CATHODE-RAY OSCILLOSCOPES

AUXILIARY INSTRUMENTS AND ACCESSORIES

CATALOG 14

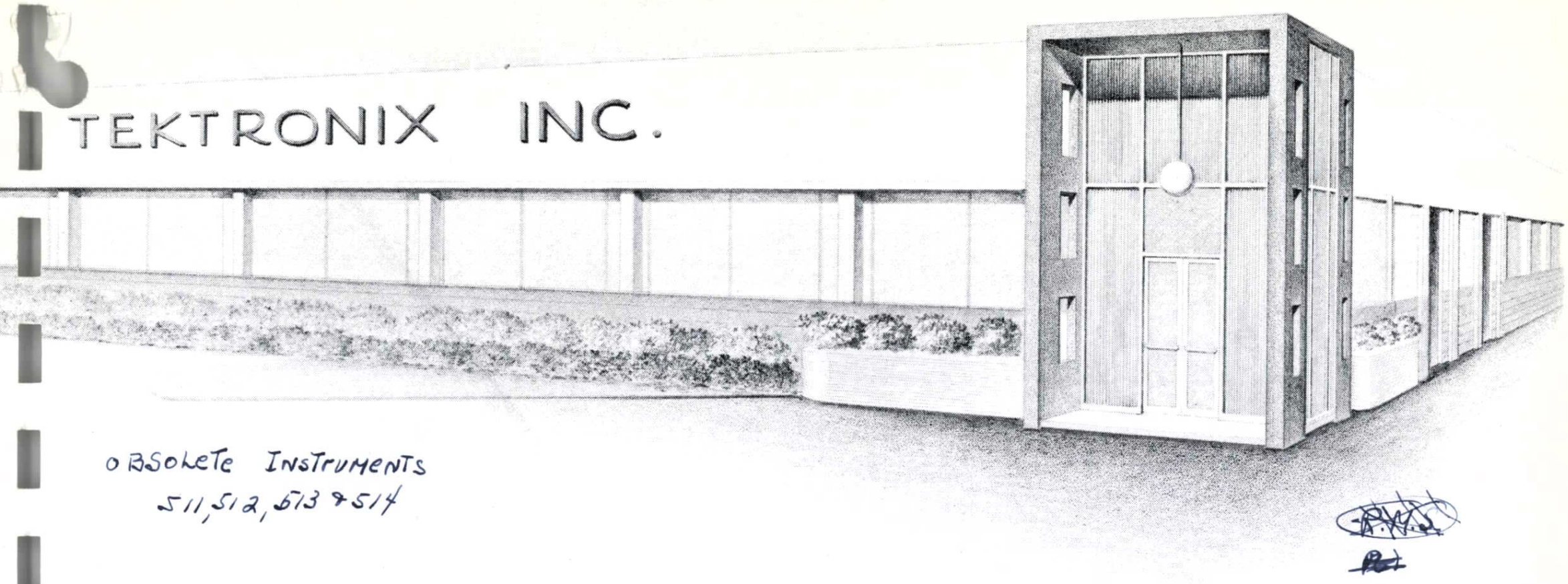
MARCH 1956

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.

Rita Tracy

TEKTRONIX INC.



OBSOLETE INSTRUMENTS
511, 512, 513 & 514

R MS. =
ROOT MEANS
SQUARE

About the Company...

Tektronix was organized in 1946 to manufacture cathode-ray oscilloscopes. To an unusual degree, Tektronix oscilloscopes have met with the approval of the ultimate user, enabling the company to grow by expanding its product lines and services.

Throughout this continuing growth period Tektronix is striving to produce instruments with the quality and utility demanded by the fast-moving electronic industry. High employee morale, fostered by an employee-management relations program that gives employees a voice in company operations, a fair share of company profits, and steady year around employment, contributes greatly to this aim.

Realizing the complexity of the modern cathode-ray oscilloscope, Tektronix continually strives to provide the best in field maintenance help, and the utmost speed in replacement parts service. Helping to keep existing Tektronix instruments in efficient operation is as much a responsibility as developing new instruments to meet the future needs of the industry. Tektronix is making every effort to continue serving its customers with the highest quality in both product and service.

Tektronix, Inc., an Oregon Corporation, Portland 7, Oregon, U. S. A.

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- **Type 540-Series—Oscilloscopes for Fast-Rise Applications**
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- **Plug-In Preamplifiers for Type 530 and 540 Series**
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REFERENCE CHART

MAIN SPECIFICATIONS of TEKTRONIX OSCILLOSCOPES for Convenience in Making Preliminary Comparisons

Oscilloscopes with Plug-In Preamplifiers

	TYPE 531 General Purpose	TYPE 532 General Purpose	TYPE 535 General Purpose	TYPE 541 Fast-Rise	TYPE 545 Fast-Rise
Vertical Frequency Response (with Type 53/54K Unit)	dc to 11 mc	dc to 5 mc	dc to 11 mc	dc to 30 mc	dc to 30 mc
Calibrated Sweep Range	0.02 μsec/cm to 5 sec/cm	0.2 μsec/cm to 5 sec/cm	0.02 μsec/cm to 5 sec/cm	0.02 μsec/cm to 5 sec/cm	0.02 μsec/cm to 5 sec/cm
Sweep Magnifier	5x	5x	5x	5x	5x
Sweep Delay	None	None	1 μsec to 0.1 sec	None	1 μsec to 0.1 sec
Accelerating Potential	10 kv	4 kv	10 kv	10 kv	10 kv
Price (without plug-in units)	$995	$825	$1300	$1145	$1450
Complete Specifications in Catalog 14	Page 71	Page 77	Page 74	Page 81	Page 84

Plug-In Preamplifiers for Type 530-Series and Type 540-Series Oscilloscopes

	TYPE 53/54A Wide-Band DC	TYPE 53/54B Wide-Band High-Gain	TYPE 53/54C Dual-Trace DC	TYPE 53/54D High-Gain DC Differential	TYPE 53/54E Low-Level AC Differential	TYPE 53/54G Wide-Band DC Differential	TYPE 53/54K Fast-Rise DC
Risetime of Combination — plugged into Types 541, 545	0.018 μsec	0.018 μsec	0.015 μsec	0.18 μsec	6 μsec	0.018 μsec	0.012 μsec
Types 531, 535	0.035 μsec	0.035 μsec	0.035 μsec	0.18 μsec	6 μsec	0.035 μsec	0.031 μsec
Type 532	0.07 μsec	0.07 μsec	0.07 μsec	0.18 μsec	6 μsec	0.07 μsec	0.07 μsec
Passband of Combination—plugged into Types 541, 545	dc to 20 mc	*2 c to 12 mc dc to 20 mc	dc to 24 mc	dc to 2 mc	0.06 cycles to 60 kc	dc to 20 mc	dc to 30 mc
Types 531, 535	dc to 10 mc	*2 c to 9 mc dc to 10 mc	dc to 10 mc	dc to 2 mc	0.06 cycles to 60 kc	dc to 10 mc	dc to 11 mc
Type 532	dc to 5 mc	2 c to 5 mc dc to 5 mc	dc to 5 mc	dc to 2 mc	0.06 cycles to 60 kc	dc to 5 mc	dc to 5 mc
Calibrated Sensitivity ac coupled	0.05 v/cm to 50 v/cm	*5 mv/cm to 50 v/cm	0.05 v/cm to 50 v/cm	1 mv/cm to 50 v/cm	50 μv/cm to 10 mv/cm	0.05 v/cm to 50 v/cm	0.05 v/cm to 50 v/cm
dc coupled	0.05 v/cm to 50 v/cm	0.05 v/cm to 50 v/cm	0.05 v/cm to 50 v/cm	1 mv/cm to 50 v/cm		0.05 v/cm to 50 v/cm	0.05 v/cm to 50 v/cm
Input Capacitance	47 μμf	47 μμf	20 μμf	47 μμf	50 μμf	47 μμf	20 μμf
Price	$85	$125	$275	$145	$165	$175	$125
Complete Specifications in Catalog 14	Page 87	Page 88	Page 89	Page 90	Page 91	Page 92	Page 93

