — It is often desirable to make a low capacity-low inductance connection to the deflection plates to permit observation of extremely high speed transients which would be distorted by the amplifier. An aperture in the side of the case permits convenient direct connection to the deflection plates.

## HORIZONTAL DEFLECTION SYSTEM

The sweep system employed in the **Type 513-D** is in most respects similar to that of the widely used TEKTRONIX Type 511-A Oscilloscope.

**Tektronix, Inc.**



# TYPE 513-D OSCILLOSCOPE

**Triggered Sweep** — A continuously variable, linear, triggered sweep is available covering the range of .01 sec/cm to .1 microsec/cm. A two dial sweep time multiplier is used which makes possible much more accurate readings than were possible with previous instruments. The sweep time is accurate to within 5% of the dial readings, permitting the **Type 513-D** to be used for many frequency and time measurements. The sweep may be readily synchronized with sine waves of frequencies as high as 10 mc or with pulses as short as .05 microsecond. When triggered by a sharp pulse, the sweep is started and the cathode ray tube is unblanked in less than .1 microsecond.

**Trigger Selector** — The sweep may be triggered by an external signal of either positive or negative polarity. It may also be triggered by either the positive or negative portion of the signal under observation, or it may be synchronized with the power line frequency.

**Trigger Rate Generator** — A built-in, free running, blocking oscillator is used as a trigger rate generator. The frequency is variable in 5 steps from 200 to 5000 pulses per sec. A positive pulse of approximately 60 volts amplitude is available on a front panel binding post so that the trigger rate generator may be used to synchronize external equipment.

**Recurrent Sweep** — A conventional free running, sawtooth sweep may be obtained merely by readjusting the sweep stability control. This sweep may be readily synchronized with the waveform under observation.

**Sweep Magnifier** — A control on the panel allows any selected 20% of the sweep to be amplified five times, except on the 0.1  $\mu$ sec/cm range, and thus expanded to cover the entire trace.

**External Sweep** — An external sweep may be applied to the horizontal deflection plates via an attenuator and a two stage direct coupled amplifier. The maximum sensitivity is 1.6 volts (peak to peak) per cm of deflection.

## OTHER FEATURES

**Delayed Gate** — A delayed positive gate of approximately 30 volts amplitude is available at a front panel binding post. The start of the gate may be positioned at any point on the sweep up to .3 microsecond from the start of the sweep by means of a control on the front panel. The rise time of this delayed gate is approximately .75 microseconds.

**Delayed Trigger** — In cases where a trigger of short rise time is desired, a trigger of 50 volts amplitude, across 100 ohms, is available on a separate output connector. The rise time is .1 microsecond and its total duration is approximately .25 microsecond. This delayed trigger may be positioned to any point on the sweep, from within .4 microseconds of its start.

The delayed gate and the delayed trigger may be used simultaneously if it is desired. This feature greatly extends the usefulness of the **Type 513-D** in the fields of radar, medical research, etc.

**Edge Lighted Graticule** — As in all other TEKTRONIX

Cathode Ray Oscilloscopes, a plastic, edge-lighted graticule is provided. The illumination on this graticule may be adjusted by a front panel control. Centimeter lines are scribed in both the horizontal and vertical directions to facilitate accurate measurement of amplitude and duration of the waveshapes being observed. A color filter is provided to increase the contrast when viewing in a brightly lighted room.

**Output Waveforms** — Binding posts are provided on the front panel, making available, in addition to the delayed gate and trigger, the sweep sawtooth and a positive gate starting simultaneously with the sweep and of the same duration. These waveforms are taken from the outputs of cathode followers, so that the termination will not affect the operation of the instrument.

**Regulated Power Supply** — All dc voltages are electronically regulated. Also, the **Type 513-D** features a regulated 12 kv accelerating voltage supply. This prevents a change in acceleration potential as the intensity is changed. It makes possible the high accuracy of the calibration on the **Type 513-D** as there is very little change of image size with a change of brightness. The **Type 513-D** is not affected by line voltage variations over the range of 105 to 125 volts.

**Intensity Modulation (Z Axis)** — A binding post is provided on the panel for the purpose of receiving external blanking pulses, time markers, etc.

## CHARACTERISTICS

**Sweep Circuit** — Hard tube type, either triggered or recurrent as desired.

**Sweep Time** — Continuously variable, .01 sec to .1 microsecond per centimeter of deflection. Calibration accuracy 5% or better.

**Trigger Requirements** — Sine waves 0.5 to 50 v peak. Pulses 0.15 to 15 v, as short as 0.05  $\mu$ sec. Signal under observation producing 0.5 cm or more deflection.

**Sweep Lag** — .1 microsecond, maximum.

**Sweep Magnification** — 5 times indicated sweep speed, except on fastest range.

**External Sweep Input** — Coupled via 100K potentiometer and 2 stage direct coupled sweep amplifier. Maximum deflection sensitivity, 1.6 volts per cm dc or peak to peak ac.

**Vertical Amplifier** — 4 stage. 3rd and 4th stage direct coupled push-pull. Distributed output (4th) stage.

**A. C. Vertical Deflection Sensitivity** — Continuously variable from .03 volts/cm. to 100 volts/cm., peak to peak.

**D. C. Vertical Deflection Sensitivity** — Continuously variable from .3 volt/cm to 100 volts/cm, peak to peak.

**Probe** — R-C frequency compensated. The sensitivity is reduced by a factor of 10 when the probe is used.

**Input Impedance** — 1 meg shunted by 40 mmf. With probe, 10 meg shunted by 14 mmf.

**Vertical Amplifier Transient Response** — Rise time (10%-90%) .025 microsecond.

**Tektronix, Inc.**

# TYPE 513-D OSCILLOSCOPE

**Signal Delay Network** — Provides .25 microsecond signal delay. Permits observation of wavefront that triggers sweep.

**Calibrating Voltage** — Square wave, approximately 1-kc. Seven ranges, 0.05 v to 50 v full scale, continuously variable. Full scale calibrations accurate within 3%; control linear within 1% of full scale.

**Output Waveforms** — Sweep sawtooth, delayed trigger, delayed gate, gate, 1 kc calibrator square wave, trigger from internal rate generator.

**Internal Trigger Rate Generator** — 5 ranges from 200 to 5000 cycles per sec.

**Cathode Ray Tube** — A metallized type 5XP cathode-ray tube with P2 phosphor is furnished with the **Type 513** unless a P1 or P11 phosphor is specified as the optional choice.

**Construction** — Completely self-contained, cabinet and chassis made of electrically welded aluminum alloy. Photo etched front panel.

**Dimensions** — 18 1/2" high, 13" wide, 24 3/4" deep.

**Weight** — 79 pounds,

**Power Requirements** — 105-125 or 210-250 volts, 50-60 cycles ac, 475 watts.

## VACUUM TUBE COMPLEMENT

Input Pre-Amplifier	12AW6
2nd Stage Pre-Amplifier	12AW6
Pre-Amplifier Cathode Follower	12AT7
Gain Control Cathode Follower	12AT7
Probe Power Cathode Follower	6J6
Internal Trigger Amplifier	12AW6
Delay Line Impedance Matching	
Cathode Follower	12AT7
Driver Cathode Follower	12AT7
Driver	4 6AH6
Driver Voltage Cathode Follower	6AS5
Cal. Multivibrator	12AU7
Cal. Limiter and Output Cathode Follower	12AU7
Output Distributed Amplifier	14 6CB6
Trigger Inverter	6AH6
Trigger Amplifier dc Restorer	1/2 6AL5
Coupling Diode	1/2 6AL5
Trigger Amplifier	6AG7
Sweep Multivibrator	6AH6
Sweep Multivibrator	6AG7
Sweep Generator Clamp Tube	6AG7
Sweep Charging Potential Cathode	
Follower	6C4
Sweep dc Restorer	6AL5
Sweep Amplifier, Phase Inverter	12AU7
Sweep Amplifier	2 6AQ5
Sweep dc Level Control	2 6CB6
+Gate Output Cathode Follower	1/2 12AU7
Astigmatism Potential Cathode Follower	1/2 12AU7
Unblanking Amplifier, Inverter	12AT7
Unblanking Cathode Follower	6C4

Sweep Length Multivibrator	12AT7
Sweep Output Cathode Follower	6C4
Sweep Magnifier dc Restorer	6AL5
Sweep Magnifier	6J6
Cathode Ray Tube	5XP
+800 v Rectifier, Doubler	2 6X4
+800 v Series Regulator	6AS5
+800 v Regulator Amplifier	6AU6
+275 v Series Regulator	6AU5
+275 v Regulator Amplifier	6AU6
+275 v Series Regulator	6AS7
+225 v Regulator Amplifier	6AU6
+225 v Regulator Comparator	12AX7
+225 v Voltage Reference	5651
-150 v Rectifier	2 6X4
-150 v Reference	OD3
High Voltage Oscillator Regulator	6AU5
High Voltage Oscillator	6AU5
High Voltage Regulator Comparator	12AU7
+10 kv Rectifier, Doubler	3 5642
-2000 v Rectifier	5642
Delayed Gate Multivibrator	12AT7
Delayed Gate Cathode Follower	1/2 12AT7
Blocking Oscillator Trigger Tube	1/2 12AT7
Delayed Trigger Blocking Oscillator	12AT7
Delayed Trigger Output Cathode Follower	12AT7
Trigger Rate Gen. Blocking Oscillator	6J6
Trigger Rate Gen. Cathode Follower	12AT7

**Price — \$1,650.00**

## TYPE 513 CATHODE RAY OSCILLOSCOPE

The **Type 513** Cathode Ray Oscilloscope is identical to the Type 513-D, except that the .25 microsecond Signal Delay Network is omitted. Price **\$1,600.00**

Includes: 1—P510A Probe  
3—A510 Binding-post adapters  
1—F510-5 Green filter  
1—Instruction Manual

### Currently Available Extras

P2 crt phosphor normally furnished;  
P1, P11 optional.....no extra charge

To provide adequate support for the Type 513-D in rack-mounted installations, and to ease handling, a special rack-mounting cabinet is now available.

With rack-mounting cabinet .....Add \$25

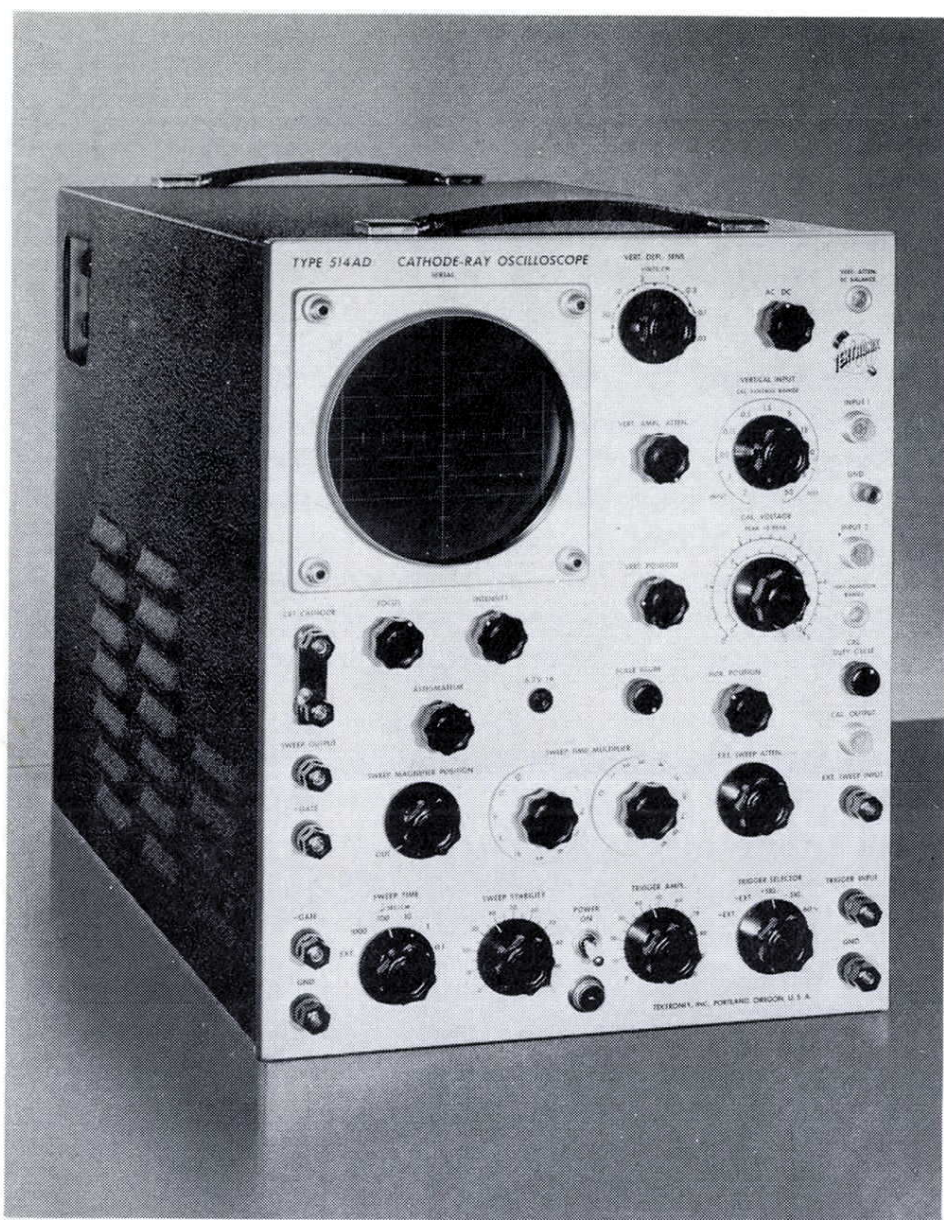
Rack-mounting cabinet may be purchased separately for use with previously purchased Type 513 Oscilloscopes with serial numbers above 1347. Type 513 Oscilloscopes with serial numbers below 1348 require relocation of the cooling fan (Modification Kit K513F, \$35) to use the rack-mounting cabinet.

Rack-mounting cabinet, purchased separately....\$50

**Prices f.o.b. Portland (Beaverton), Oregon**

**Tektronix, Inc.**

# TYPE 514-AD OSCILLOSCOPE



## NEW VERTICAL AMPLIFIER

- 6cm undistorted deflection
- Bandwidth—dc to 10 mc, 0.04  $\mu$ sec risetime
- Sensitivity—dc to 10 mc, 0.3 v/cm to 100 v/cm  
2 cps to 10 mc, 0.03 v/cm to 100 v/cm

## NEW CATHODE-RAY TUBE

- Flat-faced, 3 kv accelerating potential

## TIME BASE RANGE

- 0.1  $\mu$ sec/cm to 0.01 sec/cm, accurate within 5%

## DIRECT COUPLED UNBLANKING

- Uniform crt grid bias regardless of sweep time and repetition rate

## NEW CALIBRATOR

- Variable duty cycle square wave

## GENERAL DESCRIPTION

The TEKTRONIX Type 514-AD Cathode-Ray Oscilloscope is a self-contained general purpose precision instrument, designed specifically to incorporate the advantages of direct coupling, excellent transient response and high gain into a medium priced oscilloscope. The successful realization of these qualities in an instrument has been combined with economy and portability by the use of distributed amplifier techniques.

Accurate measurements of timing and amplitude are possible, with carefully calibrated controls reflecting the use of precision and matched components in fully compensated circuits.

## VERTICAL DEFLECTION SYSTEM

**10 mc Direct Coupled Amplifier** — The best overall criterion of amplifier response is the quality of the reproduction of a square wave. Therefore, the vertical amplifier of the TEKTRONIX Type 514-AD Oscilloscope is adjusted for optimum transient response, as are all TEKTRONIX amplifiers. A sensitivity of 0.3 v/cm is available in both direct and capacitively coupled positions. Additional sensitivity of 0.3 v/cm to 0.03 v/cm is provided with capacitive coupling only.

The desirable combination of 10 mc bandwidth, direct coupling, high sensitivity and 6 cm undistorted deflection is achieved efficiently by the use of a 3 section distributed amplifier in the push-pull output stage.

**Dual Inputs** — Provision is made for observing either one of two signal sources separately by the turn of a switch. This permits the change in wave shape between the input and output of a circuit to be conveniently seen, comparisons of amplitude and time relationships to be made, or observation of other phenomena involving the relative forms of two different signals.

**Direct or Capacitive Coupling** — In the observation of ripple voltage, noise level, etc., it is sometimes unnecessary to display the dc component. Indeed, the sensitivity necessary to amplify the ac component sufficiently to be observed often will cause the dc component to exceed the range of the vertical position control. An AC-DC switch inserts coupling capacitors for the convenient analysis of this type of waveform.

**Deflection Sensitivity Controls** — The problem of attaining a large variation of amplifier gain, to permit displaying a wide range of signal amplitudes without distortion, is multiplied by the necessity of retaining stable amplifier characteristics over the full range of sensitivity. This requirement is solved in the Type 514-AD by using a high gain amplifier and inserting precision, frequency compensated attenuator networks. These vary the over-all gain in steps of approximately 10 db, permitting a range in vertical deflection sensitivity of 0.03 v/cm to 100 v/cm.

To obtain continuous variation between the 10 db steps, a potentiometer is employed in a cathode follower circuit. No appreciable change in amplifier stability or frequency response is encountered in adjusting the gain over this range.

**Direct Input to CRT** — For those occasions when a direct, low capacity connection to the deflection plates is desired, an access panel on the side of the instrument affords convenient plug-in facilities for this purpose.

## SWEEP CIRCUITS

The Type 514-AD offers complete flexibility of operation within the limits of its design. A highly adaptable sweep system provides a fitting counterpart to the vertical amplifier previously described. The sweep generator, operating over a wide range of sweep rates, can be triggered from a versatile trigger selector system, offering convenient adaptation to the test conditions.

**Tektronix, Inc.**

# TYPE 514-AD OSCILLOSCOPE

Offering a range of sweep rates from 0.1  $\mu\text{sec}/\text{cm}$  to 0.01  $\text{sec}/\text{cm}$ , the sweep generator can be synchronized with frequencies as high as 10 mc, or triggered by pulses as short as 0.05  $\mu\text{sec}$ . The crt becomes unblanked, and the sweep is operating linearly, within 0.1  $\mu\text{sec}$  after a sharp trigger impulse is received.

**Trigger Facilities** — The ability to synchronize with positive or negative pulses—from the signal being observed or from an external source—offers great flexibility of operation. Synchronization with the power line frequency is optional.

A wide-band phase splitter and trigger amplifier preserves the risetime of high speed transients, permitting the unusually short starting and unblanking time.

**Sweep Generator** — The sweep generator circuit of the Type 514-AD is similar to that of the Type 511-AD. The versatility of operation which characterizes the Type 511-AD is shared by this instrument.

The sweep generating circuitry is such that a slight adjustment of the sweep stability control is sufficient to obtain either recurrent or triggered sweeps. Pulses occurring 5  $\mu\text{sec}$  apart will trigger individual sweeps, and the operating stability of the circuits is such that long periods can separate enabling pulses. In the free running condition, a sweep repetition rate of unusual stability is obtained.

**Sweep Amplifier** — The sweep amplifier is a direct-coupled, wide-band amplifier engineered to reproduce the sawtooth waveform faithfully and amplify it to the necessary voltage to deflect the electron beam across the cathode-ray tube screen. An internal adjustment is provided should it become necessary to compensate for the changes caused by replacement of the sweep amplifier or cathode-ray tubes.

For those occasions when it is necessary to use an external source as a sweep generator, the introduction of desired waveforms is simplified by a front panel connection. This input, which is connected to the amplifier by means of the sweep time selector switch, is provided with a separate variable attenuator, permitting a maximum sensitivity of 1.5 v/cm.

**Sweep Magnifier** — A control on the panel allows any selected 20% of the sweep to be amplified five times, except on the 0.1  $\mu\text{sec}/\text{cm}$  range, and thus expanded to cover the entire trace.

## MEASUREMENT FEATURES

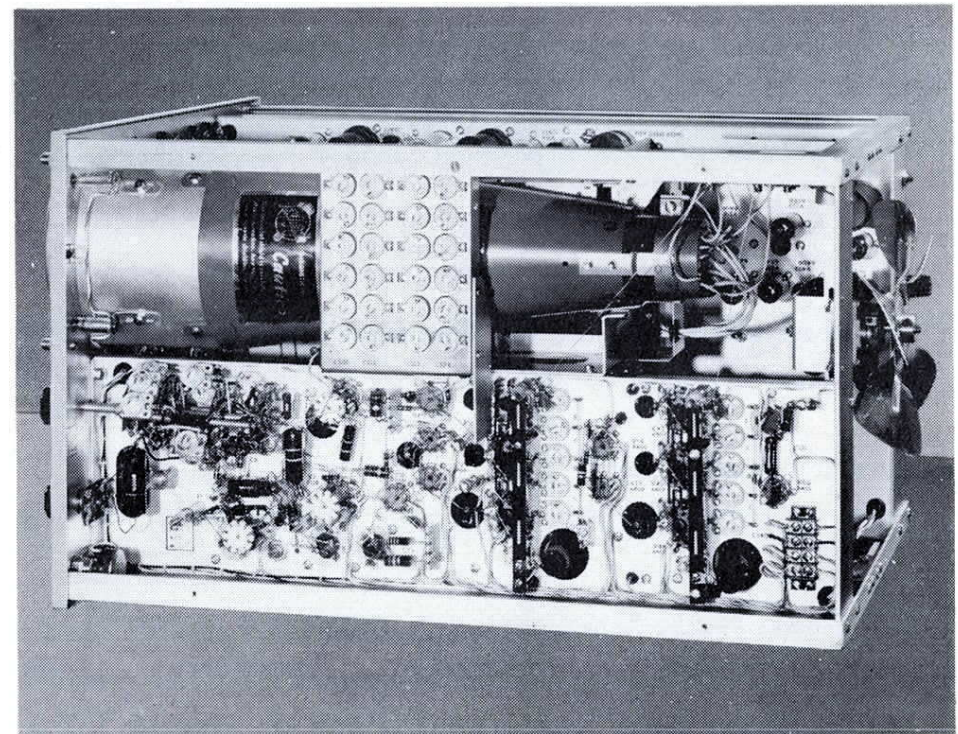
The accuracy of indication of the Type 514-AD is insured by the consistent operation of the carefully designed amplifier, sweep and calibrator circuits.

**Amplitude Calibrator** — A variable duty cycle square wave calibration voltage is provided. This voltage is continuously variable from zero to 50 volts in seven ranges, accurate within 3% on full scale. The duty cycle is variable from 2% to 98%. This permits the duty cycle of the calibrator to be matched with the duty cycle of the observed signal, thus minimizing error in amplitude calibration of an ac coupled signal due to change in amplifier bias with the duty cycle of the signal.

**Sweep Timing** — The five range sweep time selector offers a choice of sweeps ranging from 0.1  $\mu\text{sec}/\text{cm}$  to 0.01  $\text{sec}/\text{cm}$ . The sweep time multiplier, consisting of a 10 section precision fixed resistance and a calibrated variable resistor, permits readings of sweep time accurate to within 5%, thus eliminating the need for timing markers in most measurement applications.

**Illuminated Graticule** — Accuracy of timing and amplitude measurements is enhanced by scribed graticule markings, which are illuminated in a color complementary to that of the filter. Direct voltage measurements of any portion of the signal can be made when the deflection sensitivity is pre-set with the aid of the calibrator. A glance at the settings of the sweep time controls likewise suffices for accurate measurements of duration, repetition rates, etc.

**Intensity Modulation** — Provision is made for brightening or blanking pulses to be introduced on the cathode of the crt, via an rc coupling network. In cases where the observed waveform is extremely complex, and measurements must be made more accurately than is possible with the oscilloscope calibration alone, intensity modulation offers an easy method of introducing timing pulses.



## OUTPUT WAVESHAPES

In the measurement and observation of complex phenomena, it is frequently necessary that much auxiliary equipment, in addition to the oscilloscope, be operated in a strict time relationship to the phenomena. To eliminate the necessity of special external shaping and amplifying circuits, the Type 514-AD offers a variety of output waveforms to control the operation of this accessory equipment.

**Sweep Output** — To use as a sweep on an external crt, or to facilitate time delay operations, a sweep sawtooth of 15 volts amplitude is available at the front panel. Cathode follower output provides a relatively low impedance and prevents loading of the sweep generator circuit.

**Positive Gate** — Frequently, it is desirable that auxiliary equipment operate only for the period of the sweep.

**Tektronix, Inc.**

# TYPE 514-AD OSCILLOSCOPE

A square positive pulse of the same duration of the sweep, and of 40 volts amplitude, provides a convenient means of triggering and gating associated equipment.

**Negative Gate**—A similar pulse, of opposite polarity and -40 volts amplitude, appears simultaneously at another front panel binding post, offering like aid in operating auxiliary devices.

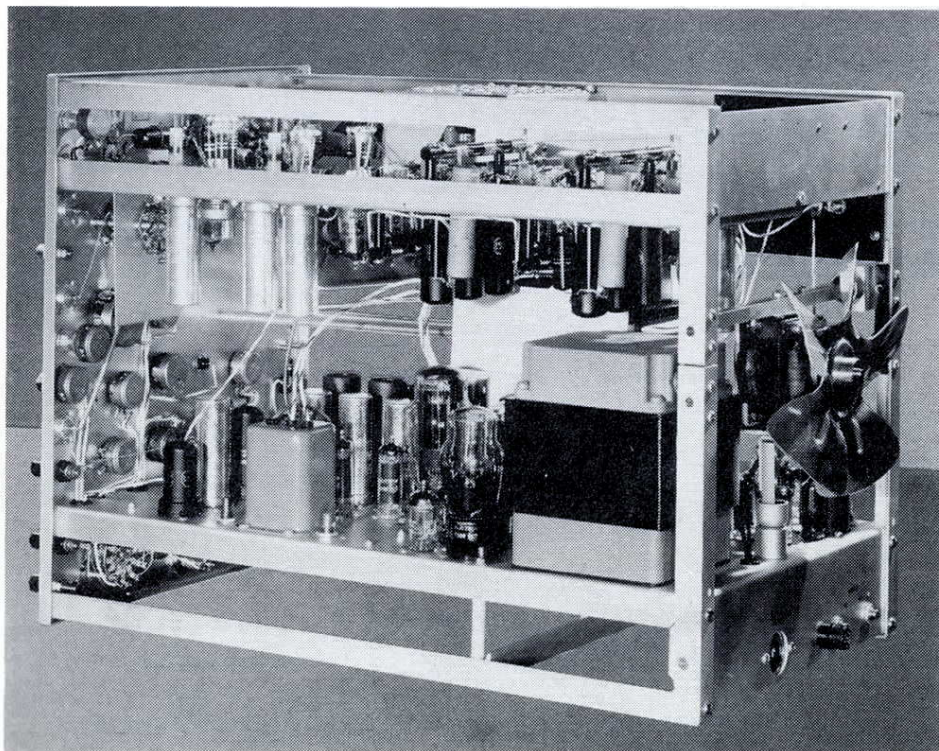
**Calibrator Output**—The square wave calibrator output, available at the front panel, permits convenient checking and adjustment of the Type 514-AD compensating capacitors, and provides an accurately adjustable signal source for calibrating other equipment.

## ADDITIONAL FEATURES

**Probe**—Some observations require great care to prevent undue interference with the signal source. A small, insulated 10x probe is furnished with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 14  $\mu\mu\text{f}$ , minimizing stray pickup and providing reduced loading on the circuit under observation.

**Regulated Power Supplies**—To insure consistency in operation, all dc power supplies in the Type 514-AD have been regulated against variations in load, and line voltage changes over the range of 105-125v. Changes in load, such as increasing the intensity of the trace, do not appreciably vary the deflection sensitivity of the instrument, thus maintaining accuracy of timing and amplitude calibration.

**Construction**—High quality, electrically welded aluminum alloy is used in the construction of the frame, chassis and case, providing a light, clean mechanical design that reflects the careful thought which enters into the development of all TEKTRONIX instruments. All chassis are mounted so that the wiring layouts and components are readily accessible, permitting easy maintenance and repair. The cabled wiring, terminal boards, mounting brackets and other details mirror the effort which is put forth to make the appearance of TEKTRONIX instruments consistent with their operation.



## TYPE 514-AD CHARACTERISTICS

**Sweep Circuit**—Hard tube type, triggered or recurrent operation as desired.

**Sweeps**—Continuously variable, 0.01 sec/cm to 0.1  $\mu\text{sec/cm}$ . Calibration accuracy 5%.

**Trigger Requirements**—Sine waves 0.5 to 50 v peak. Pulses 0.15 to 15 v, as short as 0.05  $\mu\text{sec}$ . Signal under observation producing 0.5 cm or more deflection.

**Sweep Lag**—0.1  $\mu\text{sec}$ , maximum.

**Sweep Magnification**—5 times indicated sweep speed, except on fastest range.

**External Sweep Input**—Direct coupled via 100 k potentiometer and sweep amplifier. Deflection sensitivity 1.5 v/cm.

**Vertical Amplifier**—4 stage. 3rd and 4th stage direct coupled push-pull. Distributed output (4th) stage.

**A. C. Vertical Deflection Sensitivity**—Continuously variable from 0.03 v/cm to 100 v/cm, peak to peak.

**D. C. Vertical Deflection Sensitivity**—Continuously variable from 0.3 v/cm to 100 v/cm, peak to peak.

**Input Impedance**—1 meg. shunted by 40  $\mu\mu\text{f}$ . With probe, 10 meg. shunted by 14  $\mu\mu\text{f}$ .

**Vertical Amplifier Response**—D.C. to 10 mc, sensitivity of 0.3 v/cm or lower; 2 cps to 10 mc, sensitivity of 0.03 v/cm or less.

**Vertical Amplifier Transient Response**—Risetime (10%-90%) 0.04  $\mu\text{sec}$ .

**Signal Delay Network**—Provides 0.25  $\mu\text{sec}$  signal delay. Permits observation of the waveform that triggers the sweep.

**Calibrating Voltage**—Variable-duty-cycle square wave. Seven ranges, 0.05 v to 50 v full scale, continuously variable. Full scale calibrations accurate within 3%; control linear within 1% of full scale. Duty cycle variable from 2% to 98%.

**Output Waveforms**—Sweep sawtooth, positive gate, negative gate, square wave calibration signal.

**Cathode-Ray Tube**—A 5ABP1 cathode-ray tube is furnished unless a P7 or P11 phosphor is specified as the optional choice. An accelerating potential of 3 kv is used (+ 1.5 kv and - 1.5 kv).

**Construction**—Completely self-contained, cabinet and chassis made of electrically welded aluminum. Photo etched front panel.

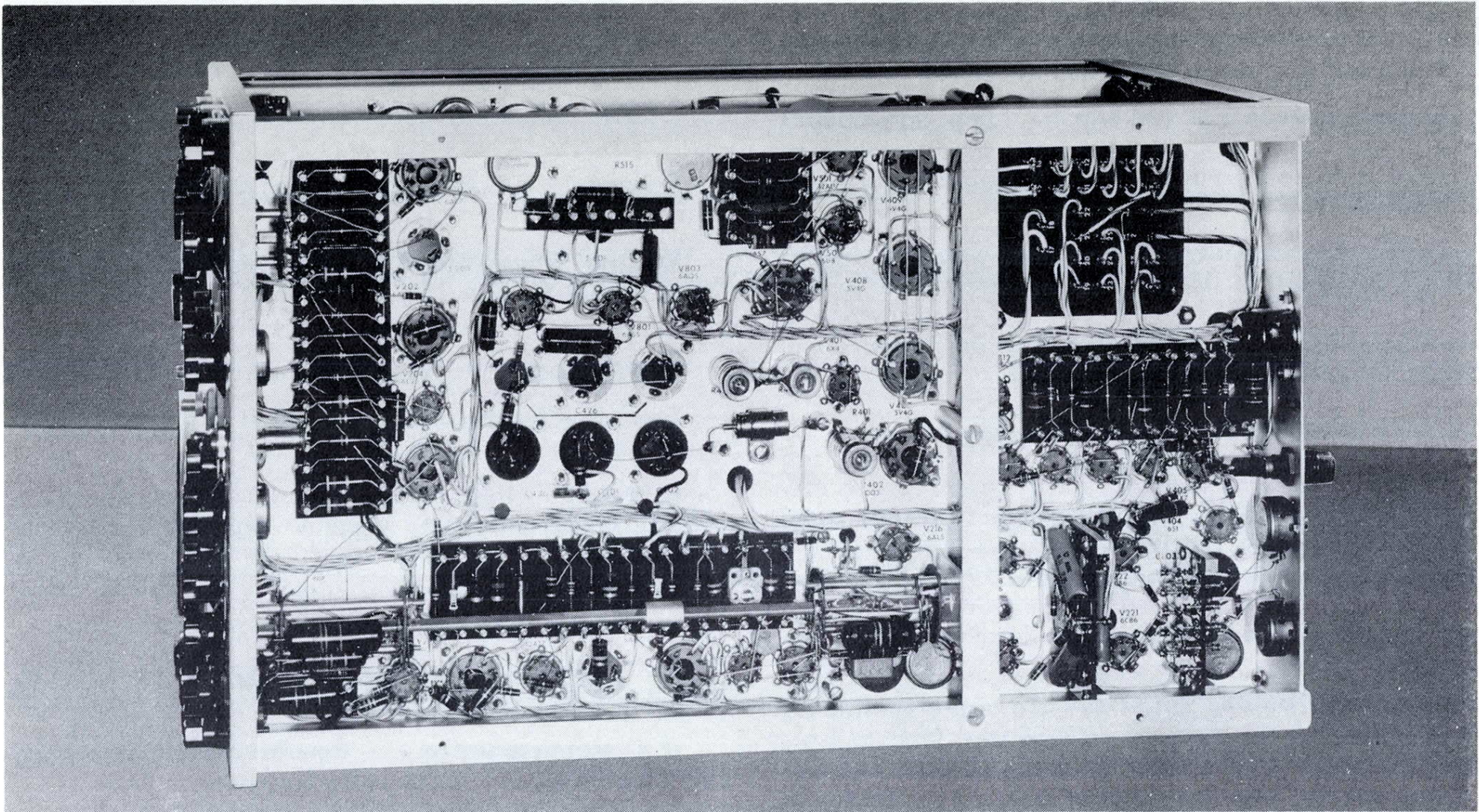
**Dimensions**—16" high, 13" wide, 24 1/2" deep.

**Weight**—61 pounds.

**Power Requirements**—105-125 or 210-250 volts, 50-60 cycles 375 watts.

**Tektronix, Inc.**

# TYPE 514-AD OSCILLOSCOPE



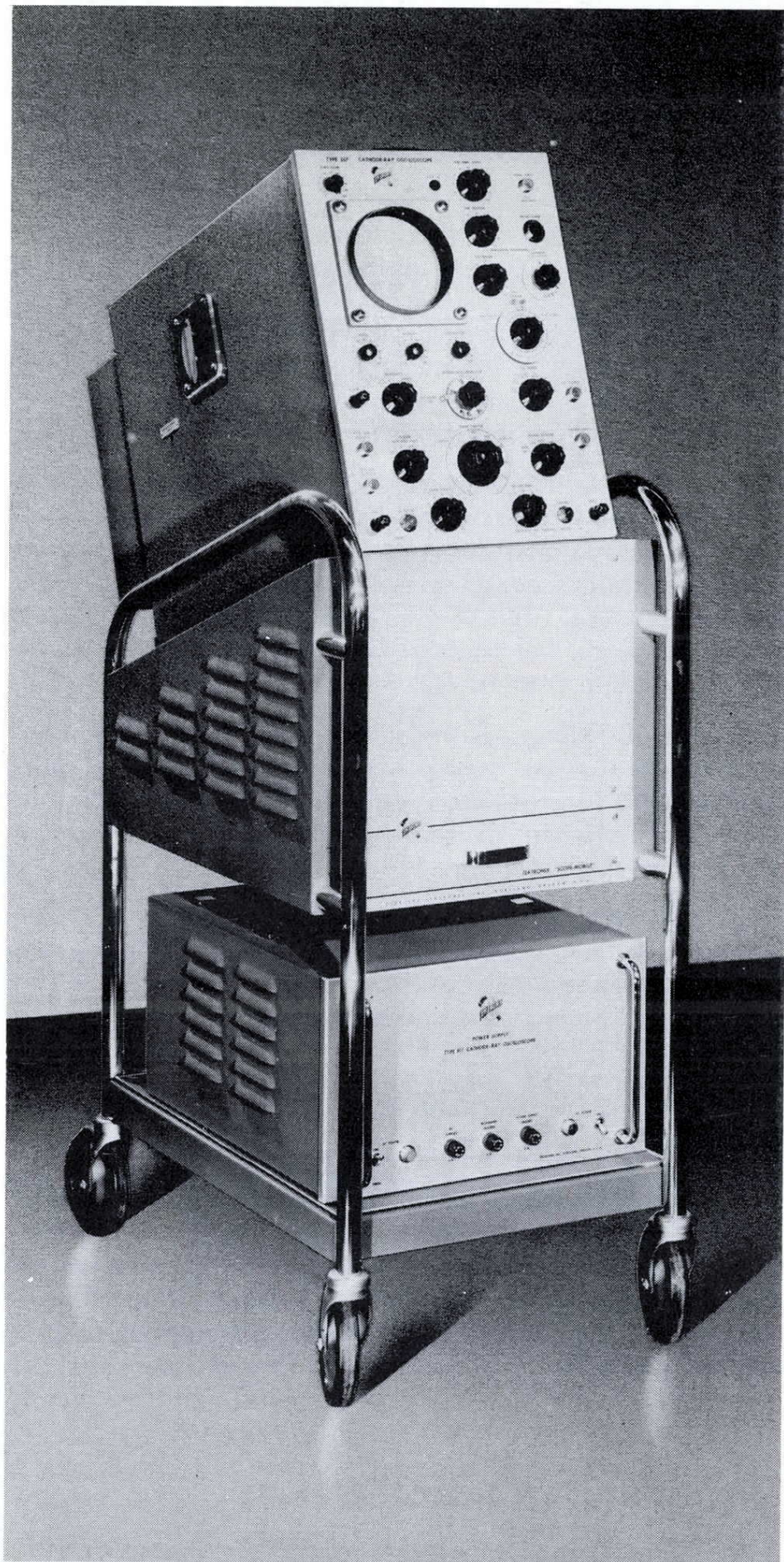
## Vacuum Tube Complement —

Trigger Phase Splitter.....	6AC7	High Voltage Regulator Comparator.....	12AU7
Trigger Coupling Diode.....	6AL5	High Voltage Oscillator.....	6AQ5
Multivibrator.....	6AC7	High Voltage Rectifier.....	3 5642
Multivibrator.....	12AT7	1st Preamp Stage.....	12AU6
Unblanking Cathode Follower..... 1/2	12AT7	2nd Preamp Stage.....	6U8
Unblanking Limiter..... 1/2	12AU7	Trigger Amplifier.....	6U8
Gate Output Phase Splitter..... 1/2	12AU7	Cathode Follower.....	2 12AT7
Second Anode Cathode Follower..... 1/2	12AU7	Phase Inverter Compensator.....	12AT7
Magnified Sweep CF Driver..... 1/2	12AT7	C. F. Voltage Regulator.....	6AS5
Sweep Output Cathode Follower..... 1/2	12AT7	Output Driver.....	4 6AU6
Sweep Generator.....	6AG7	Push-Pull Output.....	6 6AG7
Sweep Charging Potential Cathode Follower.....	6C4	Cal. Multivibrator and Output CF.....	12AU7
Sweep Magnifier.....	6J6	Cal. Multivibrator and Limiter.....	6U8
Sweep DC Restorer.....	6AL5		
Sweep Amplifier.....	2 6AU6	<b>Price — \$950</b>	
Output Level Tubes.....	2 6CB6	<b>TYPE 514-A CATHODE-RAY OSCILLOSCOPE</b>	
+450V Rectifier.....	6X4	The Type 514-A Cathode-Ray Oscilloscope is identical to the Type 514-AD except that the 0.25 $\mu$ sec Signal Delay Network is omitted.	
+450V Series Regulator.....	6AQ5	<b>Price — \$900</b>	
+450V Regulator Amplifier.....	6AU6	Includes: 1—P510A Probe	
+225V Rectifier.....	3 5V4	1—A510 Binding-post adapter	
+225V Voltage Reference.....	5651	1—Instruction Manual	
+225V Regulator Comparator.....	12AX7	<b>Currently Available Extras</b>	
+225V Regulator Amplifier.....	6AU6	Rack mounting.....	\$25
+225V Series Regulator.....	6AS7	P1 crt phosphor normally furnished;	
-150V Rectifier.....	6X4	P7, P11 optional.....	no extra charge
-150V Regulator.....	OD3		
High Voltage Regulator Amplifier.....	6AS5		

Prices f.o.b. Portland (Beaverton), Oregon

**Tektronix, Inc.**

# TYPE 517 OSCILLOSCOPE



## GENERAL DESCRIPTION

The TEKTRONIX Type 517 is a wide-band high-voltage cathode-ray oscilloscope designed primarily for the observation and photographic recording of very fast-rising waveforms having low duty cycle.

The use of 24 kv accelerating potential on a metallized cathode-ray tube permits photographic recording of single sweeps at the maximum writing-rate permitted by the vertical amplifier and sweep circuits. Distributed type vertical amplifiers provide a rise-time of 7 milli-microseconds with a maximum sensitivity of .1 v/cm. Both amplitude and time calibrations are provided. Sufficient time delay is incorporated in the vertical amplifier to

permit viewing the leading edge of the waveform which triggers the sweep.

The Type 517 consists of two units, indicator and power supply, mounted on a Scope-Mobile, thus making a very convenient mobile unit. If desired, the units may be lifted off the Scope-Mobile for bench use.

## VERTICAL DEFLECTION SYSTEM

**Distributed Amplifier** — In order to provide sufficient vertical deflection voltage with a rise-time as short as 7 milli-microseconds for a cathode-ray tube using 24 kv accelerating potential, a distributed amplifier is employed. This amplifier consists of 5 distributed stages plus a phase inverter and a trigger tube. The first two stages use six 6AK5 tubes each, next a stage of seven 6CB6 tubes and a phase inverter of three 6CB6 tubes. The signal now goes to a push-pull driver stage having six 6CB6 tubes on a side; and finally to the output stage with twelve 6CB6 tubes on each side.

**Input** — The input to the vertical amplifier is directly to a 170 ohm grid line, through a UHF type coaxial connector mounted on the front panel.

**Probe** — In order to provide higher input impedances, a cathode follower input probe, preceded by a capacitive attenuator, is used. By substituting various capacitive attenuators, a wide range of sensitivities and input capacitances can be obtained.

**Auxiliary Power** — A power supply socket is provided for a cathode follower probe or an auxiliary amplifier stage connected close to the circuit under observation. 6.3 v dc at 1 amp and 120 v regulated dc at 10 ma is available.

**Sensitivity** — A front panel vertical amplifier attenuator control is provided which decreases the sensitivity of the vertical amplifier from .1 v/cm to .2 v/cm — a range of 2 to 1. Operation of this attenuator does not appreciably affect the characteristics of the vertical amplifier.

**Signal Delay** — Approximately 60 milli-microseconds of delay cable is incorporated in the signal channel. This delay, along with the inherent delay in the vertical amplifier, permits the sweep to start before the signal reaches the vertical deflection plates.

**Amplitude Calibrator** — A pulse-type amplitude calibrator is incorporated which provides continuously variable output voltages in six ranges, from .15 v full scale to 50 v full scale, with an accuracy better than 4% of full scale.

**Direct Connection to CRT Deflection Plates** — It is often desirable to make a low-capacity, low-inductance connection to the deflection plates to permit observation of extremely high speed transients which would be distorted by the amplifier. An aperture in the side of the case permits convenient direct connection to the deflection plates.

## HORIZONTAL DEFLECTION SYSTEM

Since many of the fast-rising pulses to be observed are

**Tektronix, Inc.**

# TYPE 517 OSCILLOSCOPE

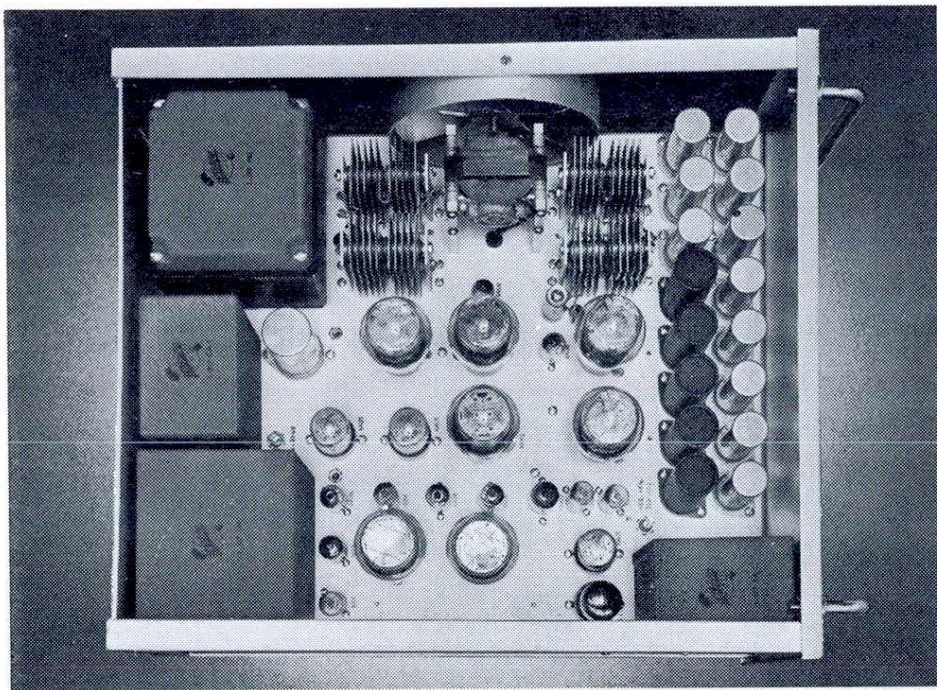
either non-repetitive or non-uniformly spaced, it is essential to have a sweep which can be triggered by the observed pulse itself. The sweep circuit of the **Type 517** can be so triggered.

**Triggered Sweep** — A linear, triggered sweep is available with eleven fixed, accurately timed sweeps ranging from  $.01 \mu\text{sec}/\text{cm}$  to  $20 \mu\text{sec}/\text{cm}$  at 24 kv accelerating potential and half these times for 12 kv. The basic sweep waveform is generated by a pentode clamp with a cathode follower boot-strap to maintain the charging current constant throughout the sweep. The waveform is inverted and fed to the opposite deflection plate for balanced deflection.

**Trigger Selector** — A front panel switch permits the choice of a trigger from an external source of either polarity, an observed signal of either polarity, or an internal trigger-rate generator.

**Trigger Amplifier** — To enable the **Type 517** to trigger from fast-rising signals of small amplitude, a wide-band, distributed type trigger amplifier is incorporated. Signals of .3 v amplitude, with a rise-time of 1 milli-microsecond, will easily trigger the sweep. When using the observed signal as trigger, any signal giving a deflection of 2 mm is adequate.

**Trigger-Rate Generator** — A continuously variable trigger-rate generator operating from 15 to 15,000 cps is incorporated. This consists of a calibrated phantastron oscillator controlling a blocking oscillator. Two cathode-follower outputs are provided so that a time delay may be inserted in one output if desired.



**POWER SUPPLY**

Since the **Type 517** is a quantitative instrument, it is necessary that sweep rates and deflection sensitivities remain constant in spite of line voltage variations. To accomplish this, all critical voltages are electronically controlled. The dc supplies utilize series-regulator tubes controlled by high-gain amplifiers. All heaters in the indicator unit are regulated in rms terms by a saturable-reactor regulator.

The accelerating potentials for the CRT are derived from an oil-filled oscillator-type supply with the CRT gun voltage regulated to compensate for both load and line changes. A panel switch on the indicator unit changes the accel-

erating voltage from approximately 24 kv to approximately 12 kv by changing the point of sampling in the regulator circuit.

Total power consumption for the **Type 517** is approximately 1250 watts at 105-125 or 210-250 v, 60 cycle, single-phase ac.

## OTHER FEATURES

**Calibrated Horizontal Shift** — In addition to the usual full scale horizontal positioning control, a vernier control calibrated in millimeters provides accurate measurements over a range of 1. cm for use in measuring rise-time, etc.

**Metallized Cathode Ray Tube** — The use of a metallized CRT screen provides two advantages: first, increased brightness; and second, removal of residual charge from previous sweeps. This is very important in single sweep operation, since any residual charge will cause the image to be displaced from its correct position.

**Forced Cooling** — Because of the high power consumption of the fast sweep and wide-band amplifier circuits, cooling fans are included in both units. The indicator unit has an efficient air filter to remove dust and foreign matter from the cooling air.

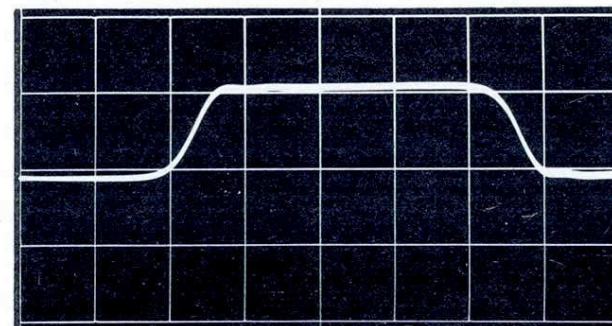
**Output Waveforms** — Coaxial connectors are provided on the front panel, making available two trigger-rate generator impedances, as well as the calibrator output voltage. A binding post makes available a positive gate waveform of 25 volts amplitude with a duration approximately equal to the sweep being generated, with a rise-time of  $.03 \mu\text{sec}$  from a cathode follower source impedance of 200 ohms.

**Edge Lighted Graticule** — As in all other TEKTRONIX Cathode Ray Oscilloscopes, a specially-designed, edge-lighted, plastic graticule is provided. The illumination on this graticule may be adjusted by a front panel control. Centimeter lines are scribed in both the horizontal and vertical directions to facilitate accurate measurement of amplitude and duration of the waveshapes being observed.

## CHARACTERISTICS

**Vertical Amplifier** — 5 stages of distributed amplification; 4th and 5th stages are push-pull.

**Vertical Amplifier Transient Response** — Rise time (10% to 90%) is  $7 \text{ m}\mu\text{sec}$  ( $.007 \mu\text{sec}$ ). Response is free of ringing and overshoot.



A 45 millimicrosecond pulse, initial risetime one millimicrosecond, displayed with a sweep time of 10 millimicroseconds per centimeter. Note amplifier rise-time and freedom from ringing and overshoot.

**Tektronix, Inc.**



# TYPE 517 OSCILLOSCOPE

**Vertical Amplifier Sensitivity** — The maximum vertical amplifier sensitivity with a 5XP cathode-ray tube\* operated at 24 kv accelerating potential is .1 v/cm without a probe. With a cathode follower probe, the maximum sensitivity is .2 v/cm.

**Vertical Amplifier Attenuator** — A continuous control with a range of attenuation from 1X to 2X is provided in the vertical amplifier. Fixed plug-on attenuators are provided for use in conjunction with the cathode follower probe. An external step attenuator with a characteristic impedance of 170 ohms and a range of 1 to 64 db in 1 db steps is provided.

**Vertical Amplifier Input Impedance** — Input impedance direct is 170 ohms resistive. Impedance looking into probe is 12 megohm and  $5\mu\mu\text{fd}$ . Higher impedance values can be had depending upon capacitive attenuator used ahead of probe.

**Signal Delay** — Delay line of RG63U coaxial cable contributes  $64\mu\text{sec}$  delay. This, plus the inherent delay of the distributed vertical amplifier stages, makes an approximate total signal delay of  $120\mu\text{sec}$ . This signal delay permits the sweep to be triggered and under way before the signal is applied to the vertical deflection plates.

**Vertical Amplitude Calibrator** — Pulse generator operating at about 25 kc available at front panel. Six ranges, 0.15 v to 50 v peak full scale. Continuously variable, accurate within 4% of full scale.

**Vertical Amplifier Position Control** — With 24 kv accelerating potential, the vertical positioning control moves the trace  $\pm 2.0$  cm from the center line.

**Sweep Circuit** — Triggered, hard-tube bootstrap type sweep circuit with inverter to produce balanced deflection.

**Sweeps** — Eleven fixed ranges of 10, 20, 50, 100, 200, 500  $\mu\text{sec/cm}$  and 1, 2, 5, 10, 20  $\mu\text{sec/cm}$ , with a maximum displacement error of 2% for 8 cm sweep length.

**Sweep Starting Time** — Approximately  $70\mu\text{sec}$  for the average instrument. A total signal delay of approximately  $120\mu\text{sec}$  permits the sweep to be triggered and underway before the signal is applied to the vertical deflection plates.

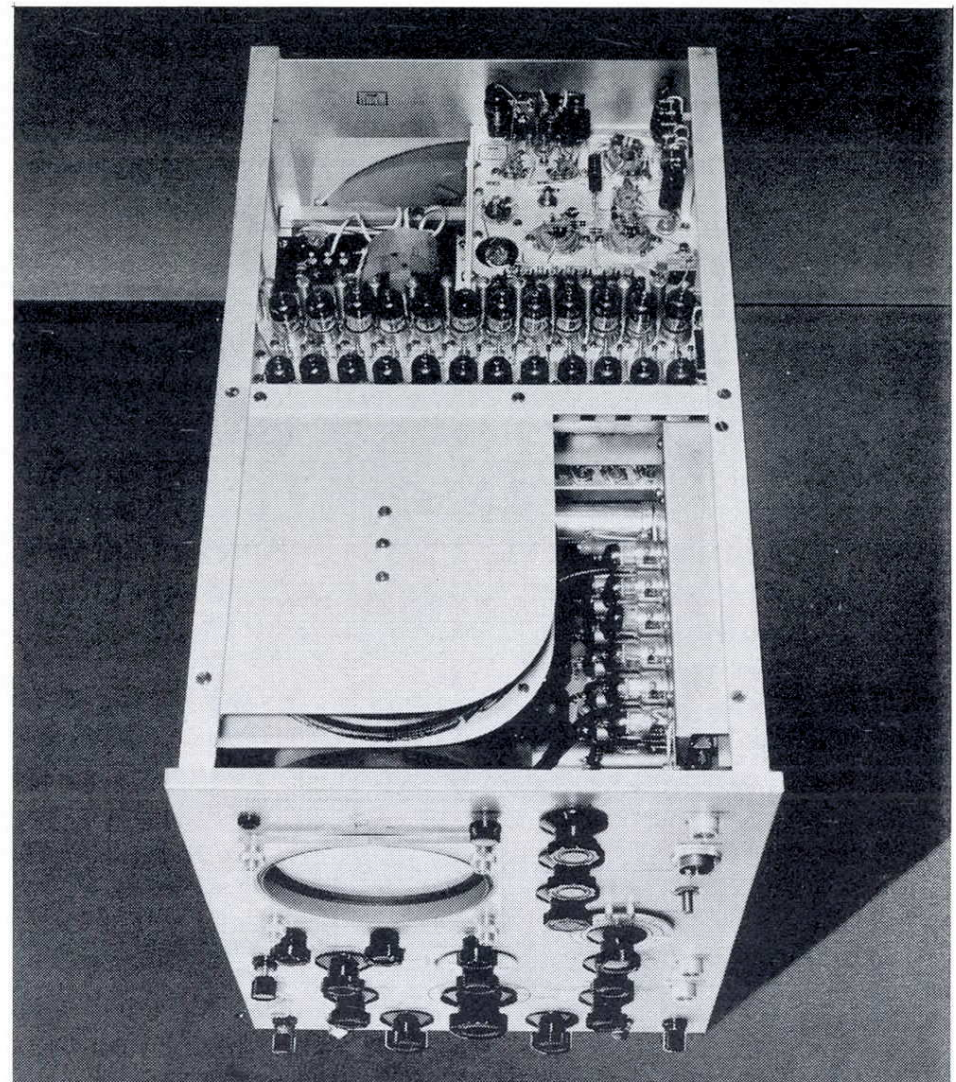
**Horizontal Position Control** — With 24 kv accelerating potential, the horizontal position control moves the trace approximately 5 cm.

**Horizontal Position Vernier** — In addition to the normal horizontal positioning control, a vernier control calibrated in millimeters provides accurate measurements over a range of 1 cm for use in measuring rise-time, etc.

**Duty Cycle** — The approximate limitations on sweep repetition rates for sweep ranges are:

Sweep Time	Maximum Repetition Rate
20 $\mu\text{sec/cm}$ .....	1.5 kc
10 $\mu\text{sec/cm}$ .....	3. kc
5 $\mu\text{sec/cm}$ .....	6. kc
2 $\mu\text{sec/cm}$ .....	10. kc
1 $\mu\text{sec/cm}$ .....	20. kc

\*With a nominal tube vertical deflection sensitivity of 30 v/cm.



Sweep Time	Maximum Repetition Rate
500 $\mu\text{sec/cm}$ .....	50. kc
200 $\mu\text{sec/cm}$ .....	50. kc
100 $\mu\text{sec/cm}$ .....	50. kc
50 $\mu\text{sec/cm}$ .....	50. kc
20 $\mu\text{sec/cm}$ .....	50. kc
10 $\mu\text{sec/cm}$ .....	80. kc

**Trigger Requirements** —

External trigger: .3 - 15 v peak amplitude.  
Internal trigger (from signal): 2 mm deflection.

For optimum triggering, the rise time of the trigger source should be as short as possible.

**Trigger Rate Generator** —

Polarity .....

Length .....

Rise time .....

Output level: 20 v with 50 ohms internal impedance;  
60 v with 200 ohms internal impedance.

Repetition rate: 15-15,000 cps variable in three ranges with an accuracy of 5% of full scale.

**Cathode Ray Tube** — A metallized type 5XP cathode-ray tube with P11 phosphor is furnished with the **Type 517** unless a P1 or P2 phosphor is specified as the optional choice.

**Construction** — Contained in two separate units of convenient size, normally mounted on a TEKTRONIX Type 500 Scope-Mobile. Cabinets and chassis are made of electrically-welded aluminum alloy. Photo-etched front panels are employed.

**Power Requirements** — 1250 watts, 105-125 or 210-250v, 50-60 cycles, single-phase ac. Three primary-circuit fuses are provided for protection against sustained over-load conditions.

# TYPE 517 OSCILLOSCOPE

## Dimensions—

Indicator unit: 12-15/16" wide, 18 3/8" high, 26-15/16" deep.

Power unit: 15-15/16" wide, 9 5/8" high, 19 3/4" deep.

## Weight —

Indicator unit: 76 lbs.

Power unit: 72 lbs.

Scope-Mobile: 42 lbs.

## TUBE COMPLEMENT

Circuit Use	Quantity	Type
<b>Vertical Amplifier</b>		
1st Distributed amplifier	6	6AK5*
2nd Distributed amplifier	6	6AK5*
3rd Distributed amplifier	7	6CB6*
Phase inverter stage	3	6CB6*
Push-pull distributed driver amplifier	12	6CB6*
Push-pull distributed output amplifier	24	6CB6*
Internal trigger coupling tube	1	6CB6*
<b>Sweep Generator Circuit</b>		
Trigger phase-splitter	1	6J6
1st Distributed trigger amplifier	3	6AK5*
2nd Distributed trigger amplifier	3	6AK5*
Trigger limiter tube		6AG7
Trigger switch tube		6AG7
Trigger coupling diode		6J6
Multivibrator	2	6AG7
Paralleled sweep clamp tubes	2	6AG7
Positive sweep out, cathode follower		12BH7
Paralleled bootstrap cathode followers	2	12BH7
Decoupling-diode, bootstrap circuit		6X4
Sweep inverter		6AG7
Bias, screen, cathode follower voltage-regulator for sweep inverter tube		12AU7
Sweep output dc restorer		6AL5
Paralleled unblanking amplifier tubes	2	6AG7
Screen cathode follower voltage-regulator for unblanking amplifier tubes		6AS5
Unblanking voltage cathode follower output tube		6J6
Plus gate output cathode follower	1	6J6
CRT grid bias stabilizers	4	NE2*
<b>Calibrator Circuit</b>		
Multivibrator		12AU7
Clipper		6J6
Cathode follower calibrate voltage adj.		6J6
Calibrator range output, cathode follower		6J6*
<b>Trigger Rate Generator</b>		
Phantastron trigger-generator tube		6BH6
Recharging cathode follower	1/2	12AU7
Trigger coupling triode	1/2	12AU7
Plate catcher		12AU7
Blocking oscillator		12AU7
50 ohm output cathode follower		12AU7
200 ohm output cathode follower		12AU7

\*Selected

## Circuit Use

## Quantity Type

### Astigmatism and Probe Voltage Supply

Astigmatism and probe voltage cathode follower tube . . . . . 12AU7

### CRT High Voltage Supply

Quadrupler rectifiers, +20 kv supply . . . . . 4 1X2  
 Rectifier, —4 kv supply . . . . . 1X2  
 High voltage oscillator tube . . . . . 6AU5  
 Paralleled series-regulator tubes . . . . . 2 6AU5  
 Comparator-amplifier . . . . . 12AU7  
 Oscillator plate voltage time-delay tube . . . . . 6C4  
 High-voltage rectifier-tube filament oscillator . . . . . 6AQ5

### Power Supply, Low Voltages

+750 volt rectifier . . . . . 6X4  
 +750 volt supply series-regulator . . . . . 6AU5  
 Comparator-amplifier, +750 v supply . . . . . 6AU6  
 Rectifier, +475 v supply . . . . . 5R4GY  
 Series-regulator, +475 v supply . . . . . 6AS7  
 Comparator-amplifier, +475 v supply . . . . . 6AU6  
 Full-wave rectifier, +365 v supply . . . . . 2 6X4  
 Paralleled series-regulator, +225 v supply . . . . . 2 6AS7  
 Comparator-amplifier, +225 v supply . . . . . 6AU6  
 Paralleled series-regulator, +150 v supply . . . . . 3 6AS7  
 Comparator-amplifier, +150 v supply, 2nd stage . . . . . 6AU6  
 Comparator-amplifier, +150 v supply, 1st stage . . . . . 12AX7  
 Rectifier, —250 v supply . . . . . 6X4  
 Series-regulator, —250 v supply . . . . . 6AU5  
 Comparator-amplifier, —250 v supply . . . . . 6AU6  
 Voltage reference source . . . . . 5651  
 Heater voltage regulator control diode . . . . . 2AS-15  
 Heater voltage regulator amplifier . . . . . 6AU5

### Cathode-Ray Tube

Cathode-ray tube with optional phosphors of P1, P2, or P11, metallized . . . . . 1 5XP

**Accessories Furnished.** The complete Type 517 Oscilloscope consists of the following items:

Indicator unit with 5XP11 metallized cathode-ray tube, unless a P1 or P2 optional phosphor is specified.