Oscilloscopes Without Plug-In Preamplifiers

	TYPE 310 3″ Portable	TYPE 315D 3″ Portable	TYPE 515 5″ Portable	TYPE 517A High-Speed	TYPE 524AD Television
Risetime	0.09 μsec	0.07 μsec	0.023 μsec	0.007 μsec	0.035 μsec
Vertical Passband ac coupled	*2 c to 3.5 mc 2 c to 4 mc	5 c to 5 mc	2 c to 15 mc		2 c to 10 mc
dc coupled	dc to 4 mc	dc to 5 mc	dc to 15 mc		dc to 10 mc
Calibrated Sensitivity ac coupled	*0.01 v/div to 50 v/div	0.01 v/div to 50 v/div	0.1 v/cm to 50 v/cm	0.05 v/cm	0.015 v/cm to 50 v/cm
dc coupled	0.1 v/div to 50 v/div	0.1 v/div to 50 v/div	0.1 v/cm to 50 v/cm		0.15 v/cm to 50 v/cm
Calibrated Sweep Range	0.5 μsec/div to 0.2 sec/div	0.1 μsec/div to 5 sec/div	0.04 μsec/cm to 2 sec/cm	0.01 μsec/cm to 20 μsec/cm	0.1 μsec/cm to 0.01 sec/cm
Sweep Magnifier	5x	5x	5x		3x and 10x
Accelerating Potential	1.8 kv	1.8 kv	4 kv	24 kv	4 kv
Price	$595	$770	$750	$3500	$1180
Complete Specifications in Catalog 14	Page 45	Page 49	Page 55	Page 59	Page 63

* An additional ac-coupled amplifier stage is switched in by use of the AC ONLY positions of the sensitivity selector, somewhat restricting the overall high-frequency response.

APPLICATIONS GUIDE

Some of the known applications of Tektronix Instruments are presented here, to help guide you in selecting instruments to fit your needs. Your Tektronix Field Engineer or Representative can be very helpful in this regard. If in doubt, please consult him before ordering. For his location and phone number, please refer to the Field Office page in this catalog.

BIOPHYSICAL-MEDICAL

Cardiac Investigation, Diagnosis

Central Nervous System Research

Cortical Research

Neural Activity and Response
- Type 532 Oscilloscope 77
- Type 53/54C Dual-Trace Plug-In Unit 89
- Type 122 Low-Level Preamplifier 21
- Type 53/54D Differential High-Gain Plug-In Unit . 90
- Type 53/54E Low-Level Differential Plug-In Unit . 91

Stimulation
- Type 160-Series Waveform Generators . . . . 31 to 35
- Type 360 Cathode-Ray Indicator 53

ELECTRONIC

Circuit Design
- All Tektronix Oscilloscopes
- Type 105 Square-Wave Generator 13
- Type 130 L,C Meter 29
- Type 190 Signal Generator 41
- Type 180 Time-Mark Generator 37
- Type 181 Time-Mark Generator 39
- Type 570 Characteristic-Curve Tracer 95

Computer Design
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- Type 130 L,C Meter 29

Computer Servicing
- Type 315D Portable Oscilloscope 49
- Type 310 Portable Oscilloscope 45

Delay-Line Testing and Design
- Type 535 Oscilloscope 74
- Type 53/54C Dual-Trace Plug-In Unit 89
- Type 545 Oscilloscope 84

Magnetic Field Investigation
- Type 530-Series Oscilloscopes . . . . . 71 to 79
- Type 53/54B Wide-Band High-Gain Plug-In Unit . 88
- Type 53/54D Differential High-Gain Plug-In Unit . 90
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Transistor Development
- Type 517A Oscilloscope 59
- Type 530-Series Oscilloscopes . . . . . 71 to 79
- Type 53/54G Differential Wide-Band Plug-In Unit 92
- Type 53/54C Dual-Trace Plug-In Unit 89

TV Receiver Production Testing
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Electrical and Mechanical Characteristics of Soils
- Type 532 Oscilloscope 77
- Type 53/54C Dual-Trace Plug-In Unit 89
- Type 53/54D Differential High-Gain Plug-In Unit . 90
- Type 53/54E Low-Level Differential Plug-In Unit . 91
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Field Equipment Maintenance
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INDUSTRIAL

Die Impact Stress Analysis
- Type 532 Oscilloscope 77
- Type 53/54C Dual-Trace Plug-In Unit 89
- Type 122 Low-Level Preamplifier 21

Metal Fracture Investigation
- Type 531 Oscilloscope 71
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TV Station Use
- Type 525 Waveform Monitor 67
- Type 524AD Oscilloscope 63
- Type 105 Square-Wave Generator 13
- Type 130 L,C Meter 29

Vibration Analysis
- Type 532 Oscilloscope 77
- Type 53/54 Dual-Trace Plug-In Unit 89
- Type 122 Low-Level Preamplifier 21

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Type 540-Series Oscilloscopes . . . . . 81 to 86
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Input-Output Comparison
Type 530-Series Oscilloscopes . . . . . 71 to 79
Type 53/54C Dual-Trace Plug-In Unit 89
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Microwave Generator Modes
Type 315D Oscilloscope 49
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Type 122 Low-Level Preamplifier 21

NUCLEAR

Alpha Particle Detector Amplification
Type 122 Low-Level Preamplifier 21

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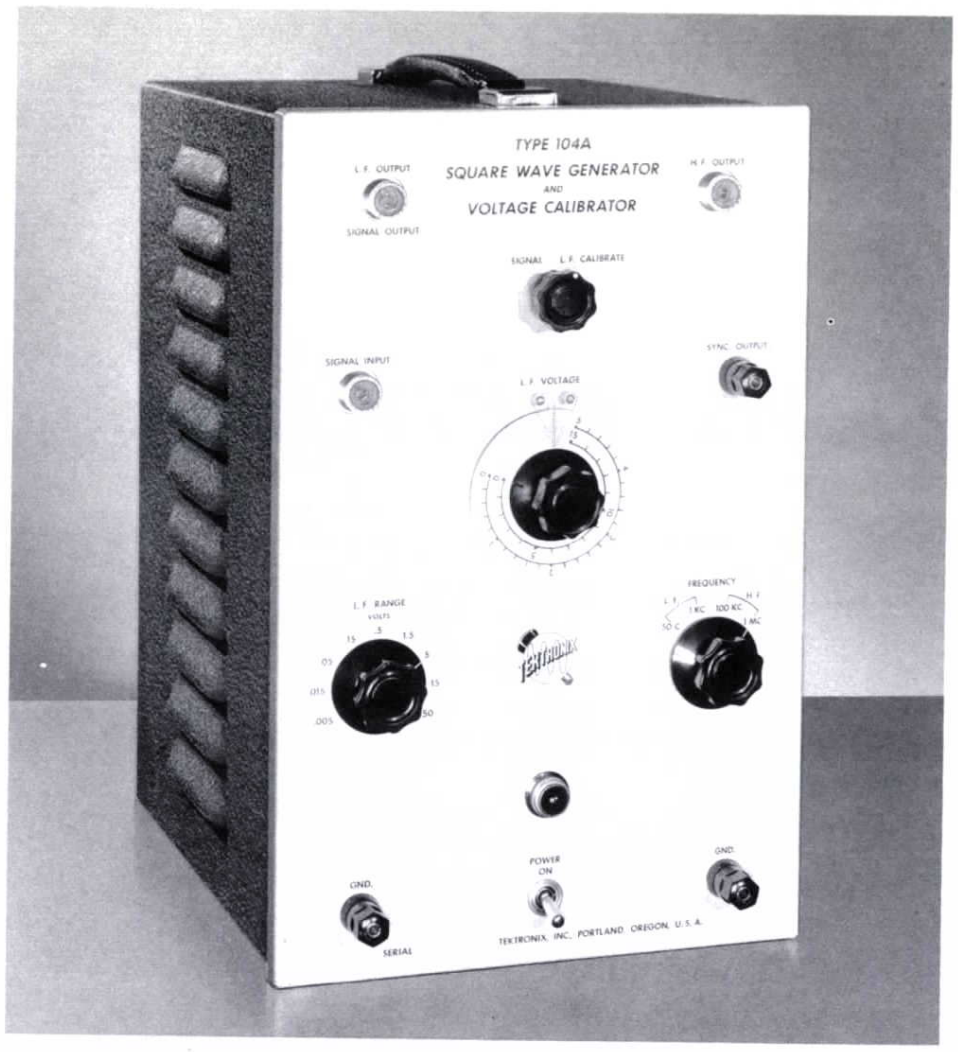
Type 517A Oscilloscope 59

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

and Voltage Calibrator



Fixed Frequencies

50 cycles, 1 kc, 100 kc, 1 mc.

High-Frequency Ranges

Risetime—less than 0.02 μsec.
Output Voltage—5 v maximum in 93-ohm terminated cable.

Low-Frequency Ranges

Risetime—less than 3 μsec.
Output Voltage—0 to 50 v in 9 calibrated ranges.

GENERAL DESCRIPTION

The Tektronix Type 104A Square-Wave Generator is a convenient source of four fixed square-wave frequencies. Standard frequencies of 50 cycles, 1 kc, 100 kc, and 1 mc are extremely useful for the study of low and high-frequency characteristics of wide-band amplifiers, adjustment of frequency-compensated attenuators, and testing filter networks in the laboratory or on the production line. An extra feature permits the low-frequency output to be used as an accurate voltage calibrator. Frequencies other than those listed can be provided to meet specialized requirements.

CHARACTERISTICS

Risetime—High-frequency square waves have a risetime of less than 0.02 μsec, making it possible to test amplifiers having passbands up to 20 mc. Risetime of low-frequency square waves is less than 3 μsec.

High-Frequency Output—The 1-mc and 100-kc outputs are available through a matched 93-ohm cable terminated by a continuously variable attenuator. Maximum output is 5 v peak-to-peak. Impedance varies from 0 to 93 ohms depending on attenuator setting.

Low-Frequency Output—(Voltage Calibrator) The 50-cycle and 1-kc square-wave outputs are continuously variable in 9 ranges, 5, 15, 50 mv, 0.15, 0.5, 1.5, 5, 15, and 50 volts peak-to-peak. Full-scale calibration is accurate within 3%, control linear within 1% of full scale. Impedance varies from 0 to 10 kilohms depending upon attenuator settings.

For calibrating purposes, the Type 104A can be inserted between a signal source and the oscilloscope. A switch connects either the signal or calibrating waveform to the oscilloscope, permitting accurate amplitude measurement of any portion of the signal waveform.

Synchronizing Signal—An oscilloscope synchronizing waveform is available at a front-panel binding post. Amplitude is 3 v for all frequencies.

Regulated Power Supply—Electronically-regulated dc supplies insure stable operation over power-line variations from 105 to 125 v and current-demand differences.

VACUUM TUBE COMPLEMENT

High-frequency multivibrators	2	6AG7
High-frequency limiter		6AG7
High-frequency output amplifier		6AG7
Low-frequency multivibrator		12AU7
Low-frequency limiter and CF		12AU7
Sync output CF		6J6
Rectifier		5V4
Regulator amplifier		6AU6
Series regulator		6AU5
Voltage reference		OC3

MECHANICAL SPECIFICATIONS

Construction—Self-contained, aluminum-alloy chassis and cabinet.

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

Dimensions—14" high, 9" wide, 12" deep.

Weight—22 pounds.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 115 watts.

Price **$195**

Includes: 1—P93A attenuator cable
1—A100 clip-lead adaptor
2—A510 binding-post adapters
1—Instruction manual

Currently Available Extras

The Type 104A can be supplied with frequencies other than 50 cycles, 1 kc, 100 kc, and 1 mc at small additional cost.

Prices for selected frequencies are:
2 in range of 50 cycles to 10 kc. $20
2 in range of 50 kc to 1 mc. $20
Prices f.o.b. Portland (Beaverton), Oregon.

TYPE 105 SQUARE-WAVE GENERATOR

Wide Frequency Range

Risetime

Less than 0.02 μsec into a terminated 93-ohm cable. As short as 13 millimicroseconds under suitable conditions.