Power unit.

Scope-Mobile, Type 500

Inter-unit connecting cable, Type W517

Cathode follower probe, Type P170CF

Step attenuator, Type B170V

AC Power cable, Type COP16-8

Viewing hood, Type H510

170 ohm coaxial input cable.

BE510 Bezel

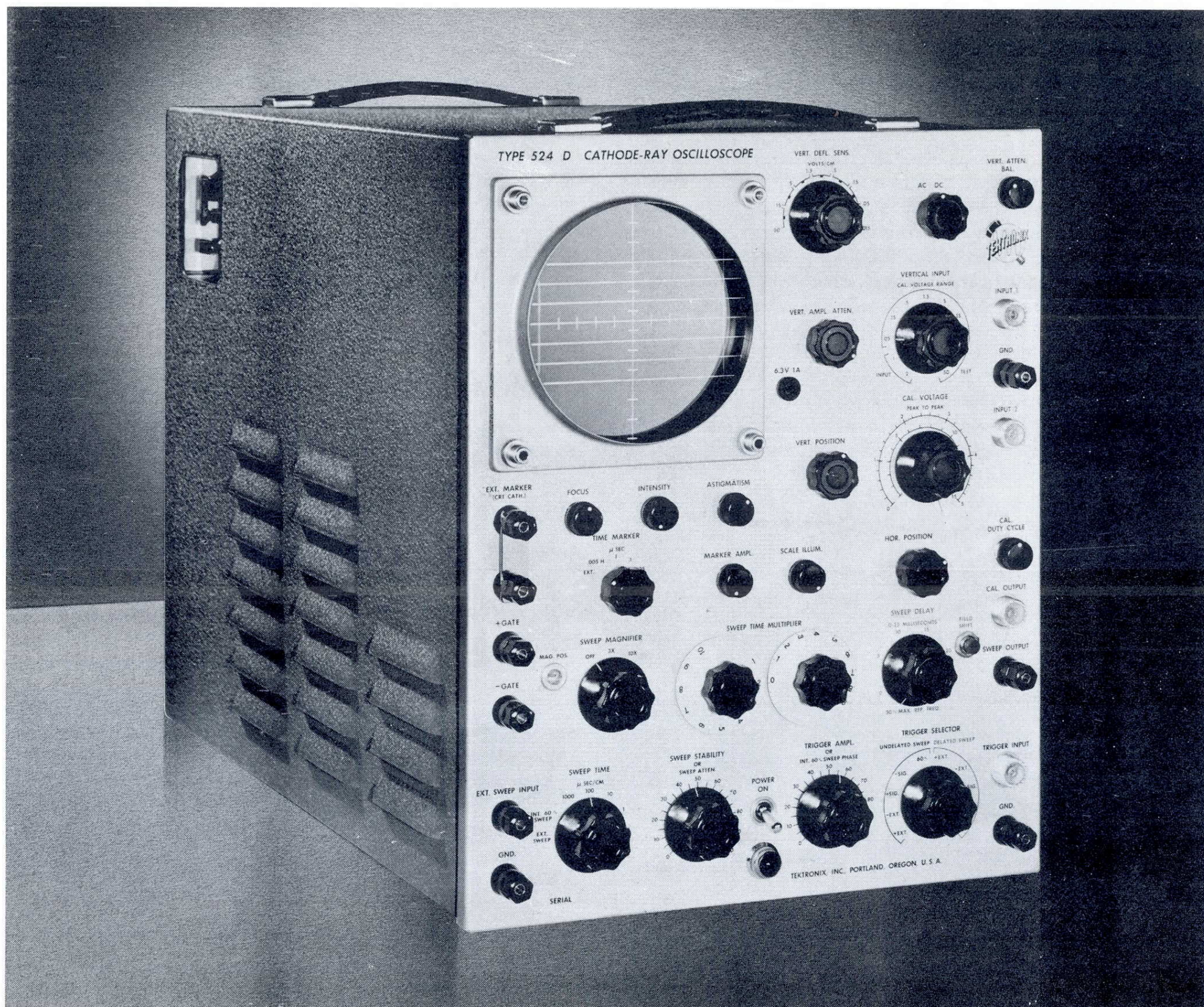
Instruction Manual, Type 517

**PRICE \$3500.00**

f.o.b. Portland (Beaverton), Oregon

# TYPE 524-D OSCILLOSCOPE

## Television Cathode-Ray Oscilloscope



### GENERAL DESCRIPTION

The TEKTRONIX Type 524-D is a portable, self-contained cathode-ray oscilloscope specifically designed for maintenance and adjustment of television transmitter and studio equipment.

With this oscilloscope, any portion of the television picture may be observed—from complete frames to small portions of individual lines. Any one of the 525 lines in the picture may be located and observed in minute detail. Accurate time markers greatly facilitate sync pulse timing. The wide-band vertical amplifier is provided with a network that may be switched in to limit the high frequency

response to that recommended by the IRE for standardized level measurements.

### VERTICAL DEFLECTION SYSTEM

**Direct Coupled Amplifier**—A 10 megacycle vertical amplifier with a maximum sensitivity of 0.15 v/cm direct coupled and 0.015 v/cm capacitively coupled provides an accurate presentation of the video signal. At sensitivities of 0.15 v/cm or lower the signal is fed into a cathode-coupled gain-control stage, then through the 0.25  $\mu$ sec delay network and into the push-pull driver stage. A cathode follower stage feeds the grid lines of the distributed output stage. For the sensitivity ranges 0.015-0.05 v/cm and 0.05-0.15 v/cm a capacitively coupled 2 stage pre-amplifier is switched in.

**Tektronix, Inc.**

# TYPE 524-D OSCILLOSCOPE

**Flat Response to 5 mc** — Some applications require a vertical-amplifier response flat within 1% from 60 cycles to 5 mc. A switch on the access panel of the Type 524-4 inserts special peaking coils in series with the vertical deflection plates of the crt, factory adjusted to provide this response in the main amplifier. When switch is in this position, about 5% overshoot will occur on extremely sharp wavefronts.

**IRE Recommended Response** — The same access-panel switch may be used to limit the vertical-amplifier response to that recommended by the IRE for television level measurements.

**Sensitivity Controls** — A seven position control inserts frequency-compensated attenuators to cover the range of 0.015 v/cm to 50 v/cm. This same control inserts the capacitively coupled pre-amplifier in the 0.05 v/cm and 0.015 v/cm positions. The vertical amplifier attenuator is in the cathode circuit of the gain-control stage. These two controls make the vertical amplifier sensitivity continuously variable over its entire range.

**Direct or Capacitive Coupling** — When the direct coupled feature of the amplifier is not needed, or when it is desirable to observe only the ac components of the signal, the ac-dc switch may be placed in the ac position. In this position a coupling capacitor is inserted in the input circuit to block the dc component of the signal.

**Dual Inputs** — The 524-D is equipped with two uhf input connectors. Selection of either input is made by the vertical input selector. This feature offers a convenient method of making a rapid comparison of two separate signals.

**Probe** — The constant input impedance of the 524-D permits the use of rc input probes. A high impedance probe on a 42" cable is supplied with the instrument. The probe is frequency compensated and has an attenuation of ten times. The input impedance of the probe is 10 megohms paralleled by approximately 14  $\mu\text{mf}$ .

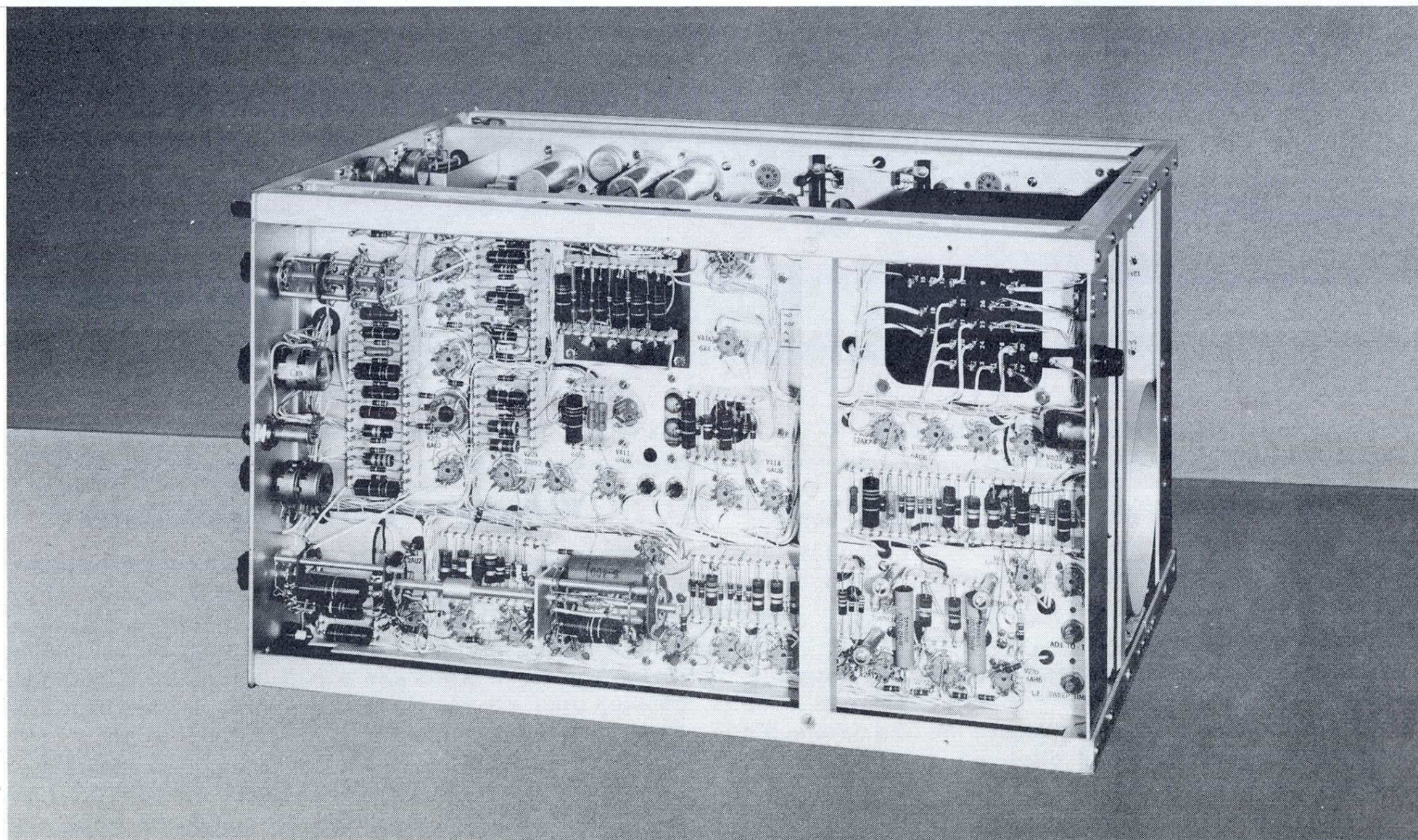
**Amplitude Calibrator** — A variable duty cycle square wave calibration voltage is provided. This voltage is continuously variable from zero to 50 volts in seven ranges, accurate within 3% on full scale. The duty cycle is variable from 1% to 99%. This permits the duty cycle of the calibrator to be matched with the duty cycle of the observed signal, thus minimizing error in amplitude calibration of an ac coupled signal due to change in amplifier bias with the duty cycle of the signal.

**Access Panel** — A panel on the side of the instrument provides a capacitively coupled connection to the vertical deflection plates and direct connection to the horizontal deflection plates, bypassing the vertical and horizontal amplifiers. The vertical position control remains operative.

## HORIZONTAL DEFLECTION SYSTEM

The Type 524-D has a continuously variable, linear, triggered time base covering the range of 0.01 sec/cm to 0.1  $\mu\text{sec/cm}$ . A seven position sweep time selector switch provides five sweep time positions, an internal 60 cycle sine wave sweep, and an external sweep position. Dual sweep time multiplier dials cover the range between steps. Calibration accuracy is within 5%.

**Unblanking** — The unblanking circuit used in the Type 524-D assures constant crt beam current at any sweep speed or duty cycle for a given intensity control setting.



**Tektronix, Inc.**

# TYPE 524-D OSCILLOSCOPE

**Sweep Delay**—To observe individual lines or sync pulses, the sweep must be fast enough to spread out the desired information. By delaying the start of the sweep until the picture has progressed to the desired portion and then triggering the sweep with one of the line sync pulses, any individual portion of the picture may be observed. The sweep delay introduced in the **524-D** is adjustable through about one and one-half fields, and operates at the frame rate of 30 cps so that only one interlaced line is observed at any time. A field shift button permits switching to the corresponding interlaced lines in the other field.

**Sweep Magnifier**—A magnifier principle has been incorporated in the **524-D** that gives either 3 or 10 times magnification of any detail that has been positioned to the center of the screen. With the magnifier on, the operator may explore the entire trace by slowly turning the 3-turn horizontal position control. The position of any detail with respect to the entire sweep may be determined by turning off the magnifier and observing which part of the trace is centered on the screen.

**Trigger Selector**—The **Type 524-D** has a ten-position trigger selector. Both normal and delayed sweeps may be triggered by an external signal of either polarity, by either the positive or negative portion of the signal under observation, or by the power line frequency.

**Recurrent Sweep**—A conventional free-running sawtooth sweep may be obtained by adjusting the sweep stability control. This sweep may be easily synchronized with the waveform under observation.

## OTHER FEATURES

**Time Mark Generator**—Time markers are inserted as intensification pips in the crt beam at time intervals of 1  $\mu\text{sec}$ , 0.1  $\mu\text{sec}$ , 0.05  $\mu\text{sec}$ , or 200 pips per television line. These markers provide a means of accurately timing the sync pulses of a composite signal. Pips spaced 200 per television line (0.005 H, where H is 63.5  $\mu\text{sec}$ ) are useful for adjusting both color and black and white equipment.

**Output Waveforms**—Positive and negative gate waveforms produced simultaneously with each sweep are provided so that intensification or blanking may be produced in a picture monitor to indicate the portion of the picture under observation. The sweep sawtooth waveform is also available on the front panel.

**60-cycle Sweep**—A 60-cycle internal sweep with phasing through approximately  $150^\circ$  and variable amplitude is provided to facilitate bandwidth measurements with a video sweep generator.

**4kv Accelerating Potential**—A flat-faced cathode-ray tube, type 5ABP1, is used in the **524-D**, with 4000 volts regulated accelerating potential.

**Grouped Controls**—The focus, intensity, and astigmatism controls are conveniently grouped below the crt screen.

**Illuminated Graticule**—An edge-lighted graticule marked in centimeters is provided. Illumination is controlled by a front panel knob. An appropriate color filter increases contrast when viewing in a brightly lighted room. Also included is a graticule marked for modulation measurement.

**Regulated Power Supply**—All dc voltages are electronically regulated to insure stable operation over the supply range of 105-125 volts, 50-60 cycles.

## CHARACTERISTICS

**Sweep Circuit**—Hard tube type, triggered or recurrent operation as desired.

**Sweeps**—Continuously variable, 0.01 sec/cm to 0.1  $\mu\text{sec/cm}$ . Calibration accuracy 5%.

**Trigger Requirements**—0.5 to 50v (peak). Pulses as short as 0.05  $\mu\text{sec}$ . Signal under observation producing 0.5 cm deflection or more. Composite television signal—1 v peak to peak external or 0.05 v to vert. amp.

**Sweep Magnification**—Magnifier expands the sweep to left and right of center. Either 3 times or 10 times magnification is available except on the 0.1  $\mu\text{sec/cm}$  sweep range.

**External Sweep Input**—Coupled via 100k potentiometer, sweep magnifier, and direct coupled sweep amplifier. Maximum deflection sensitivity, 0.25 v/cm dc or ac peak to peak.

**Time Markers**—Four markers: 1  $\mu\text{sec}$ , 0.1  $\mu\text{sec}$ , 0.05  $\mu\text{sec}$ , and 200 per television line. Accurate within 2%.

**Vertical Amplifier**—5 stage. 3rd, 4th, and 5th stage direct coupled push-pull. Distributed output (5th) stage.

**AC Vertical Deflection Sensitivity**—Continuously variable from 0.015 v/cm to 50 v/cm, peak to peak.

**DC Vertical Deflection Sensitivity**—Continuously variable from 0.15 v/cm to 50 v/cm, peak to peak.

**Input Impedance**—1 megohm shunted by 40  $\mu\text{mf}$ . With probe, 10 megohms shunted by 14  $\mu\text{mf}$ .

**Vertical Amplifier Response**—dc to 10 mc (3db down) sensitivity of 0.15 v/cm; 2 cps to 10 mc (3 db down) sensitivity of 0.015 v/cm. Undistorted deflection available—6 cm.

**Vertical Amplifier Transient Response**—Rise time (10% -90%) 0.04  $\mu\text{sec}$ .

**Signal Delay Network**—Provides 0.25  $\mu\text{sec}$  signal delay. Permits observation of the waveform that triggers sweep.

**Calibrating Voltage**—Variable-duty-cycle square wave. Seven ranges, 0.05 v to 50 v full scale, continuously variable. Full scale calibrations accurate within 3%; control linear within 1% of full scale. Duty cycle variable from 1% to 99%.

**Cathode Ray Tube**—A 5ABP1 cathode-ray tube is furnished with the **Type 524-D** unless a P7 or P11 phosphor is specified as the optional choice. An accelerating potential of 4 kv is used (+2.5 and -1.5 kv).

**Construction**—Completely self-contained, cabinet and chassis made of electrically welded aluminum. Photo etched front panel.

**Dimensions**—13" high, 16" wide, 24½" deep.

**Weight**—61 pounds.

**Power Requirements**—105-125 or 210-250 volts, 50-60 cycles, 500 watts.

# TYPE 524-D OSCILLOSCOPE

## VACUUM TUBE COMPLEMENT

Preamplifier . . . . .	2	6U8
Cathode-follower . . . . .		12AT7
Cathode-coupled amplifier . . . . .	2	6CL6
Driver . . . . .	2	6CL6
Cathode-follower, constant current triode . . . . .	2	6BQ7
Output amplifier . . . . .	6	6AG7
Cathode-follower . . . . .		6AS5
Cal. multivibrator . . . . .		12AU7
Cal. clipper amplifier . . . . .	1/2	12AT7
Cal. cathode-follower . . . . .	1/2	12AT7
Trigger inverter . . . . .	1/2	6BQ7
Clamp diode . . . . .	1/2	6BQ7
Sync amplifier . . . . .		12BZ7
Sync separator . . . . .	1/2	12BZ7
Coupling diode . . . . .	1/2	12BZ7
Phantastron . . . . .		6BH6
Voltage comparator . . . . .		12BZ7
Trigger amplifier . . . . .		6AG7
Coupling diode . . . . .		6AL5
Negative multivibrator . . . . .		12BY7
Positive multivibrator . . . . .		12BY7
Gate amplifier . . . . .	1/2	12AU7
Astigmatism cathode-follower . . . . .	1/2	12AU7
Unblanking amplifier . . . . .		12AT7
Clamp tube . . . . .		6AG7
DC restorer . . . . .		6AL5
Cathode-follower . . . . .		12AT7
Decoupling diode . . . . .	1/2	12AT7
Cathode follower . . . . .	1/2	12AT7
Feedback amplifier . . . . .		6U8
Clamp . . . . .	1/2	12AT7
Output cathode-follower . . . . .	1/2	12AT7
Sweep output amplifier . . . . .	2	6AH6
Sweep output cathode-follower . . . . .		6BQ7

Voltage reference . . . . .		5651
Regulator amplifier . . . . .	4	6AU6
Regulator series tube . . . . .	2	12B4
Rectifier . . . . .	3	6X4
Voltage comparator amplifier . . . . .		12AX7
Regulator series tube . . . . .		6AS7
Regulator series tube . . . . .		6AS5
Regulator series tube . . . . .		6AQ5
Time mark pulse shaper . . . . .	1/2	6BQ7
Oscillator gate . . . . .	1/2	6BQ7
Time mark oscillator . . . . .		6AK5
Pulse amplifier . . . . .		6AH6
Regulator amplifier . . . . .		12AU7
High voltage oscillator . . . . .		6AQ5
High voltage rectifier . . . . .	3	5642
Cathode-ray tube . . . . .		5ABP1

**Price — \$1,180 f.o.b. Portland (Beaverton), Ore.**

- Includes
- 1 — Type P510A Attenuator Probe
  - 2 — Type A510 Binding Post Adapters
  - 1 — Type GR524TV Graticule
  - 1 — Type H510 Viewing Hood
  - 1 — Instruction Manual

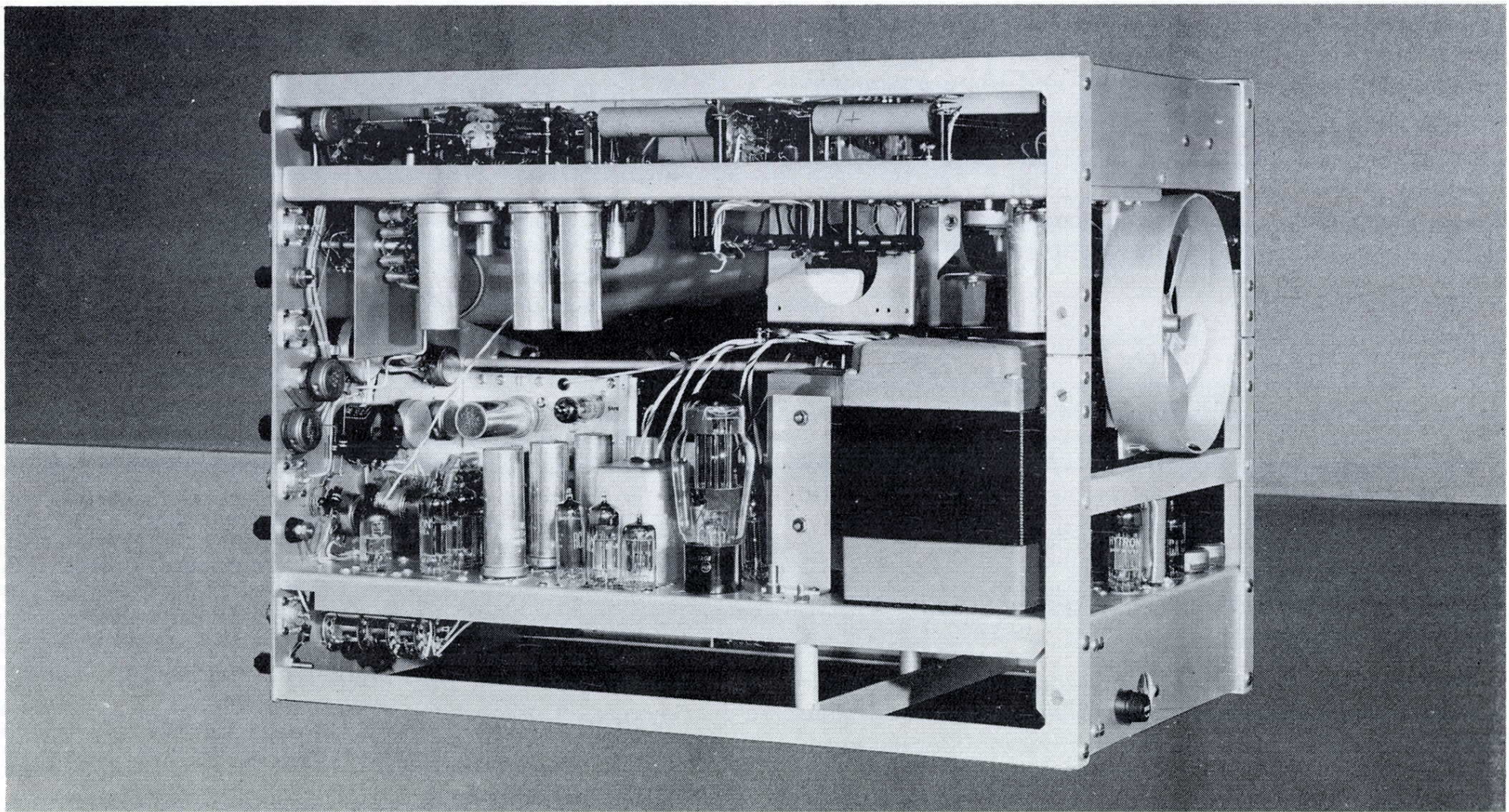
### Currently Available Extras

- Rack Mounting . . . . . Add \$25
- P1 crt phosphor normally furnished.
- P7, P11 optional . . . . . No extra charge

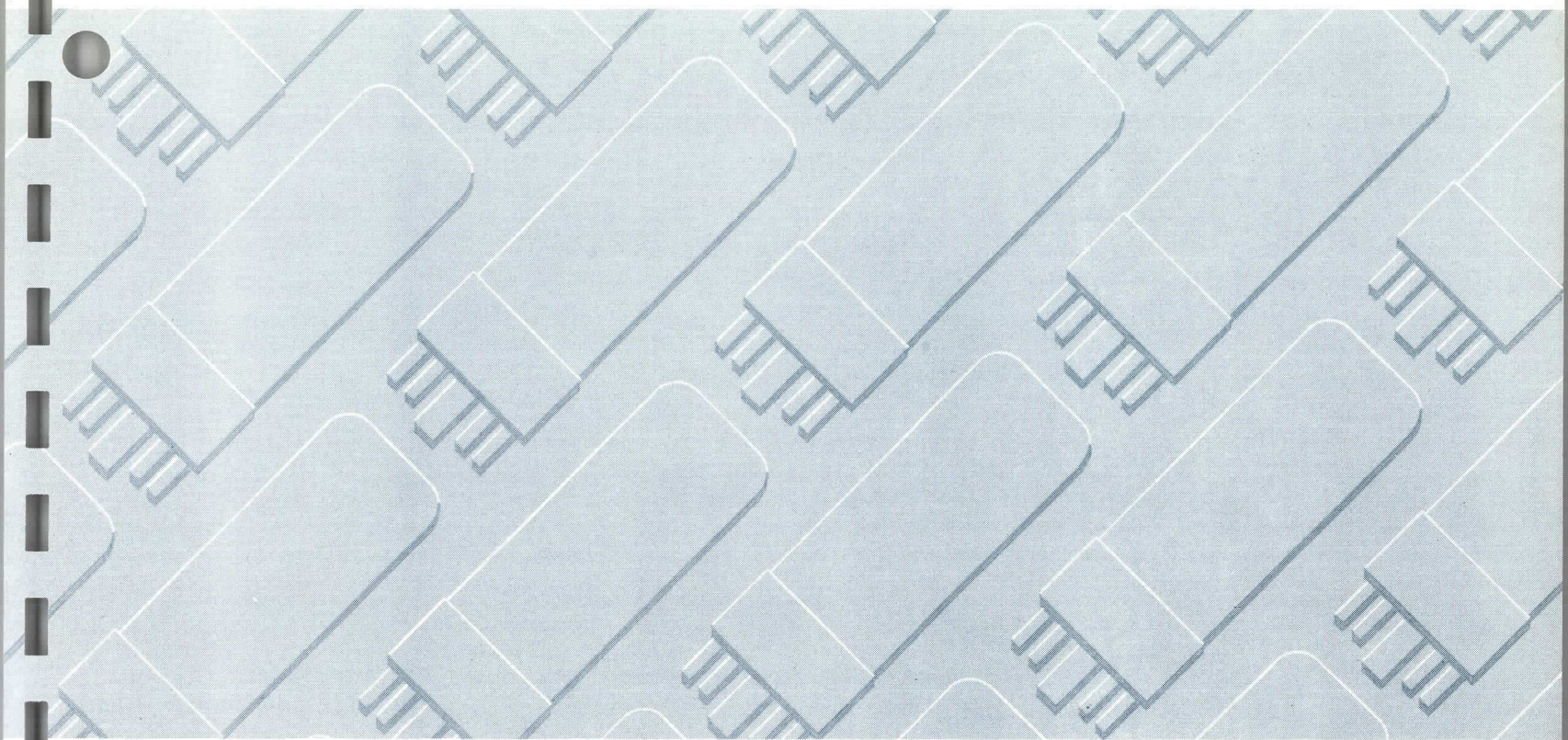
### Recommended Additional Accessories

- Type 500 Scope-Mobile . . . . . \$97.50

See Accessory Section of this catalog for 75-ohm coaxial cables, pads, and terminating resistors.