Frequency Range

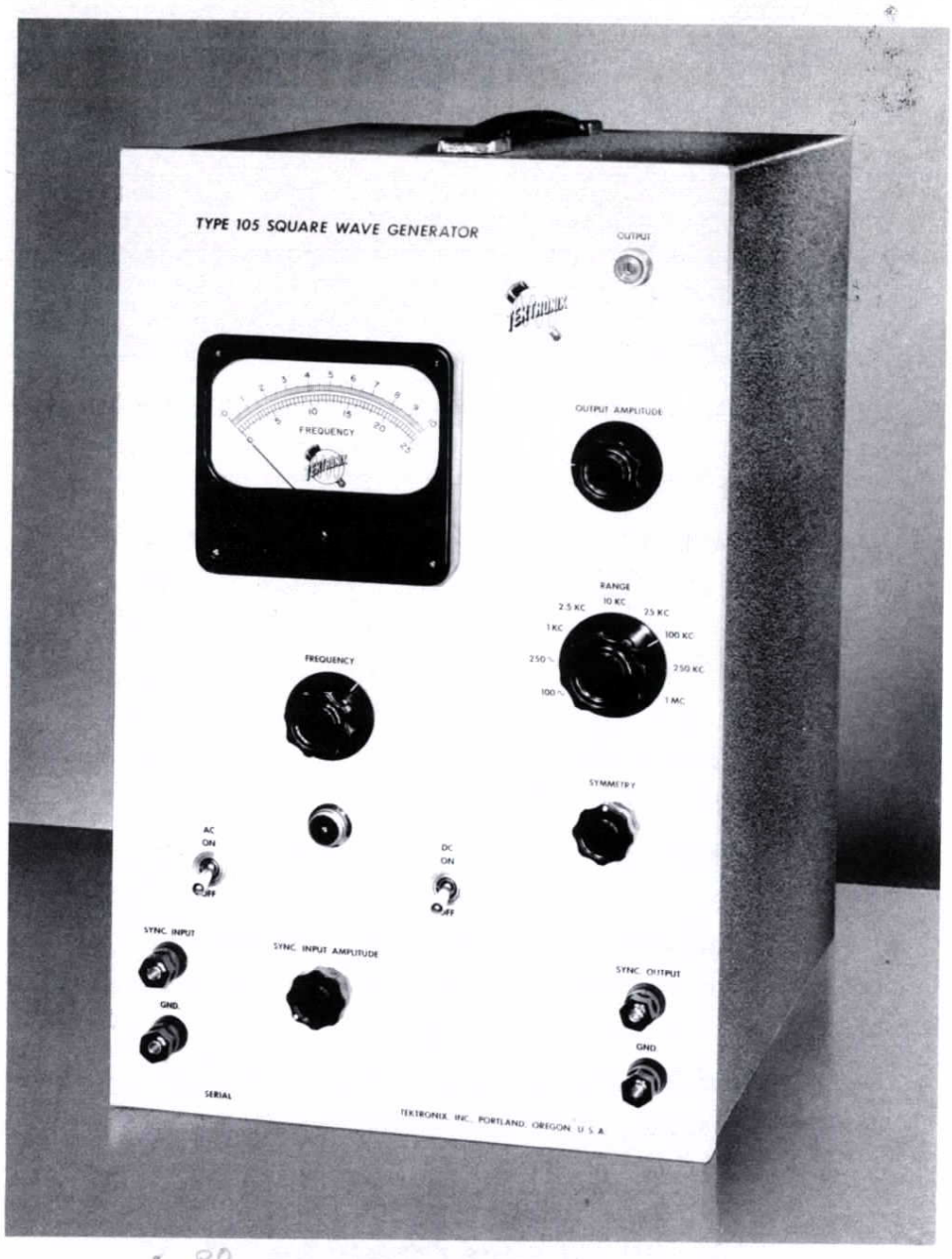
25 cycles to 1 mc, continuously variable.

Frequency Meter

Direct reading, accurate within 3% of full scale.

Output Current

More than 160 ma, peak-to-peak.



GENERAL DESCRIPTION

The Tektronix Type 105 Square-Wave Generator produces square waves with flat horizontal portions, free of overshoot and ringing, over a wide frequency range. Square-wave current greater than 160 ma, peak-to-peak, available at the output terminal, permits a useable voltage swing across very-low impedance loads. Risetime is less than 0.02 μsec into a terminated 93-ohm cable, and is approximately 13 millimicroseconds into a 52-ohm cable terminated at both ends.

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, making it possible to quickly and accurately test amplifiers, filters, etc., having passbands 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).

CHARACTERISTICS

Frequency Range—The frequency range is 25 cycles to 1 mc, continuously variable, in nine ranges—100, 250 cycles, 1, 2.5, 10, 25, 100, 250 kc, and 1 mc. Frequency is read directly on a meter accurate within 3% of full scale.

Risetime—Less than 0.02 μsec into a terminated 93-ohm cable; approximately 18 millimicroseconds when the 93-ohm cable is terminated at both ends; approximately 13 millimicroseconds into a 52-ohm cable terminated at both ends. For higher output voltages larger output impedances can be used, with a corresponding increase in risetime.

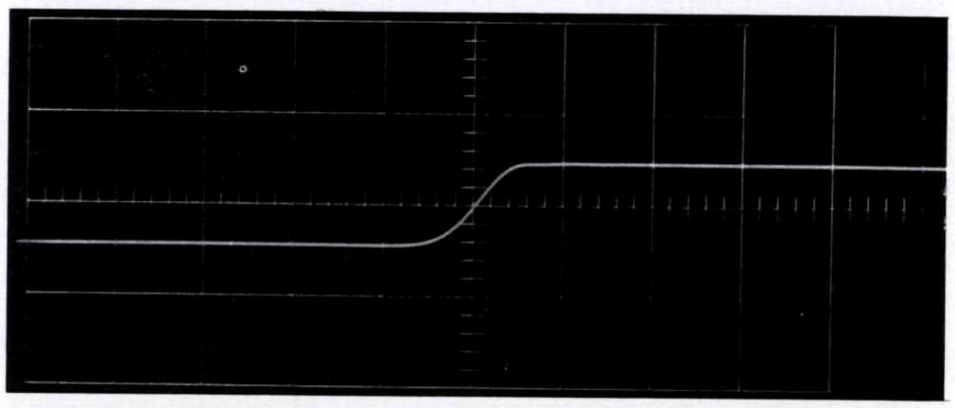


Fig. 1. 13-millimicrosecond risetime of the Type 105 displayed on 0.02 μsec/cm sweep. Generator connected to vertical deflection plates of T54P crt, sensitivity 7 v/cm, with 52-ohm cable terminated at both ends.

TYPE 105 SQUARE-WAVE GENERATOR

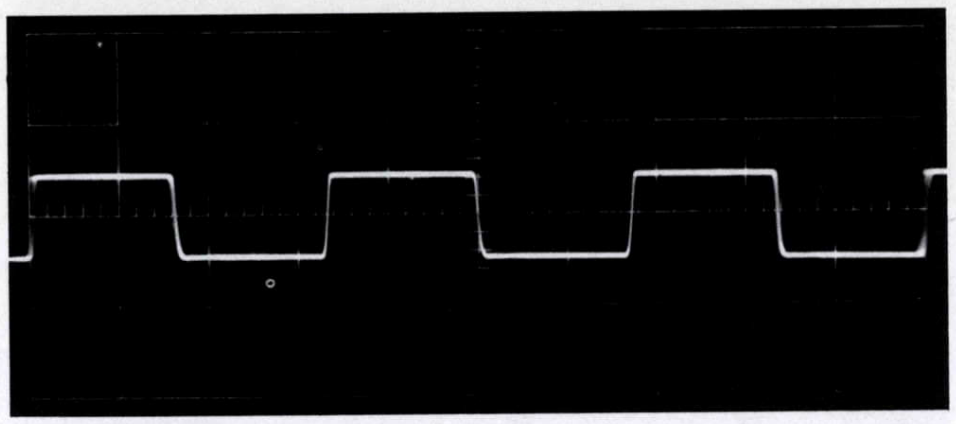


Fig. 2. Sharp leading edge, square corner, and flat top of 1-mc square-wave output of Type 105 displayed on 0.3 μsec/cm sweep Other conditions same as in Fig. 1.

Output Amplitude—The output voltage is adjustable from 10 to 100 v across the internal 600-ohm load. The maximum square-wave current available at the output is greater than 160 ma (peak-to-peak). With a 75-ohm terminated output coaxial cable, the maximum voltage available is approximately 12 volts; with a 93-ohm cable, approximately 15 v.

Sync Terminals—Provision is made to furnish an output synchronizing signal whose amplitude is independent of the square-wave output-control setting. A sync-input terminal permits the square wave to be synchronized with a frequency standard.

Regulated Power Supply—Electronically-regulated dc supplies insure stable operation over line variations of 105-125 v, 210-250 v.

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 catching diode		6AL5
Cathode follower voltage regulator		6J6
Meter amplifier		6AL5
Sync output CF		6J6
Voltage reference		5651
Rectifiers	4	5V4G
Regulator amplifiers	2	6AU6
Series regulators	4	6AU5

MECHANICAL SPECIFICATIONS

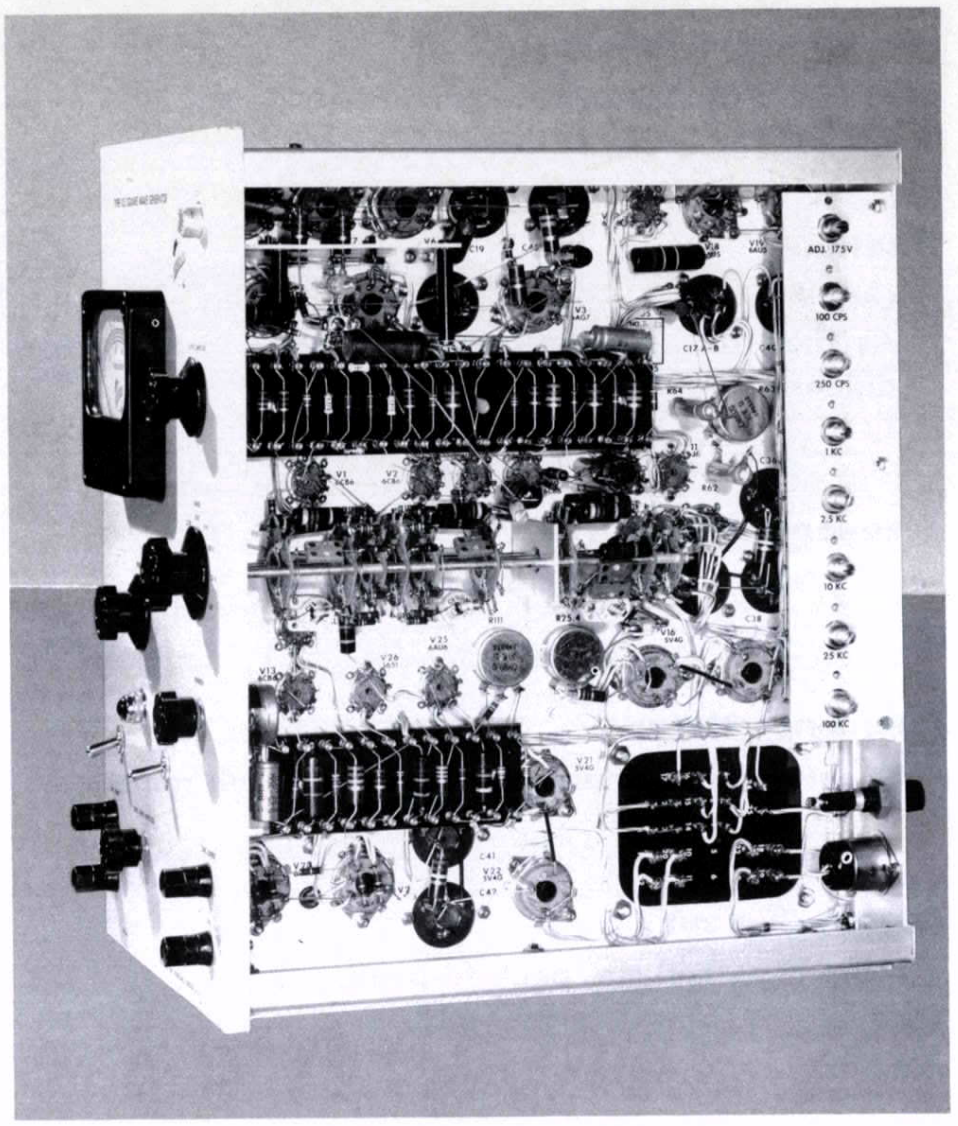
Ventilation—Forced-air ventilation assures safe operating temperature.

Construction—Aluminum-alloy chassis and cabinet.

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

Dimensions—16½" high, 10⅛" wide, 14⅞" deep.

Weight—35½ pounds.



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

Price **$395**

Includes: 1—P93, 93-ohm 42" coaxial cable
1—B93-R, 93-ohm terminating resistor
1—A510 binding-post adapter
1—A100 clip-lead adapter
1—Instruction manual

Rackmounted $415.00
Dimensions approx. 17½" × 19⅛"

Currently Available Extras

93-ohm cable and resistor normally furnished.
If specified on purchase order, 52-ohm cable and resistor or 75-ohm cable and resistor will be supplied instead of 93-ohm cable and resistor. . . . no extra charge.

Recommended Additional Accessories

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

1—P52, 52-ohm 42" coaxial cable. $4.00
1—B52-R, 52-ohm terminating resistor. 8.50
1—B52-L5, 52-ohm "L" pad, 5:1 ratio. 8.50
1—B52-T10, 52-ohm "T" pad, 10:1 ratio. 11.50

A selection of terminating resistors, pads, and coaxial cables designed to be used with the Type 105 will be found in the Accessory Section of this catalog. Within certain technical limits, special terminating resistors and pads can be supplied upon request.

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

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 μv/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

DC-Coupled Differential Amplifier

Voltage Gain
0.5 to 5000, continuously variable.

Frequency Response
DC to 2 mc for gain of 166 or less.
DC to 1 mc for gain of 166 to 5000.