**Tektronix, Inc.**

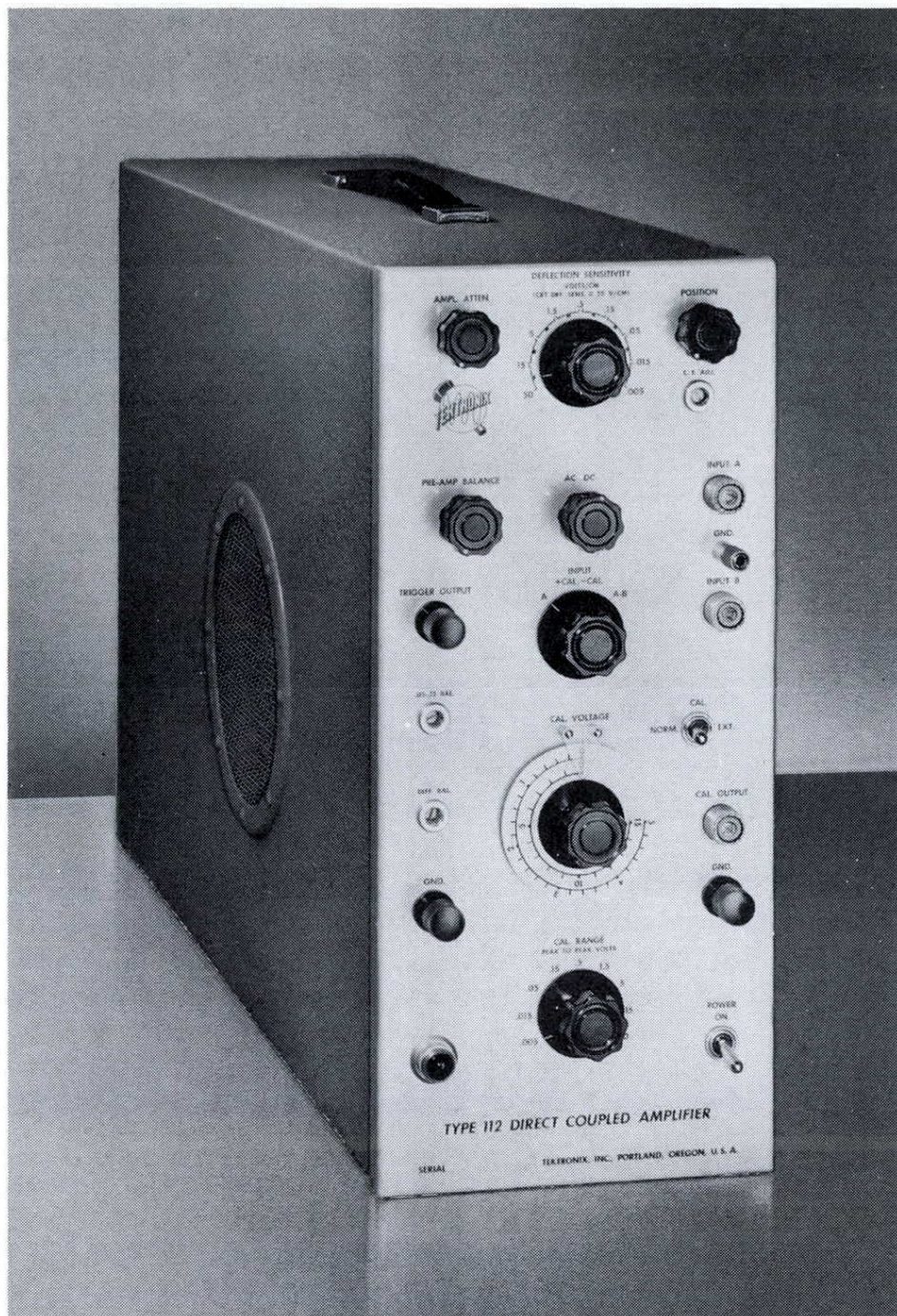


## AUXILIARY AMPLIFIERS

*are designed to expand the area of application of Tektronix oscilloscopes in certain specialized directions. Frequently it is desirable to increase the sensitivity of the oscilloscope amplifier into the mv/cm or  $\mu$ v/cm region. Other measurements may require that the horizontal deflection circuits have the same order of bandwidth or sensitivity as the vertical circuits.*

# TYPE 112 AMPLIFIER

## Direct-Coupled Amplifier



**Differential Input—Push-Pull Throughout  
Band Pass DC — 2 mc  
Gain .5 to 5000, Continuously Variable  
Shock Mounted Pre-amplifier**

The TEKTRONIX Type 112 Direct-Coupled Amplifier is an auxiliary instrument primarily intended for use with the TEKTRONIX Type 511-A, 511-AD, 512 or other cathode-ray oscilloscopes. It consists of the vertical amplifier of the Type 512 Oscilloscope complete with self-contained, fully-regulated power supply and square wave voltage calibrator. Forced air cooling is provided by a fan mounted on the power chassis.

When used with a cathode-ray oscilloscope in which the 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 means of the step attenuator and variable potentiometer. The pass band, when working into a 5CP type CRT and using short leads, is DC to 2 mc when voltage gain requirements are 166 or less, DC to 1 mc when voltage gain requirements fall within the range of 166 to 5000.

The TEKTRONIX Type 112 input impedance is approximately 1 megohm paralleled by 45  $\mu\mu\text{f}$  each side to ground for direct connection, and is approximately 10 megohms paralleled by 14  $\mu\mu\text{f}$  each side to ground when using the two RC probes which are supplied as standard accessories. The probes have an attenuation of ten. Either single-ended or a differential input may be employed.

When using the differential input, effects of the in-phase components are minimized. At full gain of the amplifier, one volt of in-phase signal will produce less deflection than 5 mv applied between the inputs. The differential input also provides a ready means of mixing two signals without interaction or frequency discrimination.

The amplitude response curves are approximately 3 db down at the high frequency points mentioned above. The rate of fall of amplitude response, however, is quite gradual, with useful amplification existing considerably above the quoted points.

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 capacitors. For other applications, short circuiting the limiting components will provide an output impedance of 8000 ohms plate to plate. A maximum output voltage of approximately 150 volts (peak to peak) is available when working into a high impedance load.

Output connections are from a right hand side access panel by means of banana jacks and plugs. Mounted at the rear of the amplifier, a coaxial connector permits the injection of time markers at a point just ahead of the output stage without interaction with other 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. The output level is adjustable between 0 and +150 v.

A rapid change between the adjusted output level and +150 v. is provided by a toggle switch.

### SPECIFICATIONS

**Deflection Sensitivity** . . . . . 5 mv/cm to 50 v/cm  
(when used with oscilloscopes in which the crt has a basic deflection factor of 25 v/cm.)

**Voltage Gain** . . . . . .5 to 5000, continuously variable

**Band Pass** . . . . . DC—2 mc, gain 166 or less  
DC—1 mc, gain 166-5000

**Input Impedance** . . . . . 1 meg paralleled by 45  $\mu\mu\text{f}$  direct  
10 meg paralleled by 14  $\mu\mu\text{f}$  with probes

**Maximum Signal Input Voltage** . . . . . 600 v (peak)

**Calibrating Voltage** — Square wave, approximately 1-kc. Nine ranges, 5 mv to to 50 v full scale, continuously variable. Full scale calibrations accurate within 3%; control linear within 1% of full scale.

**Output Voltage** . . . . . 150 v high imp.; 75 v 8000 ohms

**Power Requirement** . . . . . 105-125/210-250 v,  
50-60 cycles, 200 watts

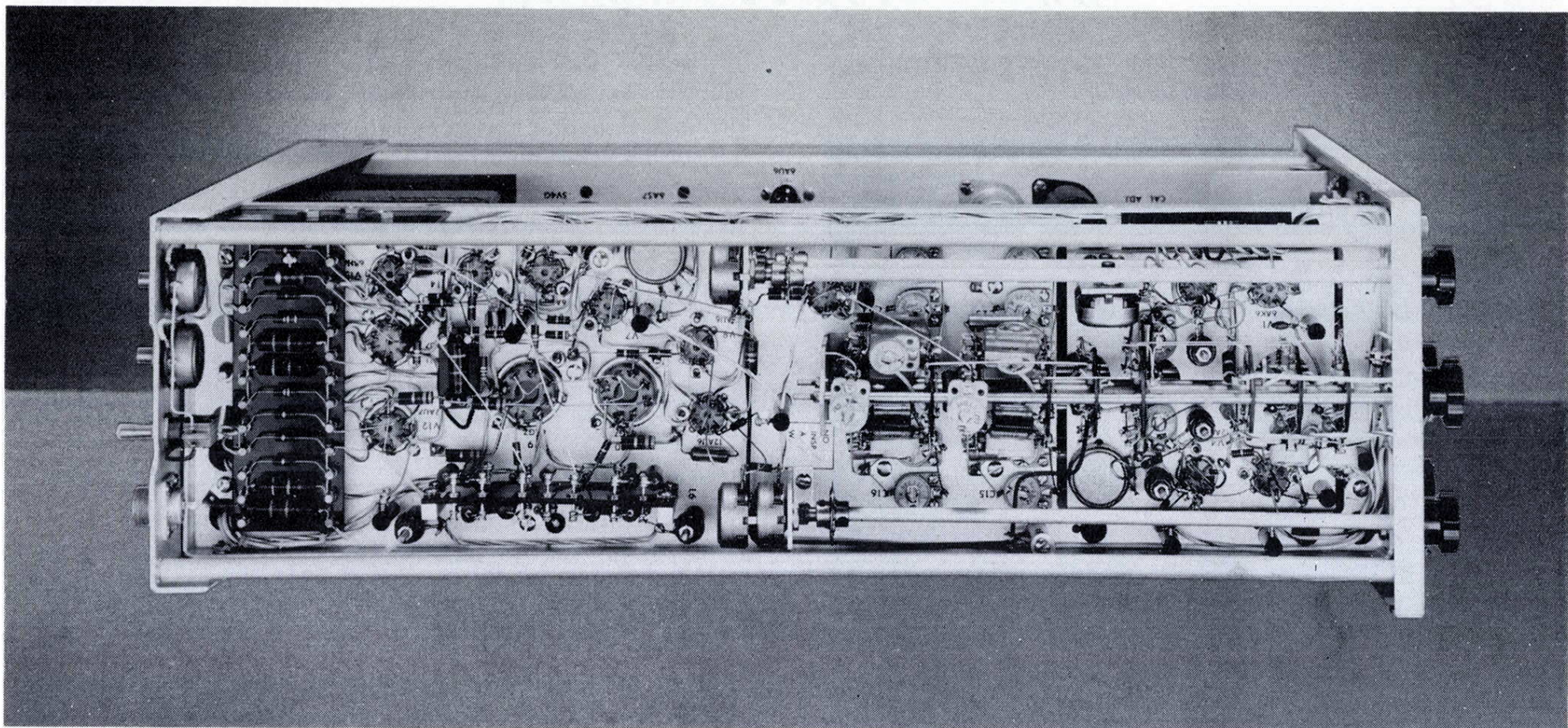
**Dimensions** . . . . . 15 1/2" high, 6 1/2" wide, 21 1/2" deep

**Weight** . . . . . 32 pounds.

**Tektronix, Inc.**



# TYPE 112 AMPLIFIER



## Vacuum Tube Complement—

1st Stage .....	2	5879
2nd Stage .....	2	12AU6
Cathode Follower .....	2	12AU6
3rd Stage .....	2	12AU6
4th Stage .....	2	6AG7
Voltage Regulators .....	2	12AU7
Marker Input Ampl .....		6AU6
Constant Current Control .....	2	6BH6
Calibrator Multivibrator .....		12AU7
Calibrator Diode and Output Cathode Follower .....		12AU7

Low Voltage Rectifiers .....	3	5V4G
Voltage Reference .....		5651
Voltage Regulator Amplifier .....	2	6AU6
Voltage Regulator Series Tube .....		6AS7G

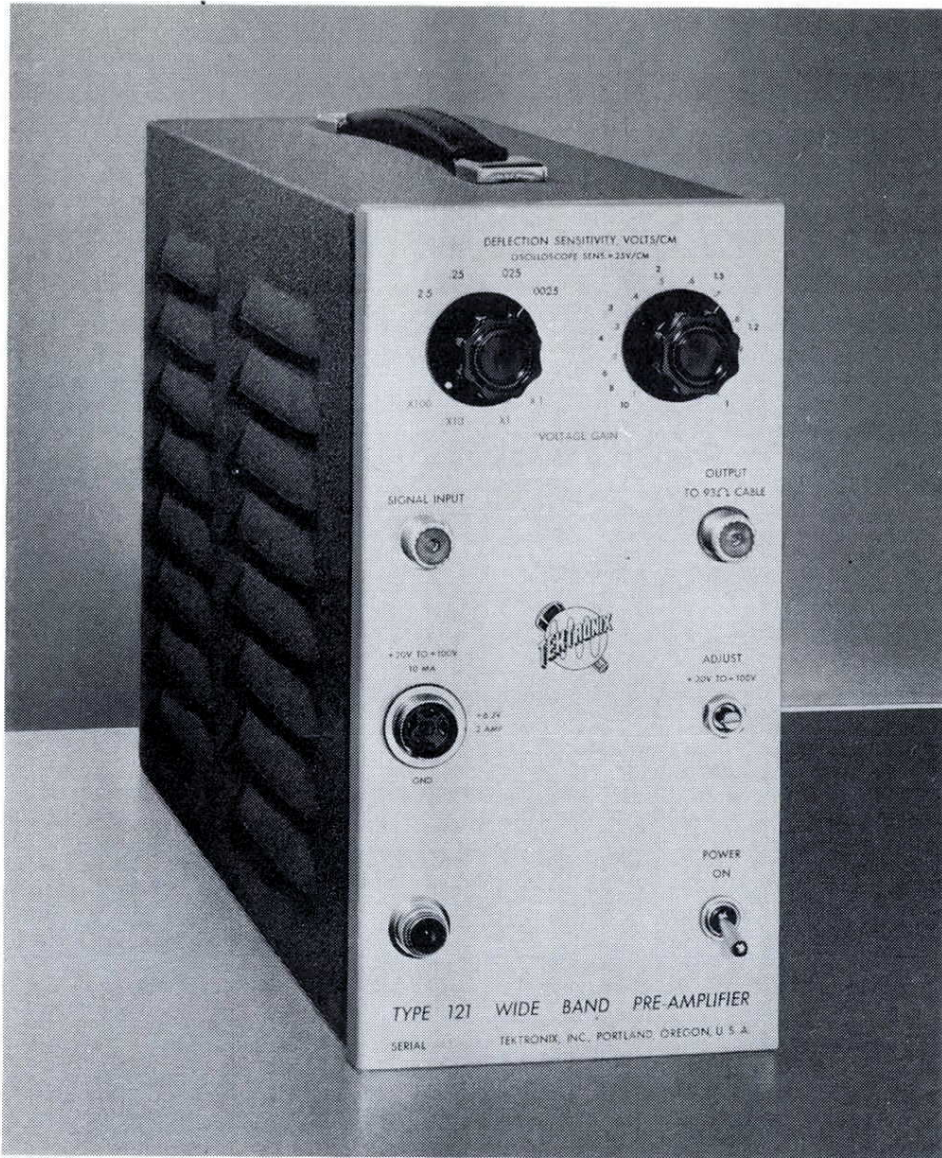
**Price—\$495 f.o.b. Portland (Beaverton), Oregon**

Includes the following: 2—P510A Attenuator Probes  
 2—W112R Output Leads  
 1—W112B Output Lead  
 2—A510 Binding Post Adapters  
 1—Instruction Manual

**Tektronix, Inc.**

# TYPE 121 PREAMPLIFIER

## Wide-Band Preamplifier



### Optimum Transient Response Unusual Adaptability

The TEKTRONIX **Type 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 TEKTRONIX **Type 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 TEKTRONIX **Type 121** and oscilloscope is via a matched 93-ohm co-axial cable so that the separation of the instruments may be 100 feet or more. As in all TEKTRONIX instruments, primary emphasis has been placed on transient response. A bandwidth in excess of 12 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 power supply 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 TEKTRONIX **Type 121** provides electronically regulated DC for the plates of the tubes and to minimize the hum level, rectified, filtered DC is supplied to the heaters of the first three

tubes as well as the front panel power supply socket. The first, second, and C.F. gain control stages are shock mounted.

### SPECIFICATIONS

<b>Voltage Gain</b> .....	100
<b>Input Impedance, Direct</b> . . . . .	1 meg paralled by 20 mmf
<b>Max. Peak Output</b> .....	±1 v in 93-ohm cable
<b>Band Pass</b> .....	5 cps — 12 mc
<b>Front Panel Power Supply Socket</b> .....	6.3 v DC 20 - 120 v DC

**Power Requirements** — 105-125/210-250 volts, 50-60 cycles, 80 watts.

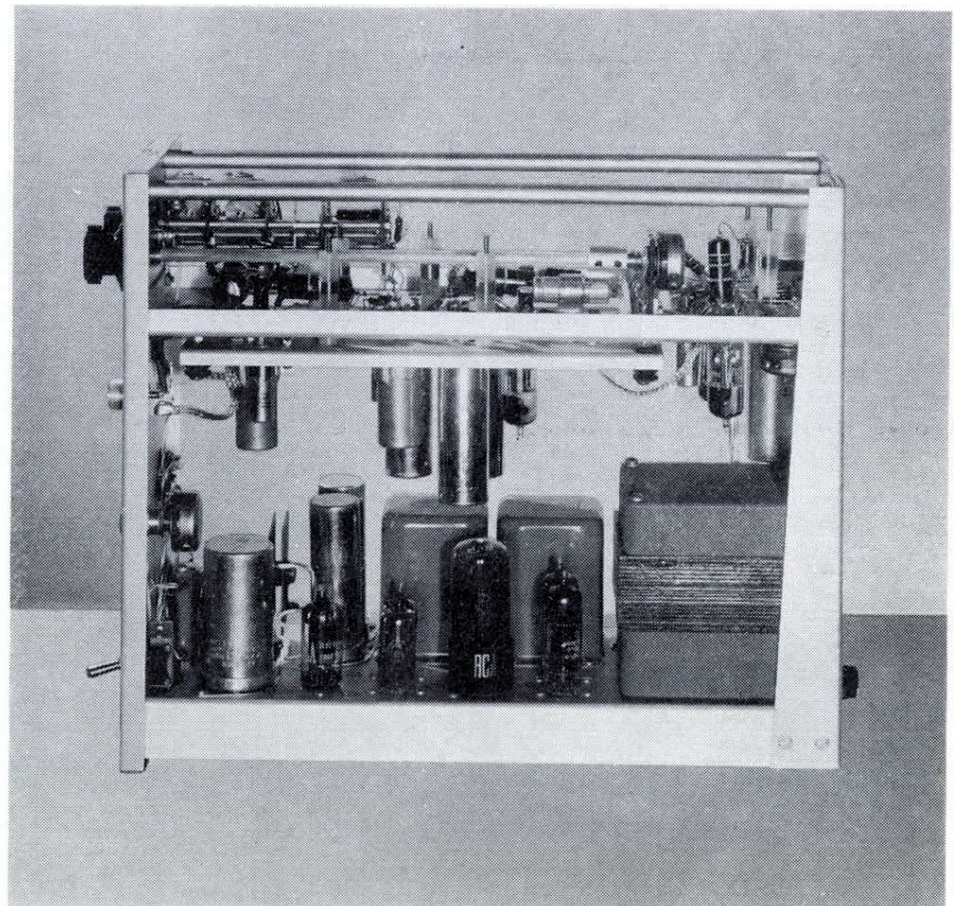
**Dimensions** . . . . . 5¾" wide, 11¼" high, 15" deep  
Self-contained — Total Weight 18 ½ lbs.

### Vacuum Tube Complement

First Stage .....	6CB6
Second Stage .....	6CB6
C.F. Gain Control .....	6J6
Third Stage .....	6AH6
C.F. Output .....	6J6
C.F. Voltage Regulator .....	6J6
Voltage Regulator Comparator .....	12AX7
Plate Rectifiers .....	2 6X4
Series Voltage Regulator .....	25L6
Regulator Amplifier .....	6AU6
Voltage Reference .....	5651

### Price \$265 f.o.b. Portland (Beaverton), Oregon

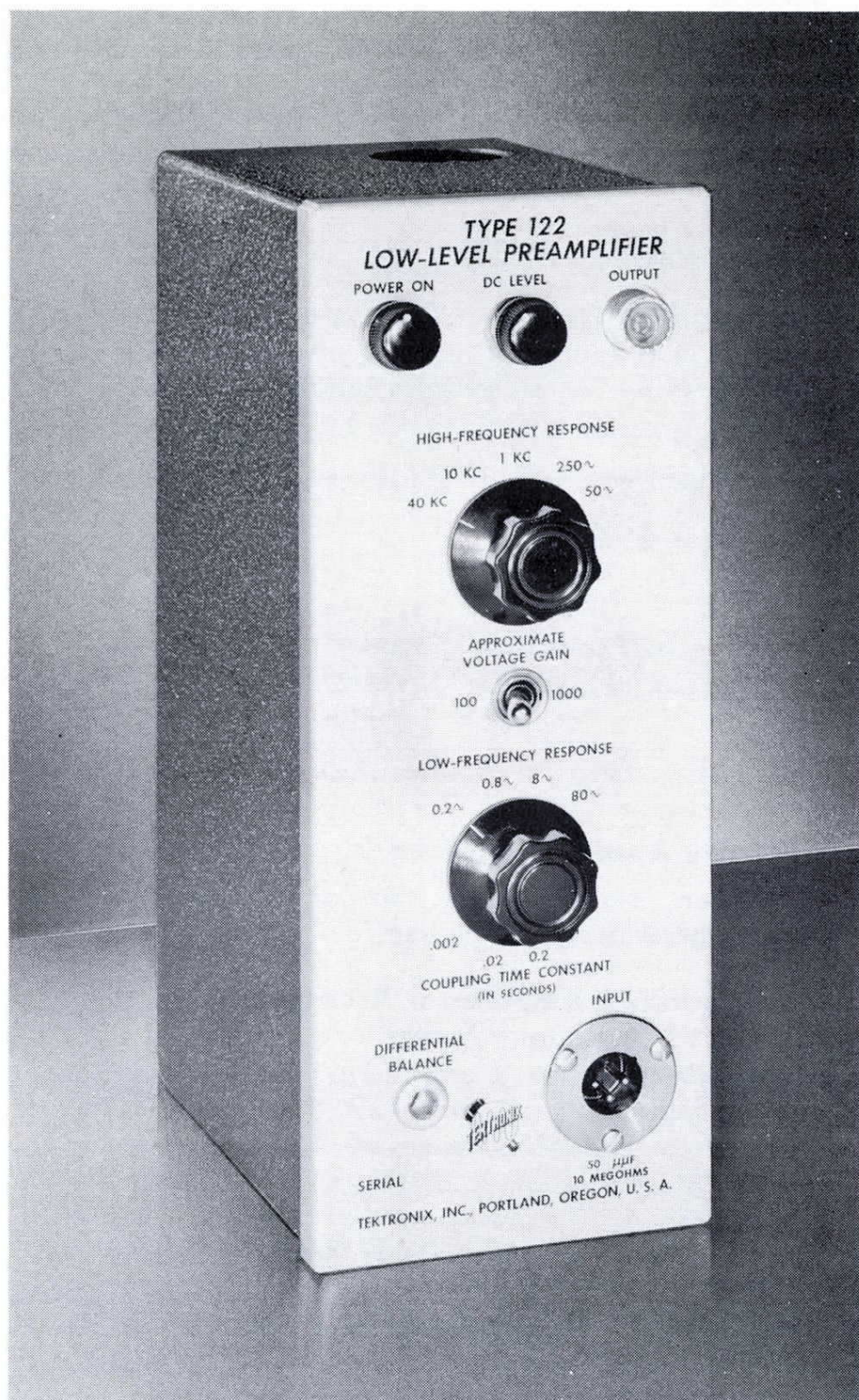
Includes the following: 1—P93B Output Cable  
1—Instruction Manual



**Tektronix, Inc.**

# TYPE 122 PREAMPLIFIER

## Low-Level Preamplifier



### GENERAL DESCRIPTION

The TEKTRONIX Type 122 Pre-amplifier is a compact three-stage, battery operated amplifier designed primarily to extend the sensitivity of the TEKTRONIX Type 512 Oscilloscope into the microvolt region. The maximum voltage gain of 1000 times increases the sensitivity of the Type 512 Oscilloscope to 5 microvolts per centimeter. At maximum gain an input of 0.02 volts peak to peak is permissible.

At maximum bandwidth setting, frequency response is essentially flat between 0.16 cycles and 40 kc. Separate low-frequency and high-frequency controls permit the bandwidth to be reduced to improve the signal-to-noise ratio where reduced bandwidth is permissible.

The first two stages of the Type 122 Amplifier are operated push-pull and are designed especially to have a high degree of balance. With careful setting of the front-panel differential-balance control, an 80- to 100-db rejection ratio can be realized between in-phase and out-of-phase signals applied to the input grids at frequencies above five cycles.

A frequency-compensated attenuator allows the voltage gain to be reduced by a factor of ten, to a gain of about

100 times. At this gain setting, a maximum input of 0.1 volts peak to peak is permissible.

A maximum output of 20 volts peak-to-peak is possible without appreciable deterioration of amplitude linearity at about 1000x gain, and an output of 10 volts at about 100x gain. Shockmounting, careful bypassing, and use of battery heater and plate supply reduce microphonics, noise, and hum to a low level.

A cathode-follower circuit provides a low impedance output of the order of 1000 ohms. An output level control permits operation at ground potential.

### APPLICATIONS

Biological research and other applications requiring the amplification of microvolt signals for observation or recording.

### CHARACTERISTICS

**Frequency Response** — 1/6 cps-40 kc.

High Frequency Cutoff,  
3 db points            40 kc   10 kc   1 kc   250 cps   50 cps

Low Frequency Cutoff,  
3 db points (frequencies-cps)    .2   .8   8.   80.  
(time constants-sec)    1.   0.2   .02   .002

**Gain** — High position, approximately 1000; low position, approximately 100. Rejection ratio for in-phase signals — 80 to 100 db (5 cps-40 kc).

**Maximum Output** — 20 v (peak-to-peak).

**Output Impedance** — 1000 ohms approximately (cathode follower).

**D. C. Output Level** — Adjustable to zero (for use with D.C. oscilloscopes).

**Maximum Input Signal** — .02v (peak-to-peak) in high gain position; .2v (peak-to-peak) in low gain position.

**Input Impedance** —

Single Ended . . . . . 10 meg. paralleled by 50  $\mu$ f max.  
Differential . . . . . 20 meg. paralleled by 50  $\mu$ f max.

**Noise Level** — 1  $\mu$ volt to 4  $\mu$ volts RMS depending on setting of frequency response controls.

**Power Requirements** — From batteries through a standard octal plug: -90 v at 4 ma.; +135 v at 5 ma.; 6.3 v at .9 amp.

**Vacuum Tube Complement** — 1 12AX7 (Specially selected for differential balance). 2 12AU7 (One specially selected for differential balance).

**Dimensions** — 10 5/8" high; 4 1/2" wide; 7" deep.

**Finish** — Panel, photo etched aluminum with black lettering; cabinet, grey wrinkle.

**Price** — \$85.00

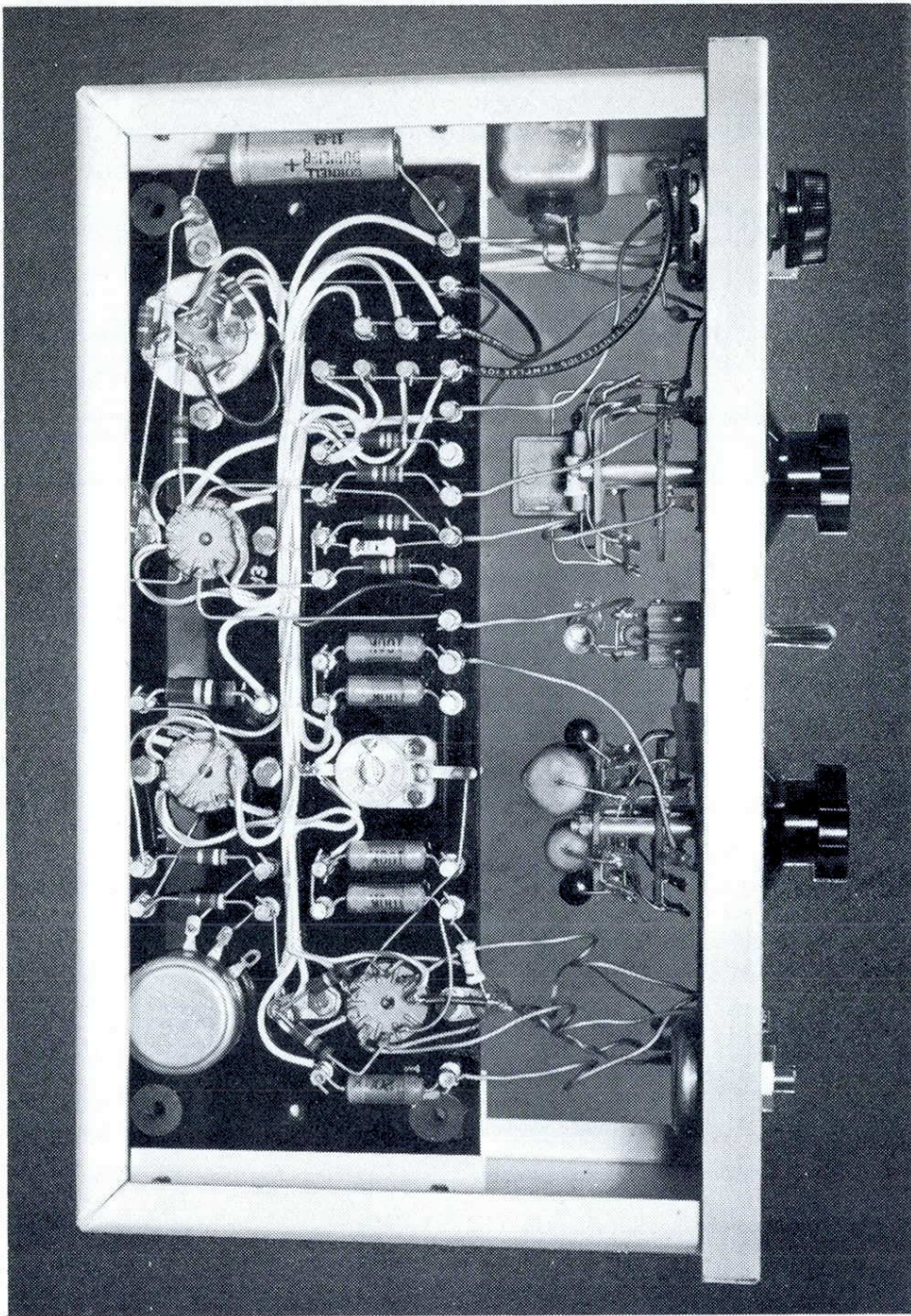
### RACK MOUNTED TYPE 122

**Mounting Method** — The Type 122 is horizontally mounted in a 1/8" thick panel with the input jack at the left end of the panel.

**Panel Size** — 19" standard relay rack width, 5 1/4" height.

**Tektronix, Inc.**

# TYPE 122 PREAMPLIFIER



**Power Input** — Battery cable socket is on right end, to rear.

**Price** — \$90.00

## FRAME MOUNTED TYPE 122

**Mounting Method** — The Type 122 is designed for mounting in a special adapter frame, Type FA160; or it may be fastened to an existing support.