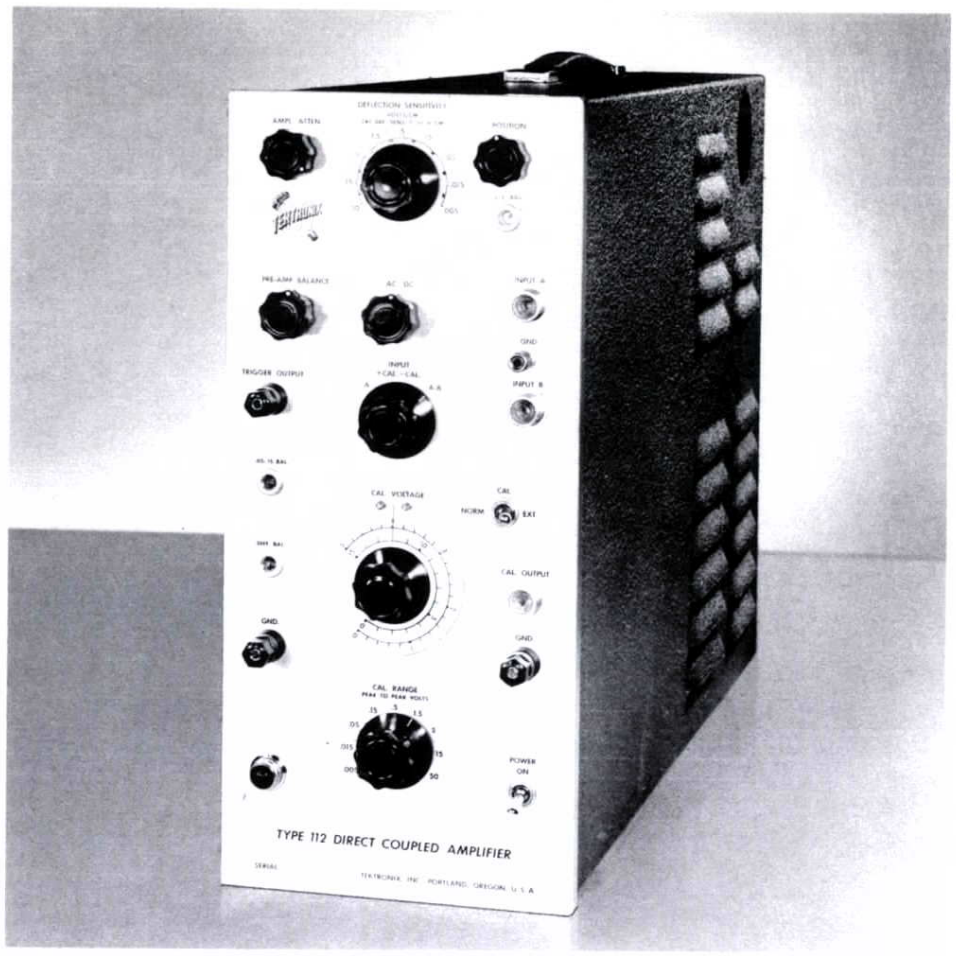
Transient Response
Risetime—0.2 μsec for gain of 166 or less.
0.4 μsec for gain of 166 to 5000.

Output Voltage
150 v at high impedance.
75 v at 8000 ohms.

Calibrating Voltage
5 mv to 50 v full scale, continuously variable.

Time-Marker Input

Trigger Output



Calibrator Accuracy—Full scale calibrations accurate within 3%; control linear within 1% of full scale.

Power Requirements—105 to 125 or 210 to 250 volts, 50 to 60 cycles, 200 watts.

GENERAL DESCRIPTION

The Type 112 is a dc-coupled differential-input amplifier designed primarily for the amplification of signals to a magnitude suitable for observation on a cathode-ray tube. It is a four-stage balanced push-pull amplifier with the input stage shock mounted. Heaters of the first three stages and all plate circuits are operated on electronically-regulated dc supplies to provide stability against line-voltage fluctuations. Choice of single-ended or differential input, either dc-coupled or ac-coupled, provides flexibility of connection to circuits under observation, and often permits rejection of undesired signal pickup.

The Type 112 is especially well adapted for use with Tektronix Type 511, 512, 514, and 524 Oscilloscopes. The necessary connections at the crt access panel and trigger input of the oscilloscopes are easy to make. Sensitivity is increased to 5 mv/cm in oscilloscopes in which the crt has a basic deflection factor of 25 v/cm; and to 3 mv/cm where the basic deflection factor is approximately 15 v/cm. Because characteristics of the Type 112 are identical to those of the vertical amplifier of the Tektronix Type 512 oscilloscope, this combination can be used where identical characteristics are needed in both horizontal and vertical axes. For example, for Lissajous presentations.

OTHER CHARACTERISTICS

Deflection Sensitivity—When used with a crt having a basic deflection factor of 25 v/cm, the sensitivity is 5 mv/cm to 50 v/cm in 9 calibrated steps. A potentiometer fills in between steps, making the sensitivity continuously variable.

Input Impedance—1 megohm paralleled by 45 $\mu\mu$f. With probe, 10 megohms paralleled by 14 $\mu\mu$f.

VACUUM TUBE COMPLEMENT

Amplifiers	2	5879
Amplifiers	4	12AU6
Amplifiers	2	6AG7
Cathode followers	2	12AU6
Voltage regulators	2	12AU7
Marker amplifier		6AU6
Constant-current control	2	6CB6
Cal multivibrator		12AU7
Cal diode and output CF		12AU7
Rectifiers	3	5V4G
Voltage reference		5651
Regulator amplifiers	2	6AU6
Series regulator		6AS7G

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel, gray wrinkle cabinet.
Size—15½" high, 6½" wide, 21½" deep.
Weight—32 pounds.

Price **$495**

Includes: 2—P510A attenuator probes
2—W112R output leads (012007)
1—W112B output lead (012008)
2—A510 binding-post adapters
1—Instruction manual