**Panel Size** — 4 1/8" wide, 12 1/4" high.

**Power Input** — Battery cable socket is on top, to rear.

**Price** — \$90.00

## Prices f.o.b. Portland (Beaverton), Oregon

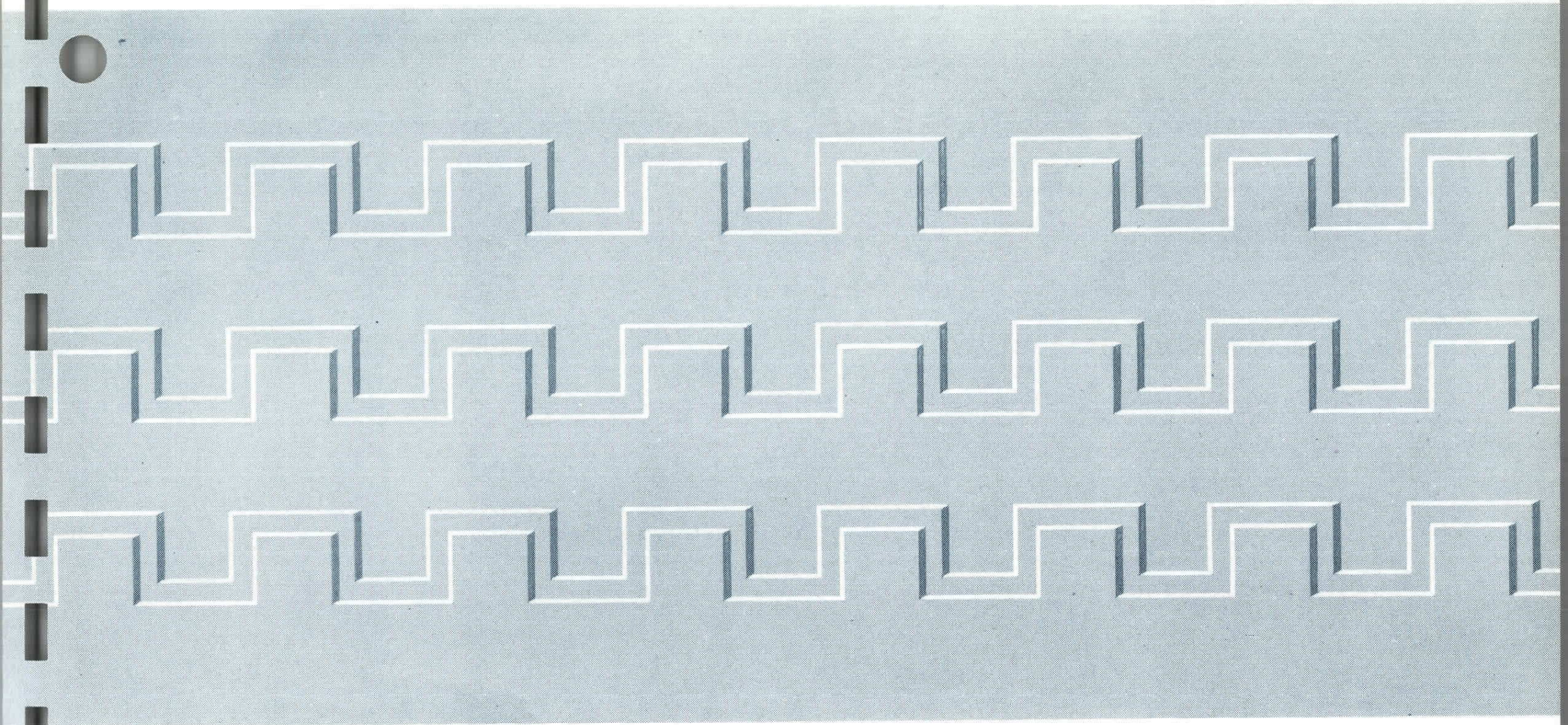
Included with the Type 122: 1—W122 Battery Cable  
1—CON3P Input Plug  
1—P93 Output Cable  
1—Instruction Manual

## Currently Available Extras

Extra long battery cables, similar to Type W122, may be ordered as special items.

## Recommended Additional Accessories

Type FA 160 Adapter Frame . . . . . \$5.00  
Mounts in relay rack. Designed to hold four units—any combination of Type 122, Type 161, Type 162, Type 163. (The Type 160 Power Supply requires the panel space of two units). Outside dimensions—19" (standard relay rack width), 12 1/4" high. Inside dimensions—16 1/2" long, 10 3/8" high.

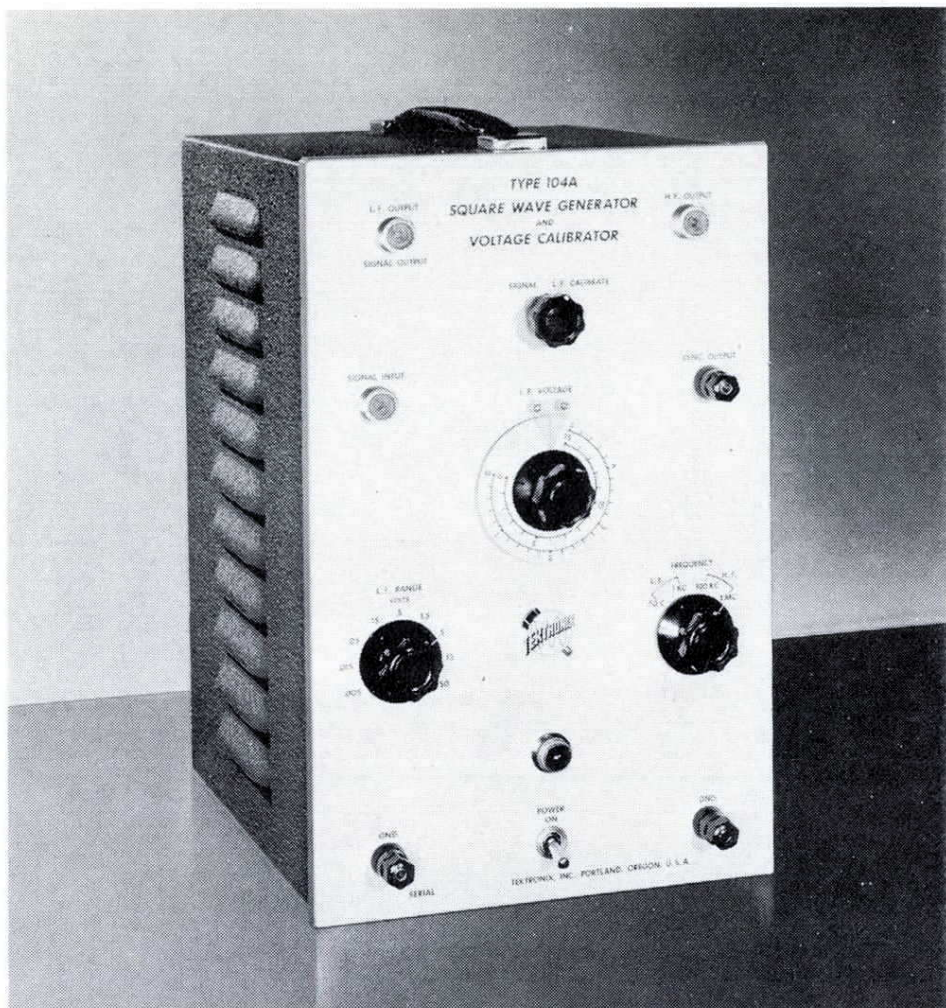


## SQUARE WAVE GENERATORS

*Square wave testing techniques are recognized as providing one of the most efficient means of determining electronic circuit response. Precise adjustment of frequency compensated attenuator, amplifier and filter circuits is reduced to a simple procedure.*

# TYPE 104A SQUARE WAVE GENERATOR

## & VOLTAGE CALIBRATOR



### GENERAL DESCRIPTION

The TEKTRONIX **Type 104-A Square Wave Generator** is an inexpensive generator of precision square waves in the frequency range most commonly used for amplifier response testing. The instrument is similar to its predecessor, the **Type 104**, except that it now includes an accurate voltage calibrator utilizing the two lower frequencies. Improved physical arrangement provides increased usefulness on the test bench. The **Type 104-A** is ordinarily furnished to supply square waves of 50 cps, 1 kc, 100 kc and 1 mc, giving good coverage of the audio and video ranges. By proper choice of these frequencies, the **Type 104-A** permits convenient adjustment of a wide range of amplifier types and accurate observation of their frequency and transient response.

### FEATURES

**Short Rise Time**—As a result of careful design, the two high frequency square waves have a rise time of not more than .02 microsecond without overshoot.

**High Frequency Output Available at Low Impedance**—The output of the two high frequencies is available through a matched cable terminated by a continuously variable attenuator and provides a signal of at least 5 volts.

**Low Frequency Output Available as Calibrating Voltage**—Since the rise time is of less consequence at the two lower frequencies, a second multivibrator-limiter circuit provides these signals at a higher impedance, making it possible to obtain the low frequency output via a precision attenuator in 9 ranges of 5 mv to 50 v peak-to-peak. A calibrated wire wound potentiometer permits continuously variable amplitude adjustment for each range, accurate to within 3% of the full scale reading.

**Synchronizing Signal**—In order to synchronize the oscilloscope being used, a separate binding post supplies a synchronizing signal of at least 3 volts at all settings of attenuator or calibrator controls.

### APPLICATIONS

The 50 cycle square wave provides a quick test for the low frequency characteristics of amplifiers. The 1 kc square wave is a convenient signal for quickly and accurately adjusting capacity compensated attenuators. The 100 kc and 1 mc square waves permit convenient adjustment of high frequency compensating networks for video amplifiers.

Provision is made on the two low frequencies for inserting the instrument between a signal source and the oscilloscope. By the turn of a switch, either the signal or the calibrating voltage can be observed, permitting accurate measurement of amplitude of any portion of the signal waveform.

The small size and low cost of the **Type 104-A** extend the square wave testing technique into many fields of production testing.

### CHARACTERISTICS

**Frequencies**—Four fixed: 50 cps, 1 kc, 100 kc, 1 mc.

**Impedance**—Varies from 0 to 93 ohms for the high frequency output, depending on the attenuator setting. Varies from 0 to 10,000 ohms for the low frequency output, depending upon the calibrator control settings.

**Rise Time**—.02  $\mu$ sec for the high frequency outputs, and 3  $\mu$ sec for the low frequency outputs.

**Amplitude**—Continuously variable from 0 to 5 volts for the high frequency outputs. Continuously variable from 0 to 50 volts, in 9 calibrated ranges, for the low frequency outputs.

**Construction**—Chassis and cabinet are made of welded aluminum alloy. Front panel is photo etched, satin finished aluminum. Cabinet has baked gray wrinkle finish.

**Dimensions**—13 1/2" high; 9" wide; 11 1/2" deep.

**Weight**—22 pounds

**Power Requirements**—105-125/210-250 volts, 50-60 cycles, approximately 115 watts.

### Vacuum Tube Complement—

High Frequency Multivibrators . . . . .	2	6AG7
High Frequency Limiter . . . . .		6AG7
High Frequency Output Amplifier . . . . .		6AG7
Low Frequency Multivibrator . . . . .		12AU7
Low Frequency Limiter Diode and Cathode Follower . . . . .		12AU7
Trigger Output Cathode Follower . . . . .		6J6
Power Supply Rectifier . . . . .		5V4G
Series Regulator . . . . .		6AU5
Regulator Amplifier . . . . .		6AU6
Voltage Reference . . . . .		OC3/VR105

**Price with listed frequencies \$195.00**

Includes: 1—P93A Attenuator cable  
1—A100 Clip-lead adapter  
2—A510 Binding-post adapters  
1—Instruction Manual

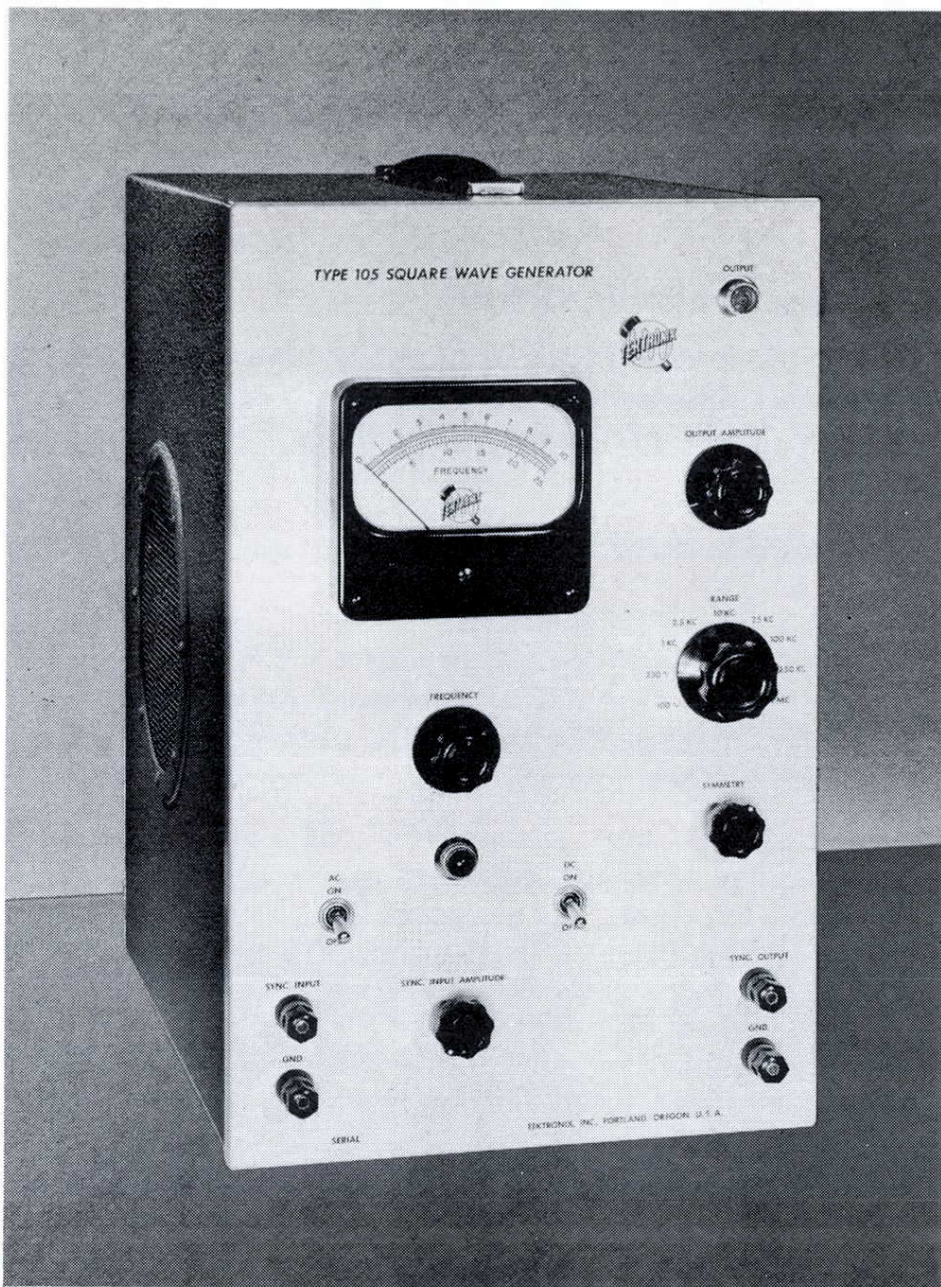
### Currently Available Extras

Selected frequencies—  
2 in range 50 cycles to 10 kc. . . . . \$20  
2 in range 50 kc to 1 mc. . . . . 20

Prices f.o.b. Portland (Beaverton), Oregon

**Tektronix, Inc.**

# TYPE 105 SQUARE WAVE GENERATOR



**Continuously Variable, 25 CPS - 1 MC**  
**Rise Time, .02 Microseconds**  
**Direct Reading Frequency Meter**

## APPLICATIONS

Testing wide-band amplifiers with a square-wave generator and an oscilloscope is a fast, efficient method both in the laboratory and in the television station. Such characteristics as transient response, bandwidth, and phase shift are quickly revealed. For examination of the high-frequency response a square wave having a risetime faster than that of the amplifier being tested is required. In addition, the test signal must be free of overshoot and ringing. For examination of the low-frequency response a square wave having flat horizontal portions is required.

The TEKTRONIX **Type 105** Square Wave Generator provides a suitable signal for both of these tests. Its frequency range extending continuously from 25 cycles to 1 mc., combined with its risetime of .02 microseconds, makes it possible to quickly and accurately test amplifiers, filters, etc., having pass bands from a few cycles to 20 mc.

For an excellent discussion on the connection between bandwidth and frequency response, composition of risetime and other details associated with square wave testing, see Vol. 18, Radiation Laboratory Series, "Vacuum Tube Amplifiers" (McGraw-Hill).

## GENERAL DESCRIPTION

The TEKTRONIX **Type 105** Square Wave Generator consists of a multivibrator frequency generator, having nine ranges in two steps per decade. The signal from the multivibrator is fed through two shaper stages to the output stage which consists of three 6AG7 tubes in parallel. The maximum square wave current available at the output terminals is approximately 160 ma (peak to peak). This gives approximately 12 v in 75-ohm cable or 15 v in 93-ohm cable. Type of output cable furnished with the instrument is optional. (52-ohm, 75-ohm or 93-ohm coaxial cable.) If higher output voltages are needed, correspondingly larger loads may be used with a deterioration of the risetime approximately proportional to the increased load. Maximum available output voltage is 100 v. A panel control permits setting the output amplitude from near zero to the previously mentioned maximums.

For convenience a direct-reading frequency meter is incorporated in the instrument. The range of the frequency meter is changed simultaneously with the range of the multivibrator, providing two scales per decade. The frequency meter is accurate within 3% of full scale.

Provision is made to furnish a synchronizing signal to an oscilloscope. The amplitude of this signal is independent of the output control setting. A sync. input binding post is also provided so that the square wave frequency may be synchronized with a frequency standard.

All DC power supplies are electronically regulated so that uniform operation is obtained at line voltages of 105-125 V, 210-250 V.

<b>Frequency Range</b> . . . . .	25 cycles to 1 mc
<b>Rise Time</b> . . . . .	.02 microseconds for output load of 100 ohms or less
<b>Output Amplitude</b> . . . . .	0-100 V. peak to peak across internal 600-ohm load 0-160 ma. available for external load
<b>Accuracy of Frequency Indication</b>	±3% of full scale
<b>Sync. Output</b> . . . . .	5 Volts
<b>Sync. Input</b> . . . . .	3 Volts
<b>Power Requirements</b> . . . . .	105-125, 210-250 V., 50-60 cycles, 250 watts
<b>Dimensions</b> . . . . .	10 1/8" wide, 16 1/2" high, 14 7/8" deep
<b>Weight</b> . . . . .	35 1/2 pounds

## Vacuum Tube Complement

Multivibrator . . . . .	2	6CB6
Shaper amplifier . . . . .		6AG7
Driver amplifier . . . . .	2	6AG7
Output amplifier . . . . .	3	6AG7
Sync input amplifier . . . . .		6CB6
Sync coupling diode . . . . .		6AL5
Meter amplifier . . . . .		6CB6
Limiter and catcher diode . . . . .		6AL5
Cathode follower voltage regulator . . . . .		6J6
Meter diode . . . . .		6AL5
Sync output cathode follower . . . . .		6J6
Fixed power supply rectifiers . . . . .	2	5V4G
Series regulator tubes . . . . .	2	6AU5

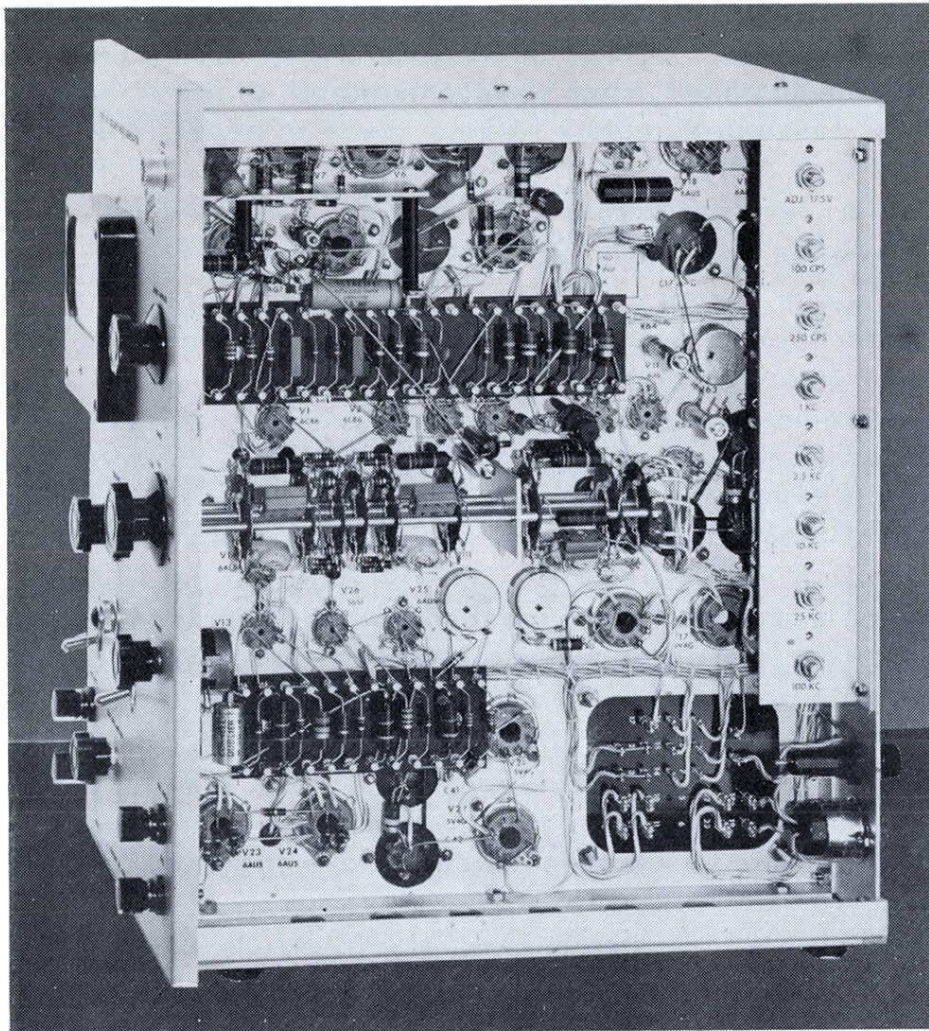
**Tektronix, Inc.**

# TYPE 105 SQUARE WAVE GENERATOR

Regulator amplifier . . . . .	6AU6
Voltage reference tube . . . . .	5651
Variable power supply rectifiers . . . . .	2 5V4G
Series regulator tubes . . . . .	2 6AU5
Regulator amplifier . . . . .	6AU6

**Price—\$395 f.o.b. Portland (Beaverton), Oregon**

- Includes the following:
- 1—P93 42" Coaxial Cable, 93 ohms
  - 1—B93-R Resistor, terminating, 93 ohm
  - 1—A510 Binding Post Adapter
  - 1—A100 Clip Lead Adapter
  - 1—Instruction Manual



**Currently Available Extras**

- 93-ohm cable and resistor normally furnished
- 52-ohm cable and resistor . . optional, no extra charge
- 75-ohm cable and resistor . . optional, no extra charge

**Recommended Additional Accessories**

When a Type 105 is used to check the transient response of a Type 513-D Vertical Amplifier, the following accessories should be used to interconnect the two instruments:

- 1—P52 Cable, coaxial, 42", 52 ohms . . . \$ 4.00
- 1—B52R Resistor, terminating, 52 ohms . . . 8.50
- 1—B52-L5 Pad, "L" 5:1 ratio, 52 ohms . . . . . 8.50
- 1—B52-T10 Pad, "T", 10:1 ratio, 52 ohms . . . 11.50

A selection of terminating resistors, pads, and coaxial cables designed to be used with a Type 105 Square Wave Generator will be found in the Accessory Section of this catalog.

Within certain technical limits, special terminating resistors and pads can be supplied upon request—we invite your correspondence regarding them.





## SPECIAL INSTRUMENTS

*Work in some fields of research and development requires the use of special instruments in conjunction with the cathode-ray oscilloscope. Special instruments developed by TEKTRONIX are described in this section.*

# TYPE 124 TELEVISION ADAPTOR

## for Triggered Wide-Band Oscilloscopes

### Line Selection

Sync separator and delayed trigger circuitry permit triggering the oscilloscope at any selected line of a field.

### Field Shift

Push button provides instant shift to corresponding line or lines in opposite field.

### Gated Time Markers

Intensity markers of 1  $\mu$ sec, 0.1  $\mu$ sec, 0.05  $\mu$ sec and 0.005 H (200 per television line).

## APPLICATIONS

The Type 124 adapts any triggered wide-band oscilloscope to the observation of the television composite video signal. Greatly increases the usefulness of the oscilloscope in television development and maintenance work.

## GENERAL DESCRIPTION

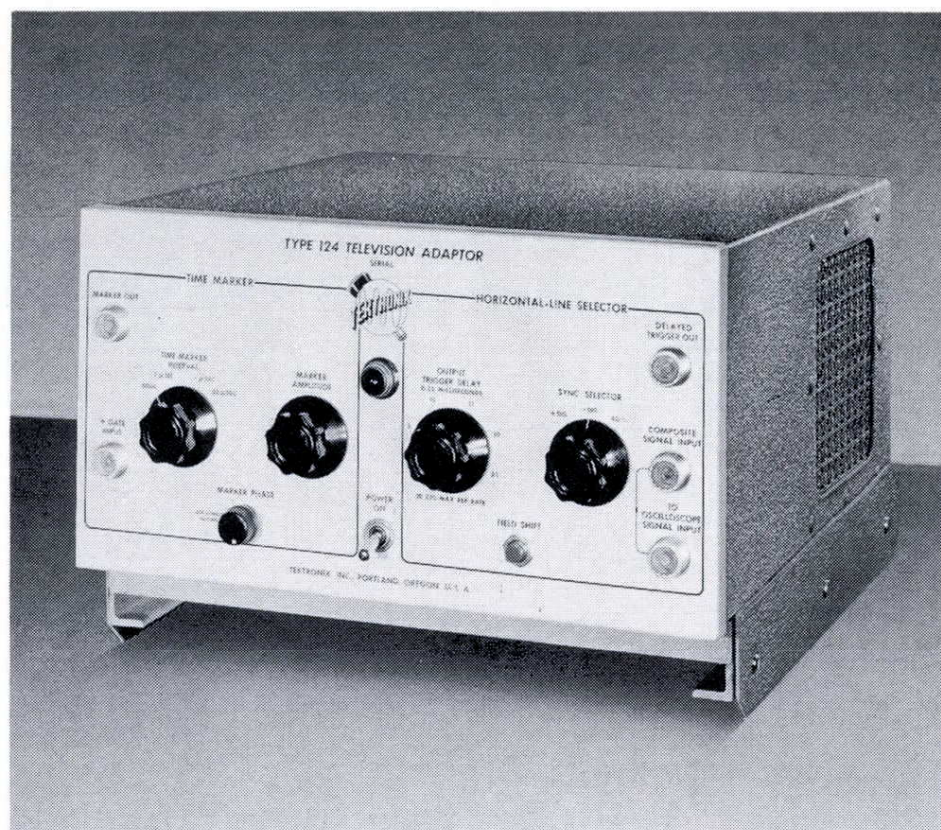
The delayed-trigger output of the Type 124 is continuously variable from zero to 25 milliseconds after receipt of a vertical sync pulse. By adjusting the delay, an oscilloscope can be triggered at the start of any desired line in a field. Panel push button provides instant shift to opposite field. Triggering occurs at half the television vertical rate. Duration of the output pulse is less than 1  $\mu$ sec, and amplitude is 2 v positive. Triggering may be accomplished by the composite video signal of either polarity, 0.5 v minimum to 20 v maximum, peak to peak, or a 60-cycle sine wave.

The time-marker generator requires a positive gate of 20 v minimum to 50 v maximum, peak to peak. Markers are supplied for the duration of the gate. Time-marker intervals are 1  $\mu$ sec, 0.1  $\mu$ sec, 0.05  $\mu$ sec, and 0.005 H (200 per television line). Amplitude is continuously variable from zero to 30 v. Phase control permits positioning the markers on the trace.

To make use of the time-marker output of the Type 124, the oscilloscope should have a positive gate output and a CRT cathode terminal.

### VACUUM TUBE COMPLEMENT

Trigger inverter and output CF . . . . .	6BQ7A
Sync separator and dc restorer . . . . .	12BZ7
Phantastron . . . . .	6BH6
Trigger coupling diode . . . . .	6AL5
Bistable multivibrator . . . . .	6U8



Cathode-coupled amplifier . . . . .	12BZ7
Bistable multivibrator . . . . .	12BZ7
Time-marker oscillator . . . . .	6AK5
Gating CF and pulse shaping amplifier . . . . .	6BQ7A
Time-marker output amplifier . . . . .	6BQ7A
Rectifier . . . . .	6AX5
Rectifier . . . . .	6X4
Regulator amplifiers . . . . .	2 6AU6
Regulator series tubes . . . . .	2 12B4
Voltage reference . . . . .	OA2

## OTHER CHARACTERISTICS

Ventilation—forced-air cooling.

Mounting frame—provides secure mounting to the top of Tektronix 5" Oscilloscopes.

Connecting cables—the four connecting cables supplied with the Type 124 are designed for use with Tektronix Oscilloscope Types 511, 511A, 513, 514, and 514A. Cable extensions will be necessary in many cases when the Type 124 is used with other triggered wide-band oscilloscopes.

Size—6 $\frac{3}{4}$ " high, 12 $\frac{3}{4}$ " wide, 12 $\frac{1}{2}$ " deep.

Weight—21 lbs.

Construction—aluminum alloy.

Finish—photo-etched anodized panel, baked gray wrinkle cabinet.

Power requirements—117/234 volts, 50-60 cycles, 120 watts.

**Price—\$295 f.o.b. Portland (Beaverton), Oregon.**

- Includes: 1—FM124 Mounting Frame
- 4—Connecting Cables
- 1—Instruction Manual

**Tektronix, Inc.**

# TYPE 130 L,C METER

## Direct-Reading Inductance and Capacitance Meter



### APPLICATIONS

Saves engineering time in circuit development work by providing quick inductance and capacitance readings even while circuit changes are being made. Aids in correct placement of critical components and leads.

Guard circuit produces a voltage of the same amplitude and phase as the voltage at the UNKNOWN terminals, but isolated from the frequency determining portions of the rest of the circuit. This permits separation of the capacitance to be measured from other capacitances and strays. Accurate measurements of direct inter-electrode capacitance in vacuum tubes can be made with ease.

The Type 130 can also be used for component testing, sorting, and color code checking on a production basis.

### GENERAL DESCRIPTION

The unknown value to be measured will determine the frequency of the variable oscillator in the Type 130. This frequency is beat against a 140-kc fixed oscillator. The difference frequency is shaped and counted, causing meter deflection proportional to the difference frequency. The direct-reading meter is calibrated in microhenries and micromicrofarads.

### Guard Voltage

Permits measuring an unknown capacitance while eliminating the effects of other capacitances from the measurements.

### Five Ranges

**Microhenries**—0 to 3, 10, 30, 100, 300.

**Micromicrofarads**—0 to 3, 10, 30, 100, 300.

### Accuracy

Within 3% of full scale.

### Coarse and Fine Zero Adjust

### Four-Inch Illuminated Meter

### VACUUM TUBE COMPLEMENT

Fixed Oscillator . . . . .	6U8
Buffer Amplifier . . . . .	6U8
Variable Oscillator . . . . .	6U8
Buffer Amplifier . . . . .	6U8
Mixer . . . . .	6BE6
Bistable Multivibrator . . . . .	6U8
Guard Circuit Cathode Follower . . . . .	6BH6
CF Clamp and Diode Clamp . . . . .	6BQ7A
Rectifier . . . . .	6X4
Voltage Regulator . . . . .	OA2

### OTHER CHARACTERISTICS

Size—5" wide, 9" high, 8½" deep.

Weight—9 lbs.

Construction—aluminum alloy.

Finish—photo-etched anodized panel, baked gray wrinkle cabinet.

Power requirements—117/234 volts, 50-60 cycles, 40 watts.

**Price . . . . . \$195**

Includes: 1—P93C Probe  
1—W130R Lead  
1—W130B Lead  
1—Instruction Manual

### Recommended Additional Accessories

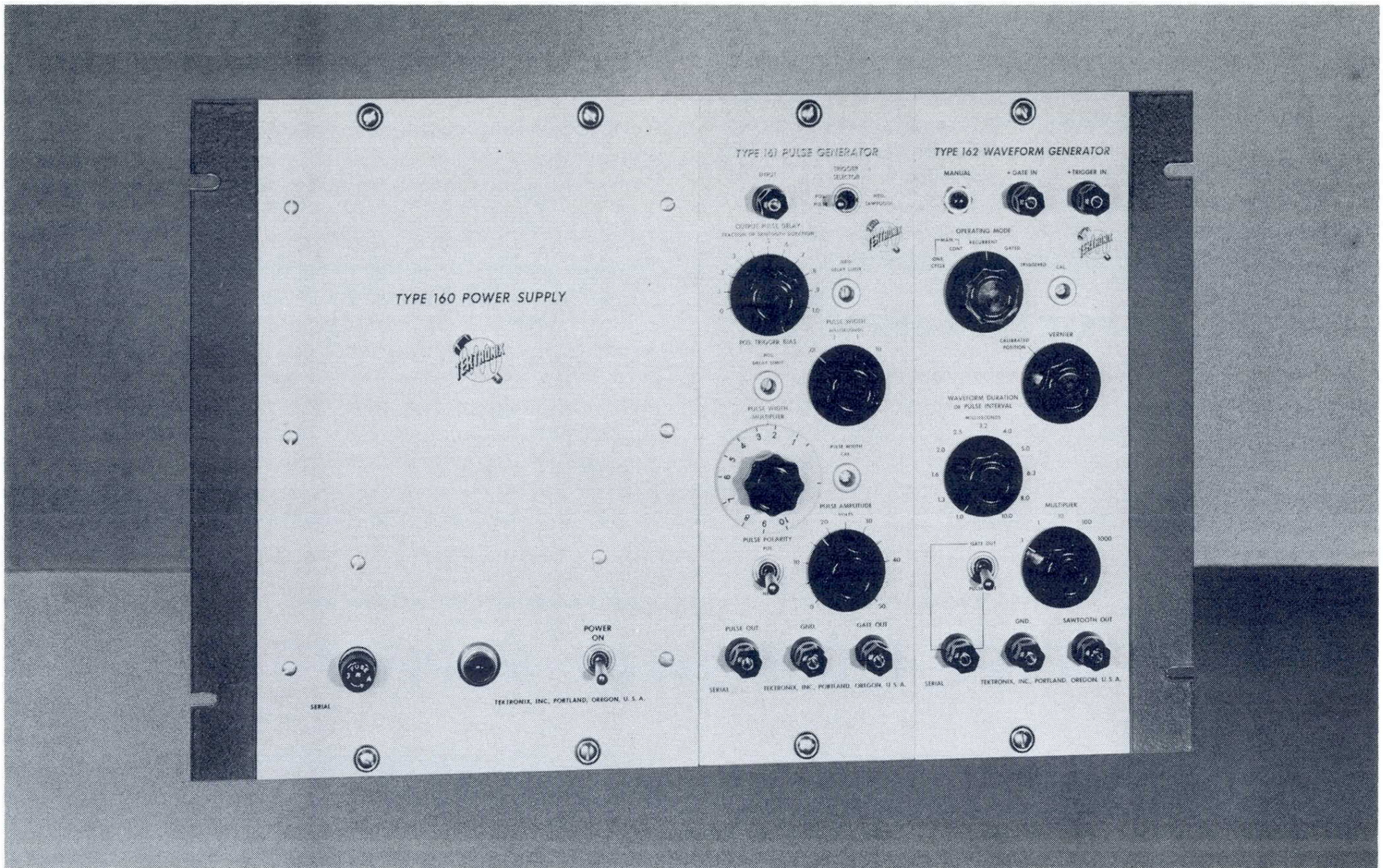
Type F30 Production Test Fixture. Speeds sorting and testing of capacitors and inductors . . . . . \$3.00

Type S30 Delta Standards, for calibration of Type 130 L,C Meters . . . . . \$22.00

Prices f.o.b. Portland (Beaverton), Oregon.

**Tektronix, Inc.**

# TYPE 160 SERIES WAVEFORM GENERATORS



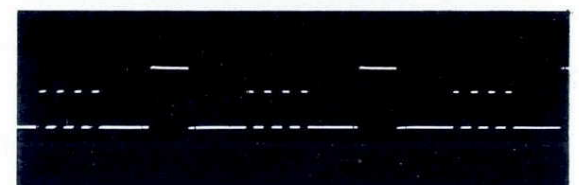
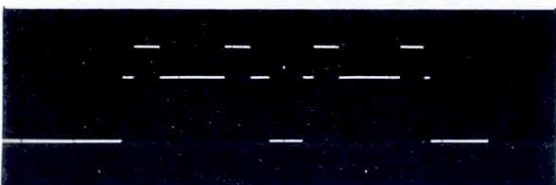
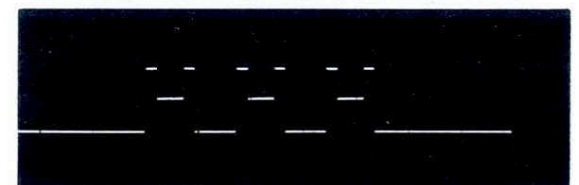
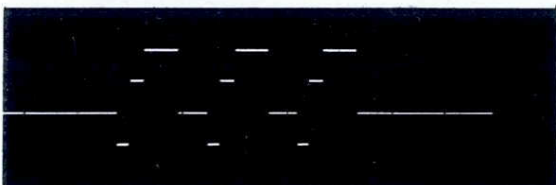
**TYPE 160 POWER SUPPLY**  
**TYPE 161 PULSE GENERATOR**  
**TYPE 162 WAVEFORM GENERATOR**  
**TYPE 163 PULSE GENERATOR**

The **TEKTRONIX 160 Series** of instruments are designed to supply timed pulses of adjustable amplitude and duration. They have been used extensively for nerve stimulation, for example, in neurophysical experiments. In a typical use the response time and the nature of the response to an electrical stimulus generated by a Type 161 or Type 162 is measured on an oscilloscope. By using several instruments

together a variety of pulse patterns can be obtained, such as a simulation of a tetanus stimulus.

### TYPE 160 POWER SUPPLY

The **Type 160 Power Supply** provides regulated DC voltages and AC filament supply for as many as six Type 161 or Type 162 instruments in any combination.



Some of the waveform combinations possible with Tektronix Type 160 Series Waveform Generators

**Tektronix, Inc.**

# TYPE 160 SERIES WAVEFORM GENERATORS

## TYPE 161 PULSE GENERATOR

The **Type 161 Pulse Generator** can be controlled by means of either pulse or sawtooth outputs of the Type 162. The output pulse of the **Type 161** occurs simultaneously with the input pulse from the Type 162, or can be made to occur at any point on the input sawtooth from the Type 162. By selecting the desired portion of the sawtooth for the generation of the pulse, the **Type 161** can provide a delay of any fraction of the sawtooth duration.

## TYPE 162 WAVEFORM GENERATOR

The **Type 162 Waveform Generator** provides gating or enabling pulses and sawtooth waves which can be initiated by means of externally-derived signals such as might be provided by a push button and external battery, or which can be provided by a stable repetition rate generator built into the instrument itself.

## USES OF COMBINATIONS OF TYPE 161 AND TYPE 162 GENERATORS

A convenient mounting frame is available which adapts these instruments to relay-rack mounting. One mounting frame will accommodate one **Type 160 Power Supply** and two **Type 161** or **Type 162** generators, or four generators. The **Type 160 Power Supply** will supply the required power for as many as six generator units in any combination. The **Type 161 Pulse Generator** can be used to gate one or more **Type 162 Waveform Generators**, and the **Type 162** can be used to trigger several **Type 161 Pulse Generators**. By using combinations of the generators, a variety of waveforms can be produced. One interunit octal power cable furnished with each generator and two furnished with each **Type 160 Power Supply** provide a convenient means of supplying power to a number of the instruments in combination.

# TYPE 160 POWER SUPPLY

## GENERAL DESCRIPTION

The **TEKTRONIX Type 160 Power Supply** is designed to provide the required voltages and current for as many as six **TEKTRONIX Type 161** or **Type 162 Generators** in any combination. Three regulated DC voltages are supplied. The output terminals consist of three octal sockets, each capable of supplying power for two of these generators.

## CHARACTERISTICS

### Voltages —

- +300 volts DC, unregulated, at 170 milliamps.
- +225 volts DC, regulated, at 125 milliamps.
- +150 volts DC, regulated, at 5 milliamps.
- 170 volts DC, regulated, at 125 milliamps.
- 6.3 volts AC, unregulated, at 10 amps.

**Type of Regulation** — Electronic, with Type 5651 gas diode reference element.

**Output Connections** — Three octal female sockets mounted on rear of chassis. Each socket is capable of supplying power to two generators. Two 17-inch octal interunit power cables are supplied.

**Dimensions** — 8 1/4" wide, 12 1/4" high, 10" deep.

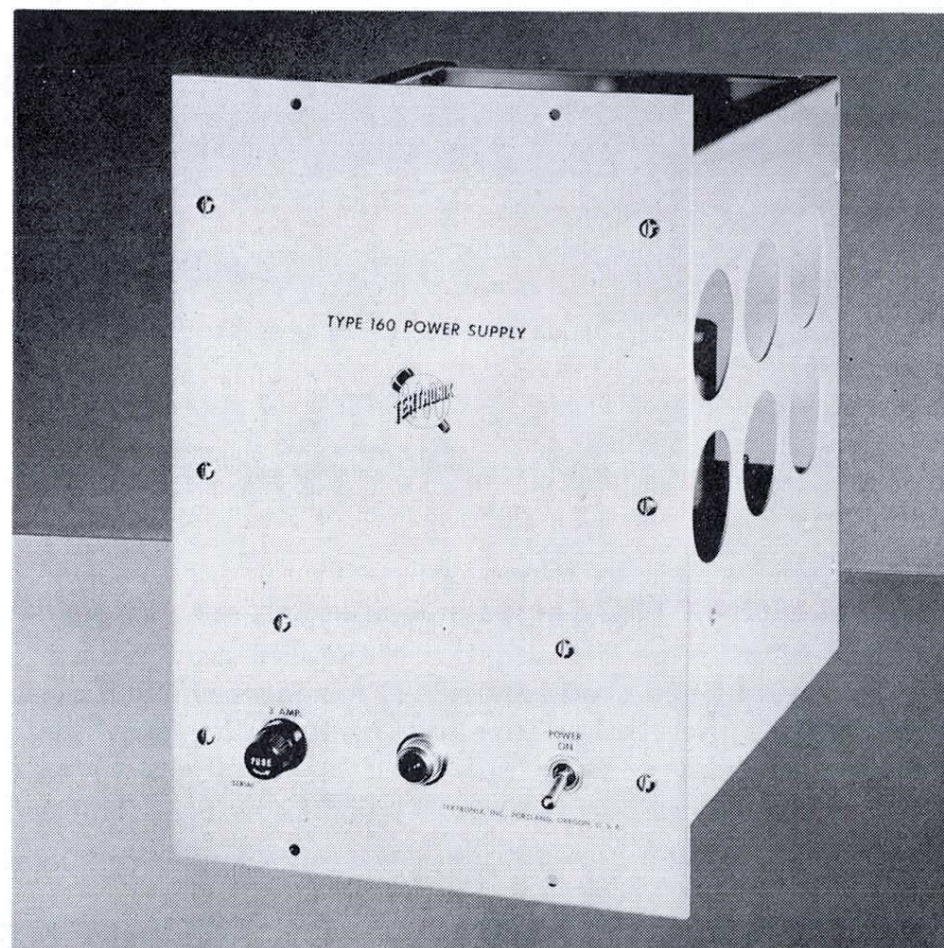
**Weight** — 13.5 pounds.

**Construction** — Aluminum alloy.

**Finish** — Buffed photo-etched metal panel, etched metal chassis.

## VACUUM TUBE COMPLEMENT

+300 v rectifier . . . . .	2	5V4
-170 v rectifier . . . . .		5V4
+225 v series regulator . . . . .	1/2	6AS7



-170 v series regulator . . . . .	1/2	6AS7
-170 v error voltage amplifier . . . . .		6AU6
Gas diode voltage reference . . . . .		5651
-225 v error voltage amplifier . . . . .		6AU6
+150 v error voltage amplifier . . . . .	1/2	12AU7
+150 v series regulator . . . . .	1/2	12AU7

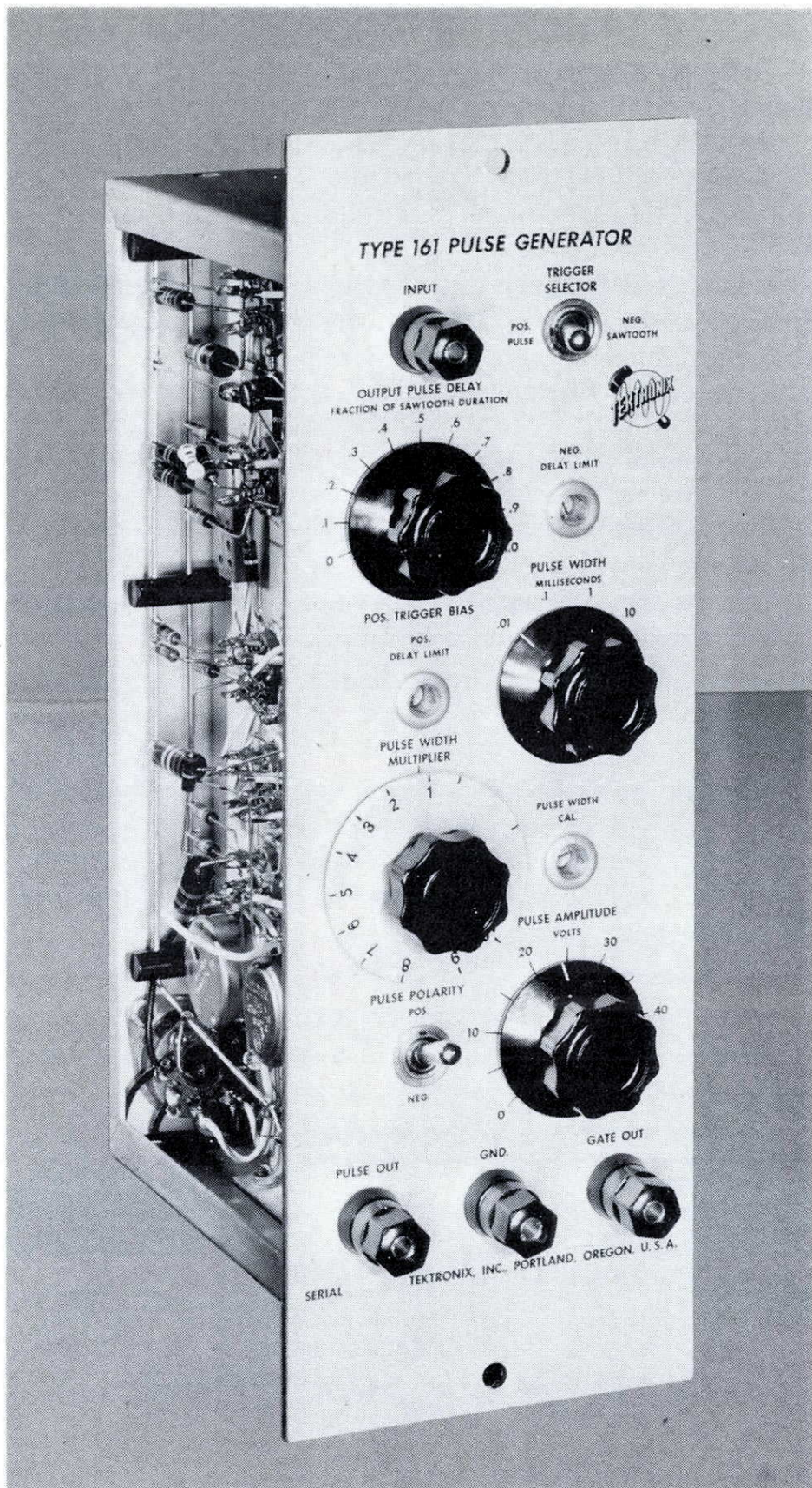
## Type 160 Power Supply — \$110

- Includes: 2—W160L 17" Connecting cables  
 1—Set mounting screws and cup washers  
 1—Instruction Manual

**Tektronix, Inc.**

# TYPE 160 SERIES WAVEFORM GENERATORS

## TYPE 161 PULSE GENERATOR



### GENERAL DESCRIPTION

The TEKTRONIX Type 161 Pulse Generator is designed to supply calibrated rectangular output pulses of adjustable duration and amplitude and of either polarity when the required trigger voltage is received from an external source. Two types of trigger waveforms can be used to trigger the Type 161, a negative-going sawtooth or a positive pulse. One output pulse is generated for each input pulse or each cycle of the sawtooth.

When a negative sawtooth waveform is used to trigger the generator a rectangular pulse of either polarity and a 50-volt positive gating pulse are generated. The time of occurrence of the pulse and of the gate can be adjusted to any point throughout the duration of the sawtooth. The duration of the generated pulse and the output gate are the same.

When a positive pulse is used to trigger the generator, the same output waveforms are available, but there is no delay available in the generation of the pulse.

### CHARACTERISTICS

**Output Waveform** — Positive gate. Positive pulse. Negative pulse.

**Positive Gate Characteristics** — Amplitude, 50 volts positive from ground potential, not adjustable. Duration, 10  $\mu$ sec to 0.1 sec.

**Positive Pulse Characteristics** — Amplitude, 0 to 50 volts, continuously variable. Duration, 10  $\mu$ sec to 0.1 sec continuously variable. Risetime, 0.5  $\mu$ sec. Overshoot, less than 5%. Delay, 0 to 100% of duration of input sawtooth.

**Negative Pulse Characteristics** — Identical with positive pulse, except polarity.

**Output Impedance** — Positive pulse, 1800 ohms maximum. Negative pulse, 5000 ohms maximum. Positive gate, 1000 ohms maximum.

**Method of Triggering** — Positive pulse, or negative-going positive sawtooth.

**Trigger Sensitivity** — Positive pulse, 2-volt peak minimum. Sawtooth, rate of change of input waveform, 15 volts/sec. Maximum repetition rate, 50 kc.

**Construction** — Aluminum alloy.

**Finish** — Buffed photo-etched metal panel, etched metal chassis.

**Dimensions** — 4 1/8" wide, 12 1/4" high, 7 1/2" deep.

**Weight** — 5 pounds.

**Power Requirements** — 225 volts DC positive at 22 ma. 170 volts DC negative at 17 ma. 6.3 volts AC at 1.1 amps.

### VACUUM TUBE COMPLEMENT

Comparator .....	12AU7
Schmitt trigger .....	12AT7
Coupling diode and first half of one-kick multivibrator .....	12AT7
Second half multivibrator and positive pulse cathode follower .....	12AT7
Negative pulse amplifier .....	6J6

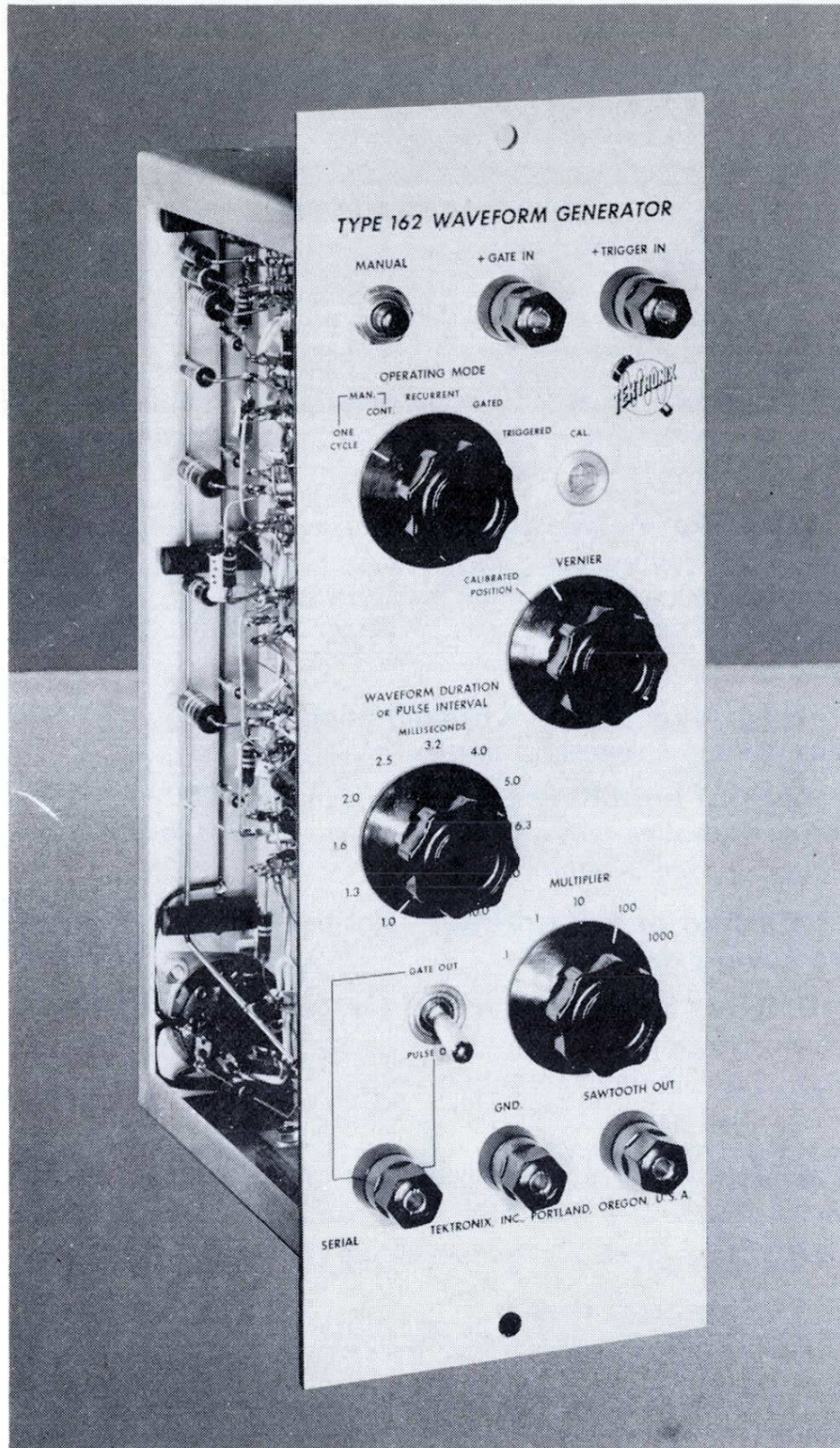
### Type 161 Pulse Generator — \$95

Includes: 1—W160S 10" Connecting cable  
1—Set mounting screws and cup washers  
1—Instruction Manual

**Tektronix, Inc.**

# TYPE 160 SERIES WAVEFORM GENERATORS

## TYPE 162 WAVEFORM GENERATOR



### GENERAL DESCRIPTION

The TEKTRONIX Type 162 Waveform Generator provides three types of waveforms of adjustable duration and repetition rate; pulse, gate, and sawtooth. Generation of the waveform can be initiated either by means of an externally derived electrical impulse, or by means of front-panel controls and switches. Pulse and gate waveforms have a minimum risetime of approximately one microsecond and an amplitude of 50 volts. The shortest pulse duration is approximately 10 microseconds. The sawtooth waveform is a positive voltage decreasing uniformly from positive 150 volts to positive 20 volts.

The Type 162 is useful for initiating chains of events electrically, and for controlling the duration of their occurrence and their repetition rate. When generating waveforms recurrently the instrument provides an unusually stable repetition rate. The Type 162 is specifically designed to operate in conjunction with TEKTRONIX Type 161 Pulse Generators.

### CHARACTERISTICS

**Output Waveform** — Positive pulse. Positive gate. Negative-going sawtooth.

**Pulse Characteristics** — Amplitude, 50 volts positive from ground. Duration, 10  $\mu$ sec to 0.2 sec. Risettime, 1  $\mu$ sec, approximately, minimum. Repetition rate, 0.1 cps to 10 kc for recurrent operation.

**Gate Characteristics** — Amplitude, 50 volts positive from ground. Duration, 100  $\mu$ sec to 10 sec. Repetition rate, 0.1 cps to 10 kc for recurrent operation.

**Sawtooth Characteristics** — Amplitude decreases uniformly with time from positive 150 volts to positive 20 volts. Duration, 100  $\mu$ sec to 10 sec. Repetition rate, 0.1 cps to 10 kc for recurrent operation.

**Output Impedance** — Approximately 1000 ohms for all outputs.

**Triggering Means** — Externally derived electrical pulse or gate. Front-panel pushbutton or switch.

**Triggering Input Impedance** — High impedance, consisting of control grid with 1-megohm grid return resistor.

**Trigger Sensitivity** — Positive pulse, 3 volts peak or greater with risetime 5 milliseconds or less. Sine-wave, 2 volts rms, frequency between 5 cps and 50 kc. At frequencies below 5 cps, the product of rms voltage times frequency must exceed 10.

**Gate Sensitivity** — Three volts.

**Construction** — Aluminum alloy.

**Finish** — Buffed photo-etched metal panel, etched metal chassis.

**Dimensions** — 4  $\frac{1}{8}$ " wide, 12  $\frac{1}{4}$ " high, 7  $\frac{1}{2}$ " deep.

**Weight** — 5 pounds.

**Power Requirements** — 225 volts DC positive at 28 ma. 150 volts DC positive at 1 ma. 170 volts DC negative at 1.5 ma. 6.3 volts AC at 1.7 amps.

### VACUUM TUBE COMPLEMENT

Schmitt trigger circuit . . . . .		12AU7
Trigger amplifier (operating mode selection)	$\frac{1}{2}$	12AU7
Multivibrator . . . . .	$\frac{1}{2}$	12AU7
Multivibrator . . . . .	$\frac{1}{2}$	12AU7
Pulse and gate shaping amplifier . . . . .	$\frac{1}{2}$	12AU7
Phantastron . . . . .		6BH6
Pulse and gate amplifier . . . . .	$\frac{1}{2}$	12AU7
Phantastron plate coupling cathode follower, sawtooth out . . . . .	$\frac{1}{2}$	12AU7
Pulse and gate output cathode follower . . . . .	$\frac{1}{2}$	12AU7
Phantastron plate catching diode . . . . .	$\frac{1}{2}$	12AU7

### Type 162 Waveform Generator — \$95

Includes: 1—W160S Connecting cable  
1—Set mounting screws and cup washers  
1—Instruction Manual

**Tektronix, Inc.**

# TYPE 160 SERIES WAVEFORM GENERATORS

## TYPE 163 FAST-RISE PULSE GENERATOR

### Output Waveforms

Variable-amplitude positive pulse.  
Fixed-amplitude positive gate.

### Output Characteristics

**Risetime**—less than  $0.2 \mu\text{sec}$  (without load capacitance).  
**Decay Time**— $0.2 \mu\text{sec}$  (without load capacitance).  
**Overshoot**—can be adjusted to zero.  
**Duration**—calibrated, continuously variable,  $1 \mu\text{sec}$  to  $10,000 \mu\text{sec}$ .  
**Delay**—calibrated, continuously variable, 0 to 100% of triggering sawtooth duration.

### Amplitude

Pulse—calibrated, continuously variable, 0 to 25 v, peak to peak.  
Gate—fixed, 25 v, peak to peak.

### Cathode-Follower Output

Pulse—from arm of variable cathode resistor.  
Gate—from top of same resistor.

### Trigger Requirements

Positive pulse, 2 v peak to peak minimum.  
Negative-going sawtooth; must include dc bias sufficient to keep voltage positive.

### Power Requirements

—170 v at 26 ma.  
+225 v at 35 to 45 ma (minimum to maximum pulse duty cycle).  
6.3 v ac at 3.6 amp.