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

TYPE 121 PREAMPLIFIER

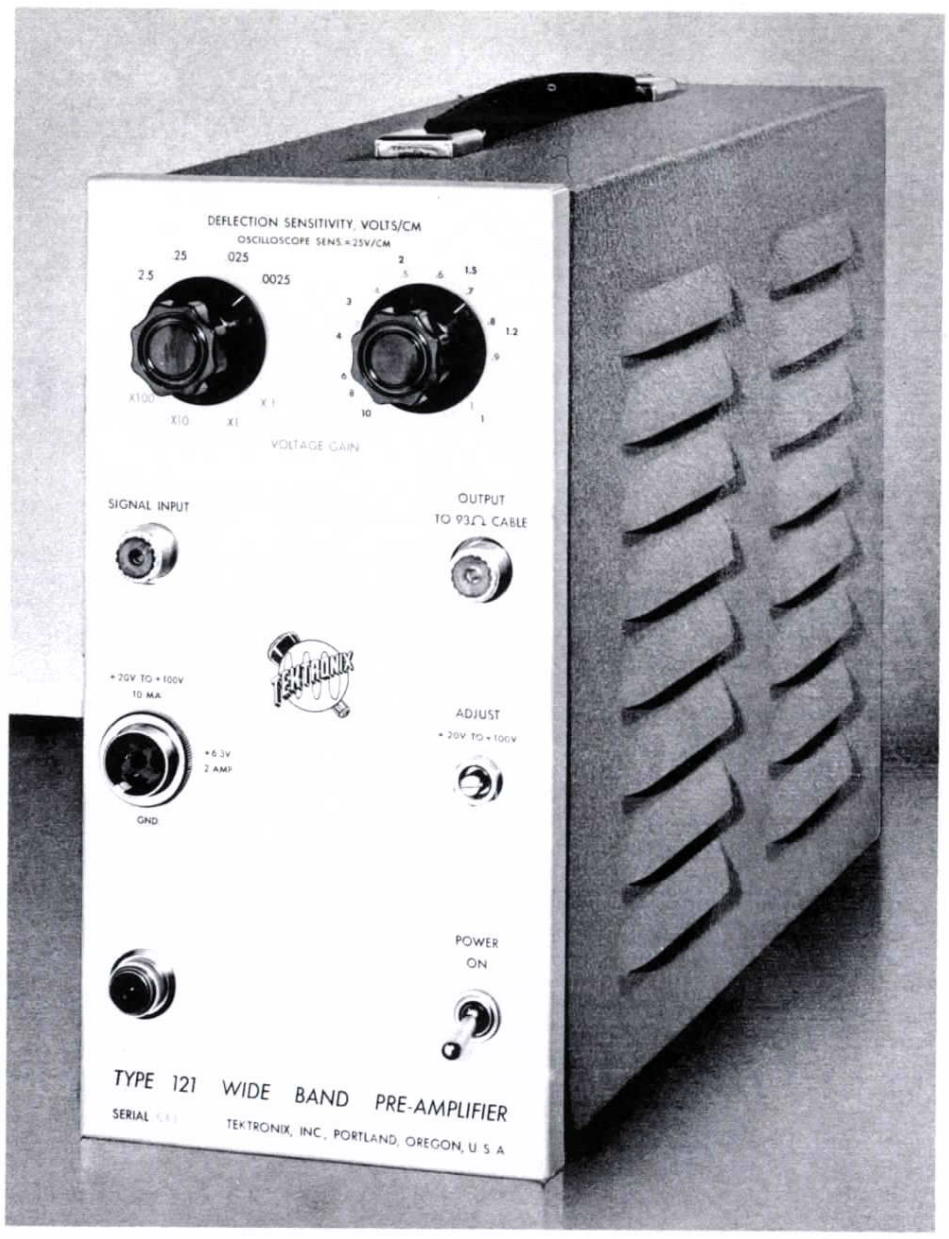
Wide-Band Preamplifier

Voltage Gain
0.01 to 100, continuously variable.

Frequency Response
5 cycles to 12 mc.

Transient Response
Less than 0.03-μsec risetime.

Maximum Output Voltage
3 v peak-to-peak in terminated 93-ohm cable.



GENERAL DESCRIPTION

The Tektronix Type 121 Wide-Band Preamplifier is a self-contained 3-stage ac-coupled amplifier especially well suited for increasing the sensitivity of the Type 511, 511A, 511AD Oscilloscopes and other applications where a voltage gain up to 100 is desired. Excellent output linearity is achieved on all input signals up to 0.03 v peak-to-peak. All plate circuits are operated on electronically-regulated dc supplies to provide stability against line-voltage fluctuations. To minimize the hum level, dc voltage is supplied to the heaters of the first two amplifier stages. In addition, the first three tubes are located on a shock-mounted chassis to minimize microphonic and drift effects. Cathode-follower output permits wide separation of preamplifier and oscilloscope. Power is available at the front panel for a cathode-follower probe.

CHARACTERISTICS

Voltage Gain—Continuously variable from 0.01 to 100 with four fixed calibrated ranges...0.1, 1, 10, and 100. When operated as a preamplifier for an oscilloscope into a deflection sensitivity of 0.25 v/cm, the Type 121 provides a complete range of sensitivity of 2.5 mv/cm to 25 v/cm without the use of oscilloscope attenuators.

Frequency Response—Primary emphasis has been placed on transient response. Risetime is less than 0.03 μsec; passband is 5 cycles to 12 mc.

Output Voltage—3 v peak-to-peak maximum in a terminated 93-ohm cable, permitting linear amplification of any input signal up to 0.03 v peak-to-peak. Phase inversion in the Type 121 results in the positive portion of the input signal causing a negative deflection at the output terminal. Output is via a cathode follower so a long separation of the preamplifier and oscilloscope, or other instruments, is possible.

Probe Power—20-100 v dc plate and 6.3 dc heater supplies are available at a front-panel connector for cathode-follower probe or special preamplifier use.

Regulated Power Supplies—Electronically-regulated dc supplies insure stable operation over line variations of 105-125 v.

Input Impedance—1 megohm paralleled by approximately 20 $\mu\mu$f.

VACUUM TUBE COMPLEMENT

First and second stage amplifiers	2	6CB6
Cathode follower gain control		6J6
Third stage amplifier		6AH6
Cathode follower output		6J6
Cathode follower voltage regulator		6J6
Rectifier	2	6X4
Voltage reference		5651
Comparator		12AX7
Regulator amplifier		6AU6
Series regulator	2	12B4

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis and cabinet.

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

Dimensions—5 ¾" wide, 11 ¼" high, 15" deep.

Weight—18 ½ pounds.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 80 watts.

Price **$265**

Includes: 1—P93B output cable
1—Instruction manual

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

TYPE 122 PREAMPLIFIER

Low-Level Preamplifier

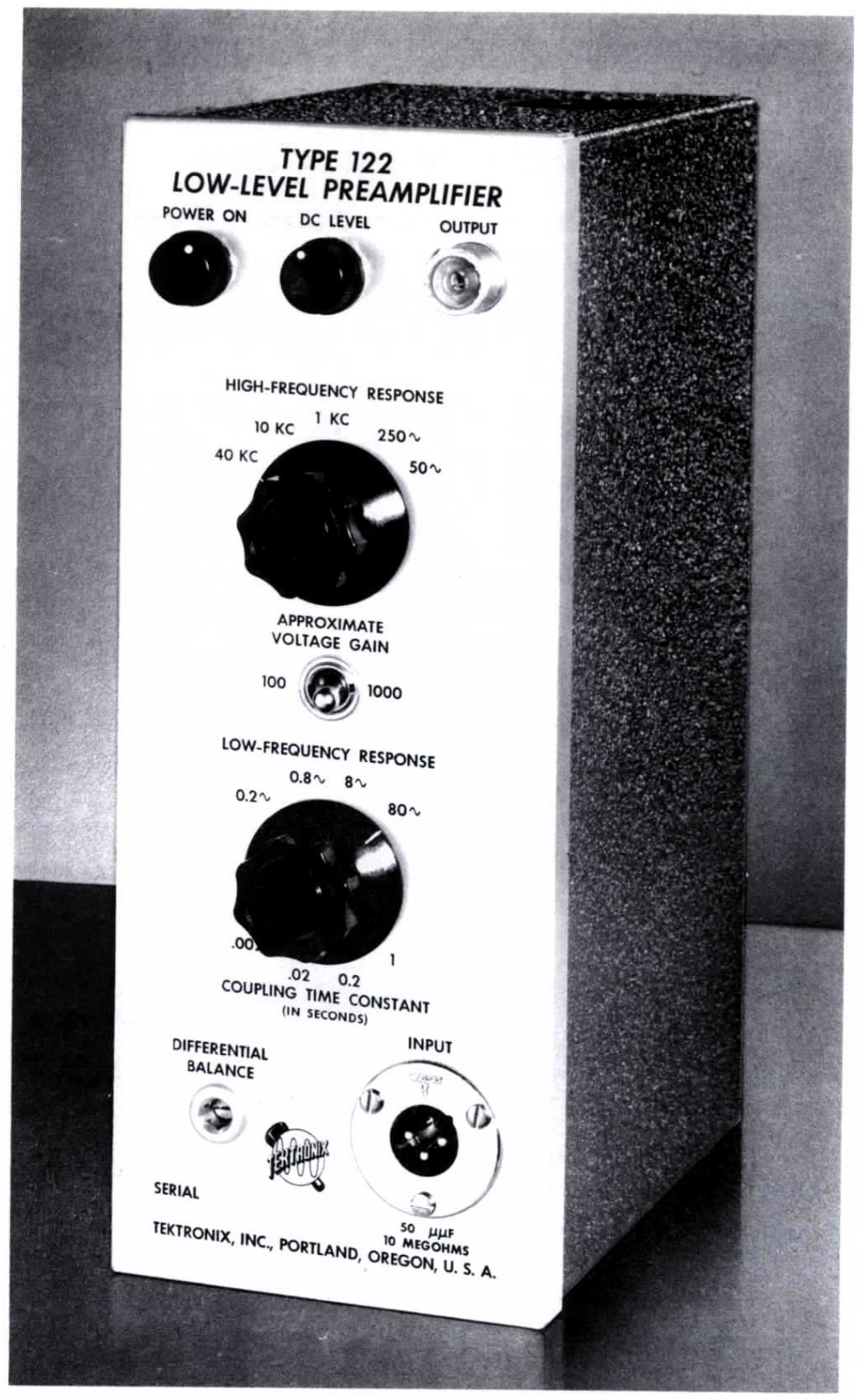
Voltage Gain
High position—approximately 1000.
Low position—approximately 100.