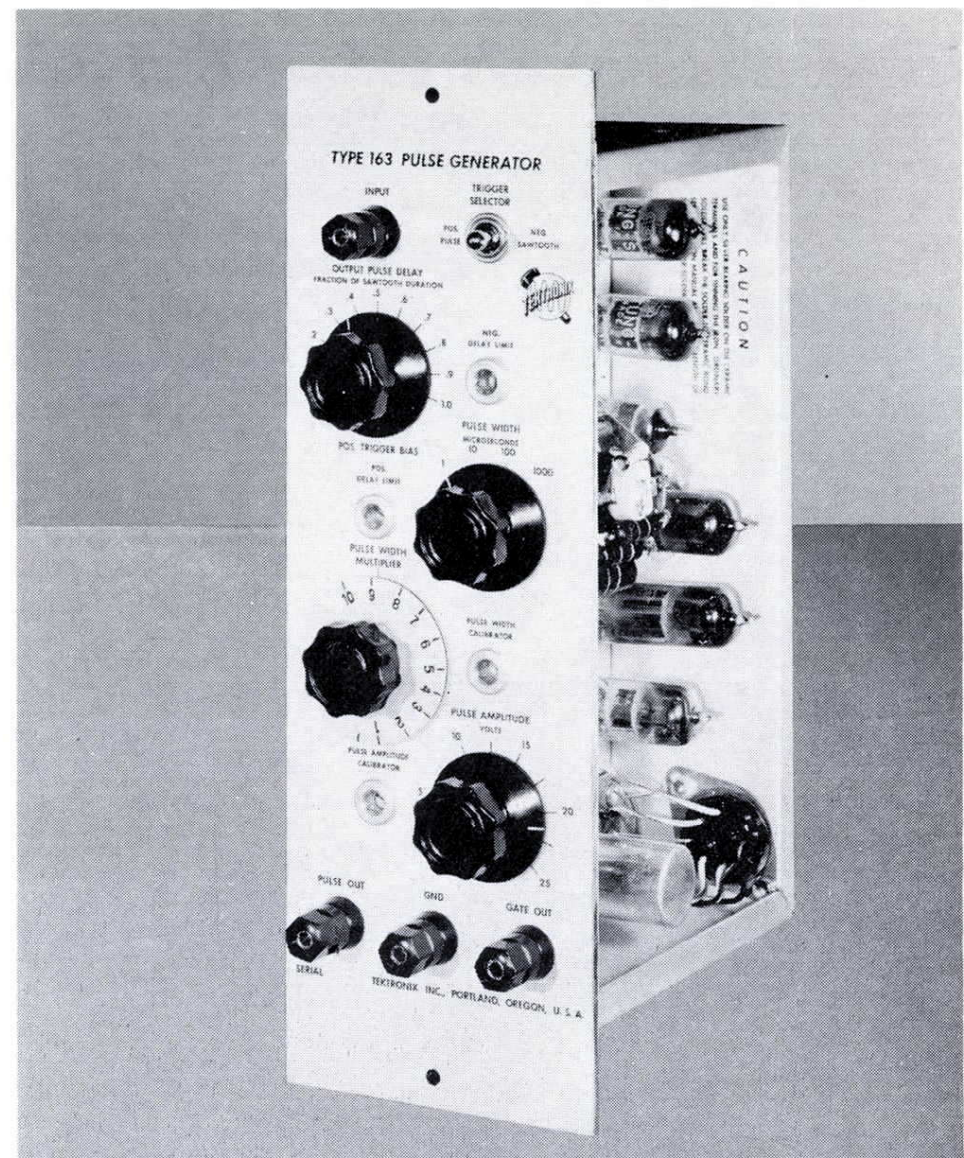
### GENERAL DESCRIPTION

The Tektronix Type 163 Pulse Generator is designed to supply rectangular pulses of less than  $0.2 \mu\text{sec}$  risetime when the required trigger voltage is received from an external source. A Tektronix Type 162 Waveform Generator is an excellent source for either the negative-going sawtooth or positive pulse necessary to trigger the Type 163.

When triggered by a sawtooth voltage the time of occurrence of the output pulse and gate can be adjusted to any point throughout the duration of the sawtooth. Output delay is indicated as a fraction of the triggering sawtooth duration by a calibrated control. Pulse and gate width in microseconds and pulse amplitude in volts may be read directly from calibrated controls.

The Type 163 can be operated up to 50% duty cycle at the minimum time setting on any range. Correspondingly higher duty cycles are obtained at higher multiplier control settings. The maximum repetition rate is 500 kc when a pulse of  $1\text{-}\mu\text{sec}$  duration is generated.

Voltages necessary to operate the Type 163 may be obtained from a Tektronix Type 160 Power Supply. As many as three Type 163 units can be powered by a single Type 160 unit.



### VACUUM TUBE COMPLEMENT

Comparator and pulse amplifier . . . . .	6U8
Regenerative trigger amplifier . . . . .	6U8
Disconnect diode and charge diode . . . . .	6AL5
Monostable multivibrator . . . . .	2 12BY7
Output Cathode follower . . . . .	6BQ7

### OTHER CHARACTERISTICS

Mounting—adapted to rack mounting by the Tektronix Type FA160 Mounting Frame.

Construction—aluminum alloy.

Finish—photo-etched anodized panel, etched chassis.

Dimensions— $4\frac{1}{8}$ " wide,  $12\frac{1}{4}$ " high,  $7\frac{1}{2}$ " deep.

Weight—5 pounds.

### Type 163 Pulse Generator . . . . . \$95

Includes: 1—W160S Connecting Cable  
1—Set Mounting Screws and Cup Washers  
1—Instruction Manual

### Recommended Additional Accessories

Type FA160 Adapter Frame adapts Type 160 Series to rack mounting. Holds four waveform generators—or two waveform generators and one power supply. \$5.00

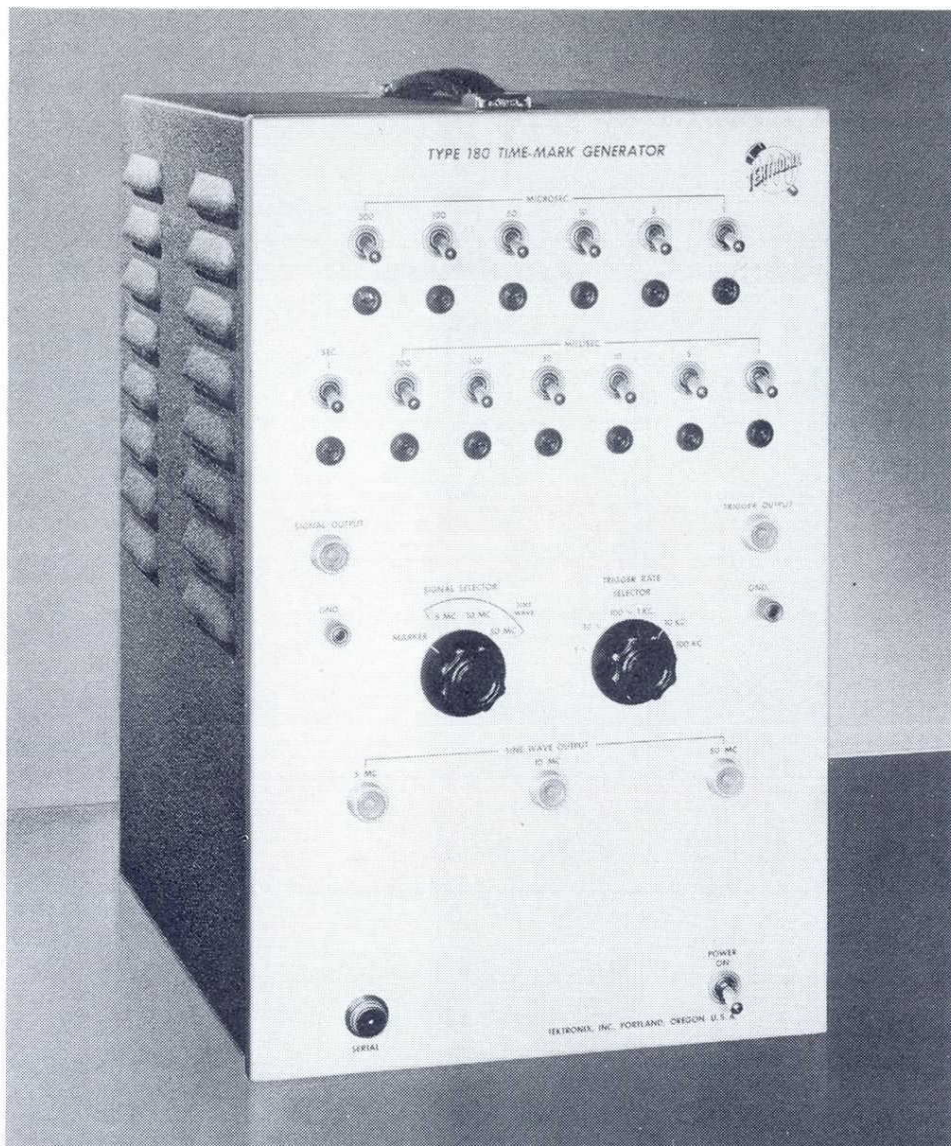
Type FA160 Blank Panel,  $4\frac{1}{8}$ " x  $12\frac{1}{4}$ ", covers openings in frame-mounted sets of Type 160 Series Instruments . . . . . \$6.50

Prices f.o.b. Portland (Beaverton), Oregon.

**Tektronix, Inc.**



# TYPE 180 TIME-MARK GENERATOR



The Type 180 Time-Mark Generator is a precision laboratory instrument of high quality design and construction. The Type 180 generates time markers of 1, 5, 10, 50, 100, 500 microseconds, — 1, 5, 10, 50, 100, 500 milliseconds, — 1 second; sine waves of 5 mc, 10 mc, 50 mc, trigger rates of 1, 10, 100 cycles, 1, 10, 100 kilocycles. A crystal-controlled oscillator operating at one megacycle controls all outputs. The 1-mc frequency is accurate within 0.03%.

The 1  $\mu$ sec markers are formed by a clipper, differentiating network, and biased cathode follower. 5  $\mu$ sec to 1 sec markers are generated in a chain of triggered multivibrator circuits and each is shaped in a differentiating network and biased cathode follower. Markers are mixed

in a resistive circuit so that marker amplitudes are added together forming a distinctive timing comb. Markers selected by the trigger rate switch are fed to a shaper and cathode follower to form the trigger output. The sine wave outputs are formed by three frequency-multiplier circuits.

A four-position switch is used to select the signal output — markers, 5-mc sine wave, 10-mc sine wave, or 50-mc sine wave. Individual switches are used to form any combination of markers desired. The markers are also available separately and simultaneously through individual pin jacks, and each sine wave frequency is available at a separate connector. A six-position switch is used to select the trigger repetition rate desired.

A Type 180 can be very helpful in the laboratory. You can use it to calibrate oscilloscope time bases; to calibrate audio, supersonic, and rf oscillators; to calibrate counters; as a time measuring instrument (calibrating points from 10  $\mu$ sec to 1 sec); as a repetition rate generator.

## Regulation

All dc voltages electronically regulated.

## Accuracy

Within 0.03%.

## Construction

Aluminum alloy chassis and cabinet. Hinged sub-chassis. Photo-etched aluminum panel with anodized finish. Gray wrinkle finished cabinet.

## Power Requirements

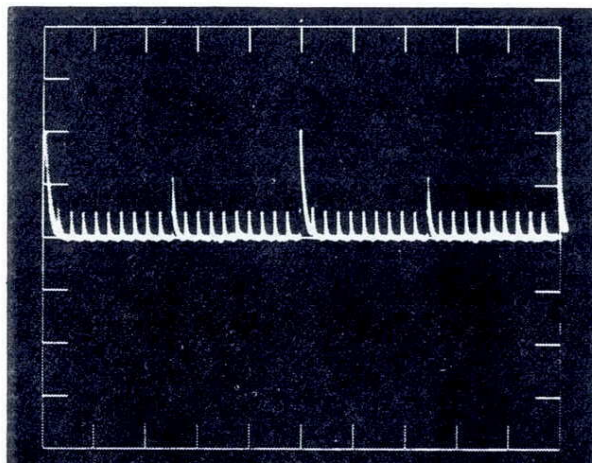
105-125 v or 210-250 v, 50-60 cycles — 330 watts.

## Dimensions

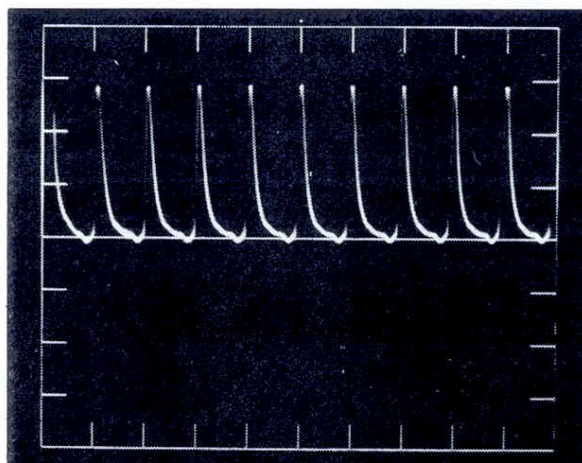
10  $\frac{1}{8}$ " wide, 16  $\frac{1}{2}$ " high, 14  $\frac{7}{8}$ " deep.

## Weight

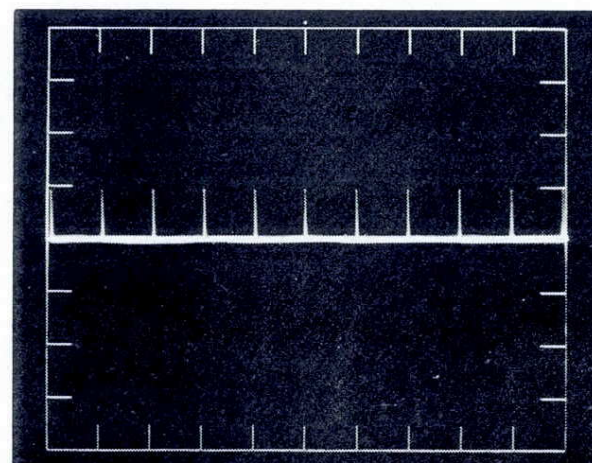
37 lbs.



Timing comb



1- $\mu$ sec Marker



1-msec Marker

Timing comb consists of 5- $\mu$ sec, 50- $\mu$ sec, and 100- $\mu$ sec markers. A Tektronix Type 315-D Oscilloscope was used for these photographs.

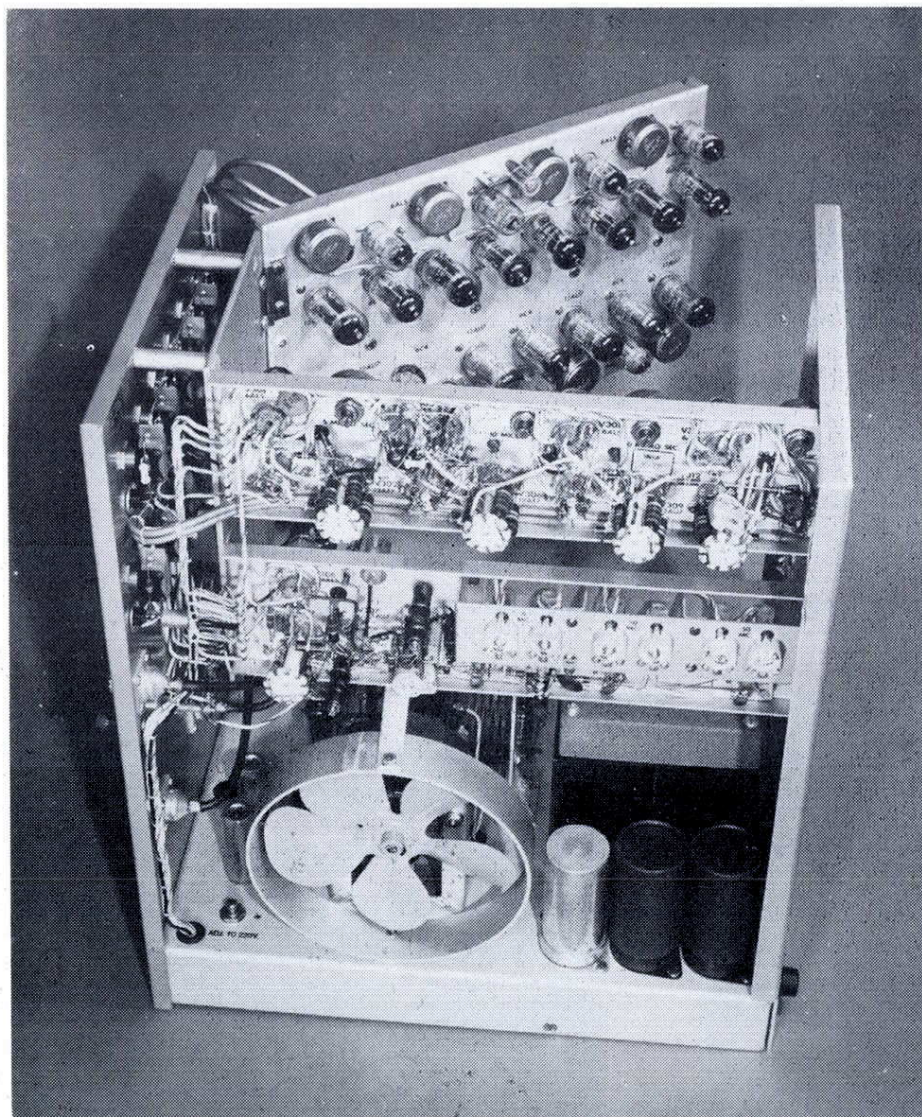
**Tektronix, Inc.**

# TYPE 180 TIME-MARK GENERATOR

## CHARACTERISTICS

### Nominal Voltage, Impedance, and Risetime Values

AT SIGNAL OUTPUT			AT PIN JACKS		
Marker	Amplitude	Impedance	Risetime	Amplitude	Impedance
1 $\mu$ sec	1 v	300 ohms	0.04 $\mu$ sec	20 v	400 ohms
5 $\mu$ sec to 10 $\mu$ sec	1 v	600 ohms	0.08 $\mu$ sec	25 v	400 ohms
50 $\mu$ sec	1.5 v	600 ohms	0.08 $\mu$ sec	25 v	400 ohms
100 $\mu$ sec to 1 sec	3 v	600 ohms	0.3 $\mu$ sec	50 v	600 ohms
Trigger Pulses					
1, 10, 100 cycles					
1, 10, kc	9 v	200 ohms	0.2 $\mu$ sec		
100 kc	3 v	200 ohms	0.2 $\mu$ sec		
Sine Waves	(across 52 ohms)				
5, 10, 50 mc	4 v	30 ohms			



### VACUUM TUBE COMPLEMENT

Oscillator and buffer . . . . .		6U8
Frequency Multiplier . . . . .	3	6AH6
Cathode Follower . . . . .		12AU7

Clamp and Clipper Diode . . . . .		6AL5
Amplifier and Cathode Follower . . . . .		12AT7
Divider Multivibrator . . . . .	2	12AT7
Divider Multivibrator . . . . .	10	12AU7
Coupling Diode and Clamp . . . . .	12	6AL5
Marker Cathode Follower . . . . .	3	12AU7
Marker Cathode Follower . . . . .	10	6C4
Trigger Shaper and Cathode Follower . . . . .		12AU7
Rectifier . . . . .		6X4
Series Regulator . . . . .	2	6AQ5
Series Regulator . . . . .		6AS7
Regulator Amplifier . . . . .	3	6AU6
Voltage Comparator . . . . .		12AX7
Voltage Reference . . . . .		5651

Price — \$575 f.o.b. Portland (Beaverton), Oregon

Included with the Type 180: 2 — P93 Output Cables  
1 — A100 Clip Lead Adapter  
1 — Instruction Manual

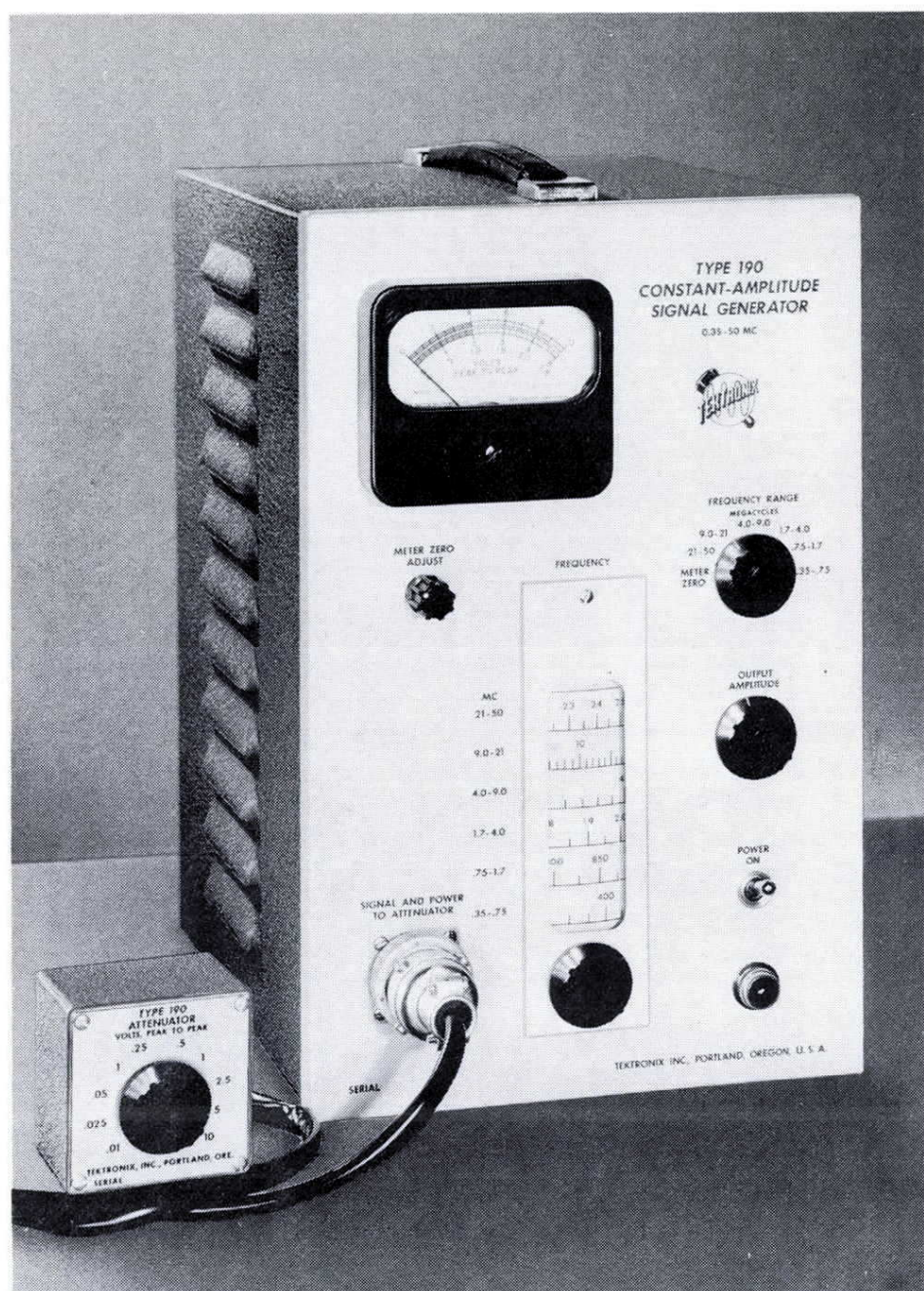
**Type 180-S1** — The same Time-Mark Generator with the 1-mc frequency controlled by a James Knights Type H-17 crystal in a Type JKO-2 temperature stabilized oven. Frequency stability over a twenty-four hour period is within two parts per million. The 1-mc frequency is adjustable within  $\pm 50$  cycles.

Price — \$625 f.o.b. Portland (Beaverton), Oregon

**Tektronix, Inc.**

# TYPE 190 SIGNAL GENERATOR

## Constant-Amplitude Signal Generator



### GENERAL DESCRIPTION

The Tektronix Type 190 Constant-Amplitude Signal Generator is designed to supply sine waves of constant amplitude for checking the high-frequency response of video amplifiers.

The Type 190 consists of two units and a 36" interconnecting cable. The larger unit contains the power supply, oscillator, and the amplitude indicating circuitry. The smaller unit contains the output attenuator and amplitude-sampling full-wave rectifier.

Peak-to-peak level of the output signal at the attenuator is indicated on the amplitude meter. Output is maintained at a constant level by the control voltage fed back from the sampling full-wave rectifier in the attenuator unit. This control signal varies the oscillator plate voltage through an electronic regulator circuit.

### Output Frequency

Continuously variable from 350 kc to 50 mc in 6 ranges. Frequency indication accurate within 2%.

### Output Amplitude

Continuously variable from 4 millivolts to 10 volts peak to peak in 10 ranges. Amplitude indication accurate within 10% of full scale.

### Amplitude Variation

Output amplitude varies less than 2% from 350 kc to 30 mc; less than 4% from 30 mc to 50 mc.

### Output Impedance

52 ohms.

### VACUUM-TUBE COMPLEMENT

Oscillator . . . . .	6C4
Meter Amplifier . . . . .	12AU7
Compensating diode . . . . .	6AL5
Sampling diode . . . . .	6AZ5
Voltage regulator . . . . .	OB2
Regulator amplifiers . . . . . 2	6AU6
Series regulator . . . . .	12AU7
Power rectifier . . . . .	5Y3G

### OTHER CHARACTERISTICS

Size—8½" wide, 13½" high, 11" deep.

Attenuator unit—2⅝" x 2¼" x 2".

Connecting cable—36" long.

Weight—24 pounds.

Construction—aluminum alloy.

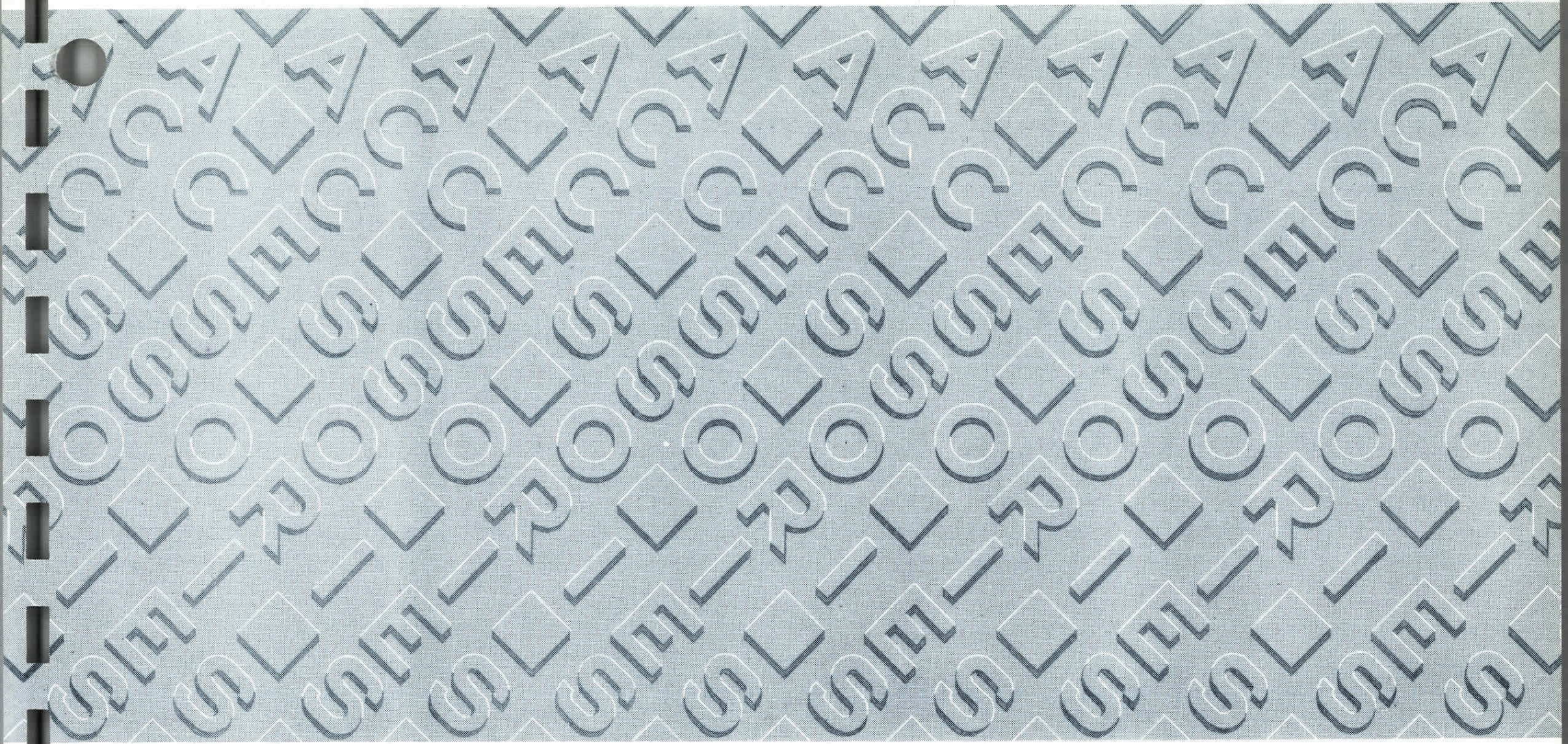
Finish—Photo-etched anodized panel, baked gray wrinkle cabinet.

Power Requirements—117/234 volts, 50-60 cycles, 100 watts.

Price—\$275 f.o.b. Portland (Beaverton), Oregon.

Includes: 1—Attenuator Unit  
1—36" Connecting Cable  
1—Instruction Manual

**Tektronix, Inc.**



## ACCESSORIES

*These accessories are designed to expand the applicability of Tektronix Oscilloscopes in order that a greater benefit might accrue to the user.*

# ACCESSORIES

## Operational Accessories

### TYPE 500 SCOPE-MOBILE



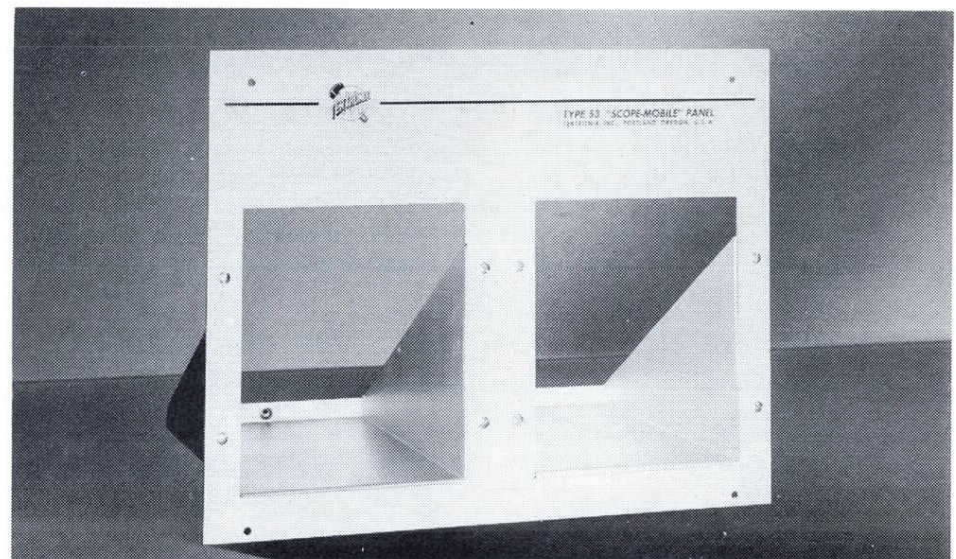
The TEKTRONIX **Type 500 Scope-Mobile** has been especially designed to accommodate the Tektronix Cathode Ray Oscilloscopes. It provides a sturdy yet mobile and therefore highly useful support for the Oscilloscope. Convenient and easy observation of the CRT face is achieved by a 20° tilt back.

A blank panel, 11"x15", fronting a mounting space of approximately 1 1/2 cubic feet allows for auxiliary built-in

equipment as an aid in meeting specialized requirements. This space is fully ventilated by means of louvres. A power input connector and three convenience outlets appear at the back.

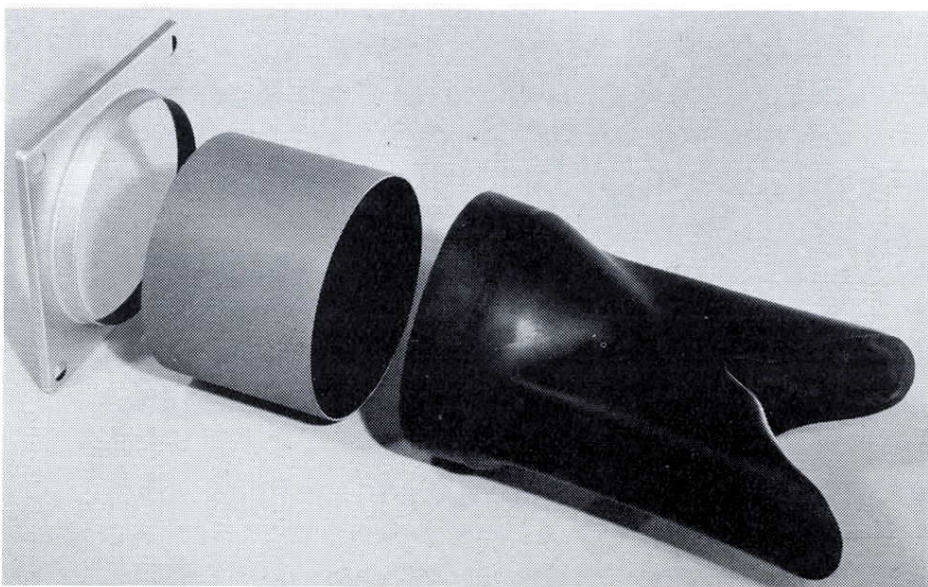
A drawer is provided for the handy storage of cords, probes, instruction books, small tools, etc. For quietness and ease of operation the drawer, 15"x15"x3" in size, is felt lined and operates in roller bearing support runners. An open shelf, 17"x24" in size and topped with battle-ship linoleum, is located at the bottom of the unit.

Total "dry" weight of the Scope-Mobile is approximately 42 pounds and clearance dimensions are 18 1/2" wide, 39" high and 30" deep. **Price — \$97.50**

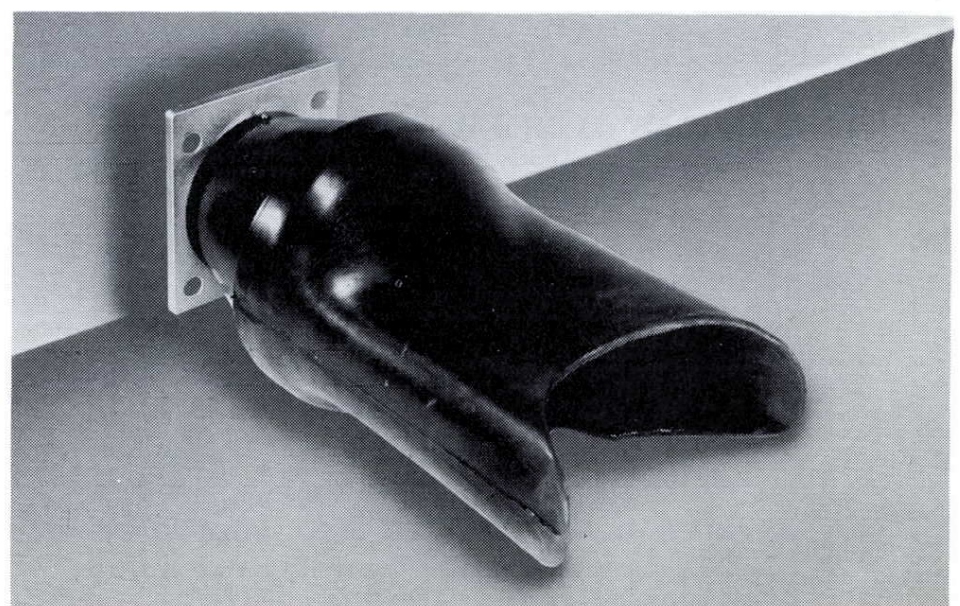


Type 53 Scope-Mobile Panel — replaces standard blank panel in the Scope-Mobile. It has two supporting cradles designed to accommodate the Type 53 Plug-In Preamplifiers used with Type 530 Series Oscilloscopes. . . . . 10.50

### VIEWING HOODS



H510 Viewing Hood, for Tektronix 5" Oscilloscopes. Two-piece construction, rubber and aluminum, permits use of aluminum tube as deep light shield for less critical applications. Replacement graticule cover included. 4.50



H310 Viewing Hood, for Tektronix 3" Oscilloscopes. Includes rubber eye-piece, spun-aluminum light shield, and replacement graticule cover. . . . . 4.50

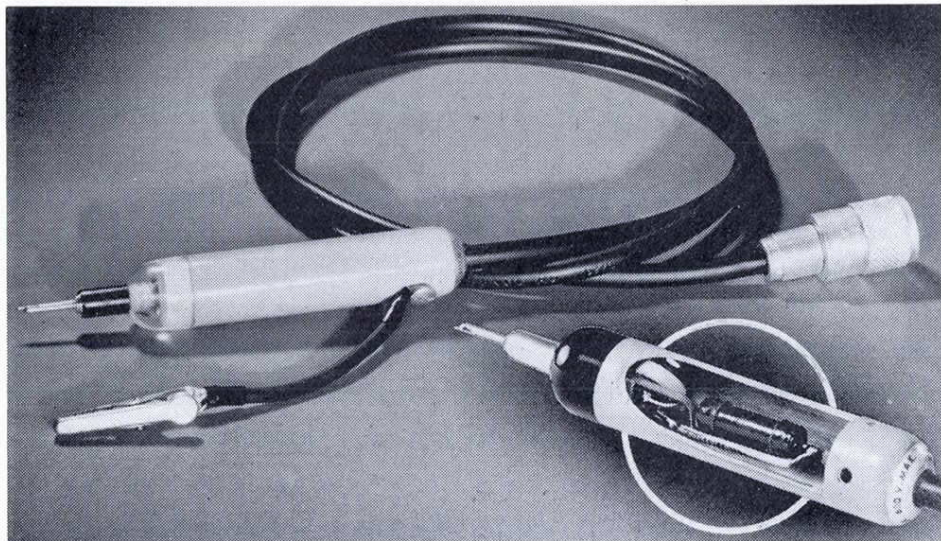
Prices f.o.b. Portland (Beaverton), Oregon

**Tektronix, Inc.**

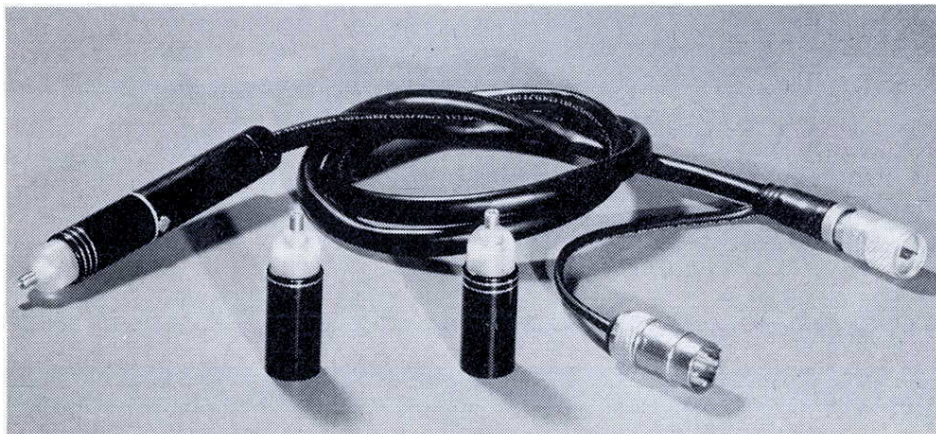
# ACCESSORIES

## Operational Accessories

### PROBES



P510A Attenuator Probe (replaces the P510) — 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  $\mu\text{mf}$ . The probe body is completely insulated — made of high impact strength Fiber Glass Reinforced Alkyd — and has an internal brass shield. Klipzon tip and attached ground clip increase its utility. The P510A has a 42" coaxial cable with uhf connector. Voltage rating, 600v peak to peak, maximum . . . . . 8.50  
Replacement Klipzon tips for P510A. . . . . .65



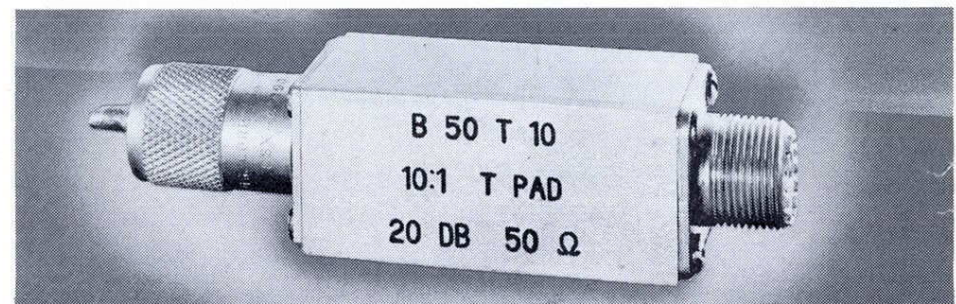
P170CF Cathode Follower Probe complete with 3 attenuator Heads. . . . .86.00  
This probe was developed for use with Type 517 oscilloscope. The cathode-follower tube is a 5718 triode whose cathode load is the 170-ohm termination of the preamplifier grid line in Type 517. Plate and heater voltage for this tube are provided at a four-terminal socket on the panel of the oscilloscope. The signal is attenuated by 2 times when using P170CF. The input impedance of the probe will depend on the attenuator head being used, also since transit time in the cathode-follower tube is involved, it will decrease appreciably at the higher frequencies. When the probe is used without an attenuator head, the input looks like 12 megohms, shunted by 5  $\mu\text{mf}$  into the grid of the 5718.

- PAX-I Attenuator Head for P170CF. . . . . 11.00  
Attenuation may be varied between 4 times and 40 times.
- PAX-II Attenuator Head for P170CF. . . . . 11.00  
Attenuation may be varied between 20 times and 200 times.
- PAX-III Attenuator Head for P170CF. . . . . 11.00  
Attenuation may be varied between 200 times and 2000 times.

P170CF may be used with Type 513 oscilloscope, but low-frequency response will suffer somewhat, depending on the attenuator head being used. It is necessary to terminate the 170-ohm cable at the oscilloscope input. B170R terminating resistor is designed for this. (See below.) A rectifier kit, KP170CF, is recommended for installation in Type 513 to rectify the 6.3 volt heater supply.

KP170CF DC Filament Kit for P170CF. . . . . 4.50

### TERMINATIONS, PADS, ATTENUATORS



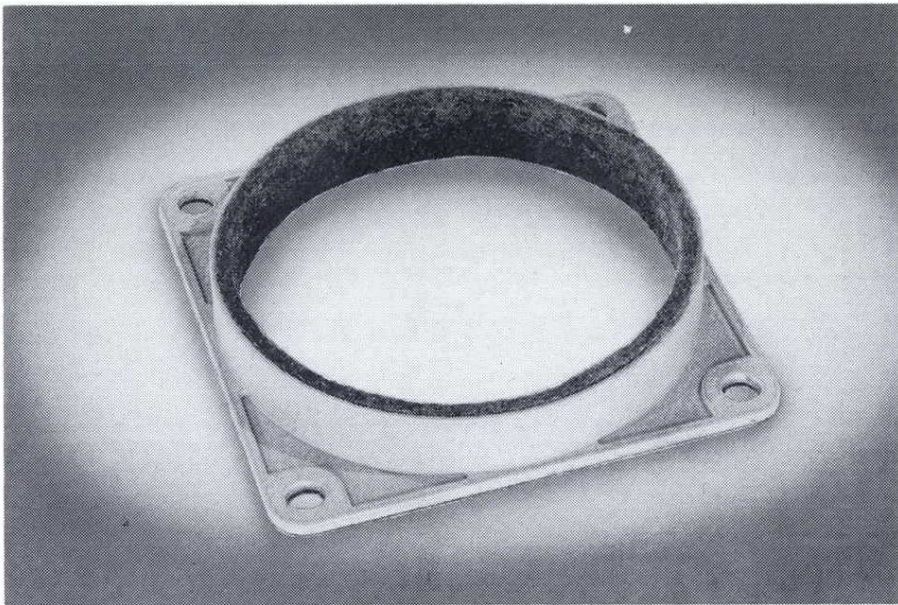
- B52-R 52-ohm terminating resistor, 1.5w. . . . . 8.50
- B52-L5 52-ohm 'L' pad, 5 to 1 voltage ratio, 1.5w 8.50
- B52-L10 52-ohm 'L' pad, 10 to 1 voltage ratio, 1.5w . . . . . 8.50
- B52-75L Minimum-loss pad, 52 ohms to 75 ohms. 11.50
- B52-170L Minimum-loss pad, 52 ohms to 170 ohms 11.50
- B52-T10 52-ohm 'T' pad, 10 to 1 voltage ratio, 1.5w . . . . . 11.50
- B75-R 75-ohm terminating resistor, 1.5 w. . . . . 8.50
- B75-L5 75-ohm 'L' pad, 5 to 1 voltage ratio, 1.5w . . . . . 8.50
- B75-L10 75-ohm 'L' pad, 10 to 1 voltage ratio, 1.5w . . . . . 8.50
- B75-T10 75-ohm 'T' pad, 10 to 1 voltage ratio, 1.5w . . . . . 11.50
- B93-R 93-ohm terminating resistor, 1.5w. . . . . 8.50
- B93-L5 93-ohm 'L' pad, 5 to 1 voltage ratio, 1.5w . . . . . 8.50
- B93-L10 93-ohm 'L' pad, 10 to 1 voltage ratio, 1.5w . . . . . 8.50
- B93-52L Minimum-loss pad, 93 ohms to 52 ohms, 1.5w . . . . . 11.50
- B93-T10 93-ohm 'T' pad, 10 to 1 voltage ratio, 1.5w . . . . . 11.50
- B170-R 170-ohm terminating resistor, 1.5w. . . . . 8.50
- B170-V 170-ohm attenuator, 1 to 64 db in 1 db steps, 0.25w . . . . . 45.00

Prices f.o.b. Portland (Beaverton), Oregon

**Tektronix, Inc.**

# ACCESSORIES

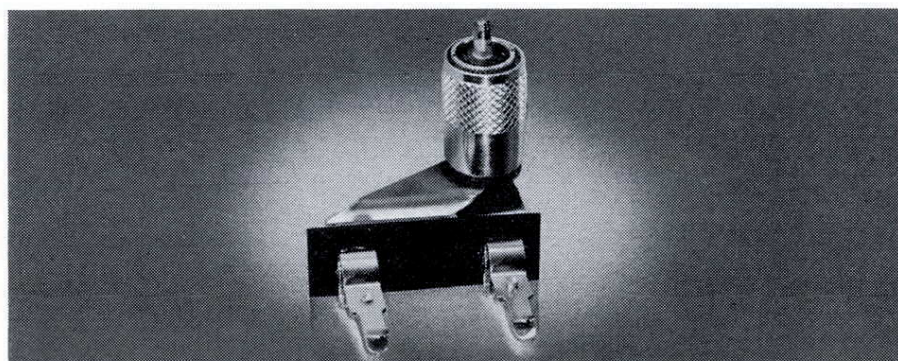
## Operational Accessories



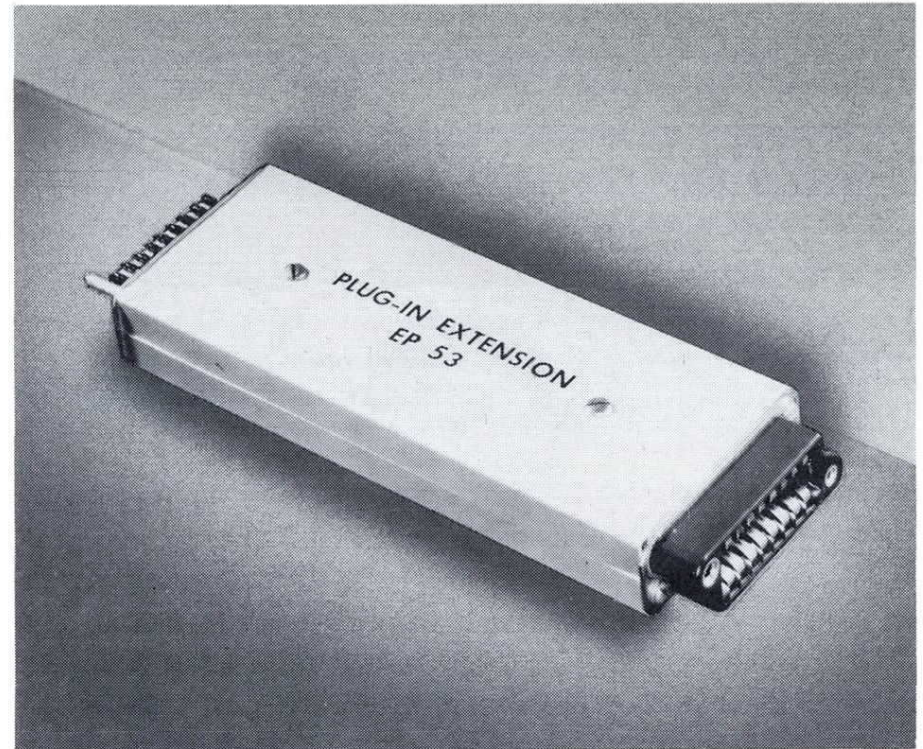
BE510 Bezel, for mounting camera on Tektronix 5" Oscilloscopes. Dimensions —  $5\frac{7}{8}$ " square; ring  $\frac{7}{8}$ " deep, diameter  $5\frac{5}{8}$ " outside,  $5\frac{1}{8}$ " inside. Die-cast construction, gray wrinkle finish, felt lined. . . . . 4.50



S30 Delta Standards, for calibration of the Type 130 L,C Meter. The unit provides accurately adjusted steps of capacitance and inductance, selected by a rotary selector switch. Values of the capacitance steps correspond to the full-scale adjustments required on the five scales of the Type 130. Two resistors of identical manufacture and similar capacitance, values of 1 megohm and 0.1 megohm, are provided for the resistance compensation adjustment. A 300- $\mu$ h standard permits proper adjustments of the inductance ranges. . . . . 22.00



F30 Production Test Fixture, for use with the Type 130 L,C Meter. Speeds sorting and testing of capacitors and inductors. . . . . 3.00



EP53 Plug-in Extension — Allows the plug-in pre-amplifier unit for the Type 530 Series oscilloscope to be operated partially out of its housing. A convenient accessory in making attenuator and transient response adjustments. . . . . 5.00

### COAXIAL CABLES

- P52 Coaxial Cable, 52 ohms nominal impedance, 42" long. . . . . 4.00
- P75 Coaxial Cable, 75 ohms nominal impedance, 42" long. . . . . 4.00
- P93 Coaxial Cable, 93 ohms nominal impedance, 42" long. . . . . 4.00
- P93A Coaxial output cable, 93 ohms, terminated at end with variable attenuator, 42" long. . . 13.50
- P93B Coaxial output cable, 93 ohms, terminated at end with  $\frac{1}{2}$ -watt 93-ohm resistor, 42" long. . . . . 5.00
- P170 Coaxial cable, 170 ohms nominal impedance, 42" long. . . . . 9.50

### DELAY NETWORKS

- 1-D-25 Delay network, .25  $\mu$ sec delay, for Type 511 . . . . . 50.00
- 1-AD-25 Delay network, .25  $\mu$ sec delay, for Type 511A . . . . . 50.00
- 3-D-25 Delay network, .25  $\mu$ sec delay, for Type 513 . . . . . 65.00
- 4-D-25 Delay network, .25  $\mu$ sec delay, for Type 514 . . . . . 50.00

### MISCELLANEOUS

- A100 Adapter, clip lead. . . . . 2.50
- A510 Adapter, binding post . . . . . 1.88
- FA160 Frame, mounting, for Type 122 and Type 160 series units . . . . . 5.00

Prices f.o.b. Portland (Beaverton), Oregon

**Tektronix, Inc.**

# ACCESSORIES

## Replacement Accessories

### GRATICULES

GR 300	Unruled; fits Type 315.....	.50
GR 315	Quarter-inch ruling, 8 spaces vertically, 10 horizontally.....	1.00
GR 500	Unruled; fits Types 511A, 512, 513, 514, 514A, 524.....	1.00
GR 511	Centimeter ruling; 4 centimeters vertically, 10 horizontally, for Types 511A and 514 with 5CP CRT.....	1.50
GR 512	Centimeter ruling; 6 centimeters vertically, 10 horizontally, for Type 512 with 5CP CRT, Types 514A and 524, and Type 511A with 5ABP CRT.....	1.50
GR 8	Centimeter ruling; 8 centimeters vertically, 10 horizontally, for Type 512 with 5ABP CRT.....	1.50
GR 513	Centimeter ruling; 4 centimeters vertically, 8 horizontally; for Type 513.....	1.50
GR 517	Centimeter ruling; 4 centimeters vertically, 8 horizontally; for Type 517 only.....	9.50
GR 524TV	RMA Style ruling for percentage measurements, for Type 524.....	1.50
GR 530	Centimeter ruling; 6 centimeters vertically, 10 horizontally; for Types 531 and 535....	1.50

### CATHODE-RAY TUBE LIGHT FILTERS

F310-3	(3" amber).....	.50
F310-5	(3" green).....	.50
F310-6	(3" blue).....	.50
F510-3	(5" amber).....	.90
F510-5	(5" green).....	.90
F510-6	(5" blue).....	.90

### AC POWER CORDS

COP16-8	(#16 wire, 8' long).....	2.40
COP18-1	(#18 wire, 1' long).....	.85
COP18-8	(#18 wire, 8' long).....	1.50

### SPECIAL CORDS AND LEADS

W112R	(Red output lead for 112).....	1.00
W112B	(Black output lead for 112).....	1.00
W122	(Battery power lead for 122).....	7.50
W160L	(17" inter-unit Power cable for 160 series) ..	2.00
W160S	(10" inter-unit Power cable for 160 series) ..	2.00
W517	(Inter-unit Power cable for 517).....	9.50

### INSTRUCTION MANUALS

104A	.....	1.50
105	.....	1.75
112	.....	1.50
121	.....	1.50
122	.....	1.50
124	.....	1.75
130	.....	1.50
160	.....	1.50
161	.....	1.50
162	.....	1.50
163	.....	1.50
180	.....	2.00
190	.....	1.50
315D	.....	4.00
511A or 511AD	.....	2.75
512	.....	2.75
513 or 513D	.....	2.75
514 or 514D	.....	2.75
514A or 514AD	.....	3.00
517	.....	4.50
524D	.....	5.00
531	.....	4.50
535	.....	5.00

### MISCELLANEOUS

Attenuator Unit	, for Type 190.....	19.00
P93C Probe	, for Type 130.....	2.00
FM 124 Mounting Frame	, for Type 124.....	5.00



# GENERAL INFORMATION

## Terms and Shipment

Our terms are 1% ten days, net thirty days on domestic orders; net thirty days on export orders. Shipping delay may be prevented by establishing credit at time of placing order. When desirable, C.O.D. shipments can be arranged. All prices are f.o.b. Portland (Beaverton), Oregon.

For information relative to discounts on quantity purchases, please contact your nearest Tektronix field office, representative, or distributor.

Although all quotations are for shipment f.o.b. Portland (Beaverton), Oregon, upon request transportation costs can be prepaid and the amount added to the invoice.

Normally, shipments are made by Railway Express or Motor Freight. If shipment by air is desired, please specify Air EXPRESS or Air FREIGHT. Experience has eliminated rail freight as a satisfactory method of surface transportation for electronic instruments.

## Export Orders

All orders and inquiries from countries other than the United States should be addressed directly to: Tektronix, Inc., Export Department, P. O. Box 831, Portland 7, Oregon. Cable address: TEKTRONIX.

## Delivery

Acceptance of purchase orders is indicated by our acknowledgment, and estimated shipment time is given from date of acknowledged acceptance. Every effort is made to meet the estimated shipment date, but there is the possibility that circumstances beyond our control might make it impossible to meet the quoted schedules.

## Field Maintenance

Tektronix Field Maintenance is provided on a non-profit basis, as a service to our customers. Work is expedited whether or not the instrument is in warranty.

Requests for repairs or replacement parts should include type number and serial number and should be directed to our representative or branch office in your area. In an emergency, please wire or phone Field Engineering, Tektronix, Inc., Portland, Oregon, in addition to notifying the local representative. This procedure will assure you the fastest possible service.

If an instrument must be returned to the factory for repairs, notify Field Engineering directly or through the local representative, **indicating type number and serial number**, and you will be notified at once as to procedure to be followed. PLEASE DO NOT RETURN AN INSTRUMENT BEFORE RECEIVING DIRECTIONS. Instruments and parts returned from countries other than the United States *must be accompanied by an invoice* to clear through customs.

It is standard practice for Tektronix to incorporate improvements into production instruments as they are developed in our laboratories. Owners of existing instruments are notified of modifications, and modification kits are made available, when practicable, to those who wish to modernize their own instruments.

For customers who have large quantities of Tektronix instruments and wish to equip their maintenance departments with factory-tested components, integrated kits of parts are available. Kits are designed to cover expected needs of a group of ten instruments of the same type.

## 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, they will be shipped from the factory, via air transportation on request, prepaid to any point within continental North America.

Tektronix transformers manufactured in our own plant carry an indefinite warranty. In the event of failure please be sure to contact the nearest Tektronix Field Engineer, Representative or Headquarters.

## APPROXIMATE SHIPPING WEIGHTS

INSTRUMENT TYPE	NET WEIGHT IN POUNDS	DOMESTIC PACKED IN POUNDS	EXPORT PACKED IN POUNDS	EQUIVALENT DIMENSIONAL WEIGHTS IN		VOLUME IN	
				POUNDS	KILOGRAMS	CU. FT.	CU. IN.
315-D .....	36	47	80	135	61.2	6	9
511-A .....	53	70	92	135	61.2	6	9
511-AD .....	55	72	93	135	61.2	6	9
512 .....	56	73	95	135	61.2	6	9
513 .....	77	95	124	178	80.7	8	11
513-D .....	79	97	126	178	80.7	8	11
514-A .....	61	78	112	178	80.7	8	11
514-AD .....	62	79	113	178	80.7	8	11
517							
Indicator Unit .....	76	103	127	178	80.7	8	11
Power Supply .....	72	86	105	105	47.7	5	3
Scopemobile .....	42	56	67	147	66.7	7	4
524-D .....	62	80	114	178	80.7	8	11
Viewing Hood .....	1¼	4	10	23	10.4	1	2
531 .....	66	83	117	178	80.7	8	11
535 .....	70½	87½	120	178	80.7	8	11
53A .....	3½	12	33	90	40.8	4	6
53B .....	3½	12	33	90	40.8	4	6
53C .....	5½	14	35	90	40.8	4	6
53D .....	4	12½	33½	90	40.8	4	6
104-A .....	22	30	53	90	40.8	4	6
105 .....	35½	47	64	90	40.8	4	6
112 .....	32	49	75	135	61.2	6	9
121 .....	18½	24	45	90	40.8	4	6
122 .....	5½	9	16	23	10.4	1	2
124 .....	21	35	54	90	40.8	4	6
130 .....	9	17	38	90	40.8	4	6
160 Series .....	22	45	66	135	61.2	6	9
160 .....	12¾	27	50				
161 .....	3½	7	14				
162 .....	3½	7	14				
163 .....	3½	7	14				
FA-160 .....	1¼	3					
180 .....	37	49	66	90	40.8	4	6
190 .....	24	38	55	90	40.8	4	6
500 .....	42	51	61	147	66.7	7	4

# Tektronix, Inc.

AN OREGON CORPORATION

**MAIN OFFICE & FACTORY — SUNSET HIGHWAY AND BARNES ROAD**  
**MAILING ADDRESS — P. O. BOX 831, PORTLAND 7, OREGON**  
**PHONE — CYpress 2-2611**

## EASTERN FIELD ENGINEERING HEADQUARTERS

TEKTRONIX, INC. . . . . 49 PONDFIELD ROAD . . . . . BRONXVILLE 8, NEW YORK  
 DEerfield 7-3771

J. J. Cassidy

F. K. Frost

### FIELD OFFICES

TEKTRONIX, INC. CLEVELAND 11, O.  
 3353 Edgecliff Terrace  
 Clearwater 2-2121  
 Dayton Area Phone:  
 ENterprise 7121  
 Detroit Area Phone:  
 ENterprise 7121  
 Pittsburgh Area Phone:  
 ZEnith 0212  
 Fred J. Hart  
 C. B. Gibson

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 8118 Harford Road  
 Phone: Boulevard 2600  
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 NEWTONVILLE 60, MASS.  
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 TEKTRONIX, INC. SYRACUSE 10, N.Y.  
 313 Nottingham Road  
 Phone: 72-3339 George Edens  
 S. H. Pyle

### TEKTRONIX ENGINEERING REPRESENTATIVES

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 1931 West Vermont Ave.  
 Alpine 2-5290 Bill Saxon

FLORIDA FORT MYERS  
 Arthur Lynch & Associates  
 P.O. Box 466  
 Fort Myers 5-6762 Arthur H. Lynch

NEW MEXICO ALBUQUERQUE  
 Neely Enterprises  
 107 Washington St. S.E.  
 Phone: 5-5586 L. E. French  
 John Davis

CALIFORNIA LOS ANGELES, 46  
 Neely Enterprises N. B. Neely  
 7422 Melrose Ave. R. L. Morgan  
 WEBster 3-9201 John O'Halloran  
 Bob Brunner  
 Jerry Cain

GEORGIA ATLANTA  
 Bivens & Caldwell  
 267 East Paces Ferry Road, N.E.  
 CHerokee 7522 W. P. Bivens

NORTH CAROLINA HIGH POINT  
 Bivins & Caldwell Dave Caldwell  
 Security Bank Bldg. John Bivins  
 Phone: 3672 C. M. Smith, Jr.

CALIFORNIA SACRAMENTO, 14  
 Neely Enterprises  
 1317 15th St.  
 Gilbert 2-8901 Rudy Poucher

ILLINOIS CHICAGO, 45  
 Everett Associates Jim Everett  
 6744 N. California W. Anderson  
 Ave. John Scheck  
 AMbassador 2-3702

OREGON PORTLAND, 14  
 Hawthorne Electronics  
 700 S. E. Hawthorne  
 Blvd. Glenn McDowell  
 Fillmore 9375 Pat Houck

CALIFORNIA SAN DIEGO, 6  
 Neely Enterprises  
 1029 Rosecrans Street  
 ACademy 3-8106 Ed Moore

INDIANA INDIANAPOLIS, 24  
 Everett Associates  
 Box 6232  
 BElmont 4893 Dale Towers

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