Frequency Response
0.16 cycles to 40 kc maximum.

Noise Level
4 μv rms maximum.

Output Voltage
Maximum 20 v (peak-to-peak).

Input Selection
Single ended or differential.



GENERAL DESCRIPTION

The Tektronix Type 122 Low-Level Preamplifier is a compact 3-stage battery-operated amplifier extending the usefulness of the oscilloscope into the microvolt region. The Type 122 is especially useful in biological research and other applications requiring the amplification of microvolt signals.

The Type 122 can be used with any dc-coupled oscilloscope, increasing its sensitivity by a factor of either 1000 or 100. When used with the Tektronix Type 512 Oscilloscope, sensitivity is increased to 5 μv/cm; with the Tektronix Type 360 Indicator, sensitivity is increased to 50 μv/cm. If the Type 122 is used with an ac-coupled oscilloscope, the overall low-frequency response will be limited to that of the oscilloscope.

Shock mounting, careful bypassing, and use of battery heater and plate-supply voltages reduce microphonics, noise, and hum to a low level.

CHARACTERISTICS

Frequency Response—Maximum passband is 0.16 cycles to 40 kc, with 5 high-frequency 3-db cutoff points . . . 50, 250 cps, 1, 10, and 40 kc; and 4 low-frequency 3-db cutoff points. . .0.2, 0.8, 8, and 80 cycles. Corresponding low frequency time constants are 1, 0.2, 0.02, and 0.002 seconds. High and low-frequency cutoff points are controlled by separate switches so a variety of frequency response characteristics can be obtained.

Rejection Ratio—80 to 100 db for in-phase signals from 5 cycles to 40 kc; maximum signal input is 10 v.

Voltage Gain—A toggle switch selects either a gain of 100 or 1000.

Signal Output—For a maximum signal input of 0.02 v (peak-to-peak) in high-gain position and 0.2 v (peak-to-peak) in low-gain position, maximum signal output is 20 v peak-to-peak. The output dc level is adjustable to zero for use on dc oscilloscopes. Output is via a cathode follower with impedance approximately 1000 ohms.

Input Impedance—With single-ended input, the impedance is 10 megohms paralleled by approximately 50 $\mu\mu$f. Impedance for differential input is 20 megohms paralleled by approximately 50 $\mu\mu$f.

Noise Level—Depending on the setting of the frequency response controls, the noise level is 1 to 4 microvolts rms.

TYPE 122 PREAMPLIFIER

VACUUM TUBE COMPLEMENT

Input amplifier . . . . . selected 12AX7
Second stage amplifier . . . . . selected 12AU7
Third stage amplifier and CF out . . . . . selected 12AU7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis and cabinet.

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

Dimensions—10⅝" high, 4½" wide, 7" deep.

Weight—5½ pounds.

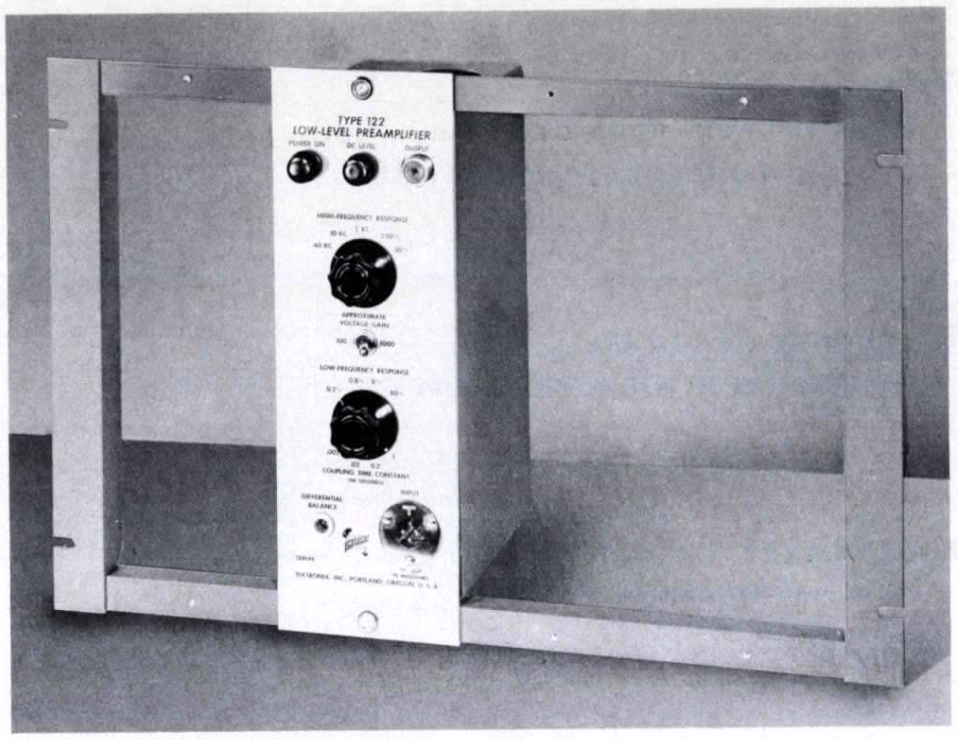
Power Requirements—Battery powered through a standard octal plug: +135 v at 5 ma, —90 v at 4 ma, and 6.3 v at 0.9 amp.

Type 122 . . . . . $85

Includes: 1—W122 battery cable (012009)
1—CON3P input plug
1—P93 output cable
1—Instruction manual

Type 122 Rack Mount—fits into standard 19" relay rack. Type 122 mounted horizontally on a panel ⅛" thick, with input connector at left side of panel. Height, 5¼".

Type 122 Rack Mount $90



Type 122 Frame Mount—fits vertically into special adapter frame FA160, or can be mounted in an existing support.

Type 122 Frame Mount $90

Currently Available Extras

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

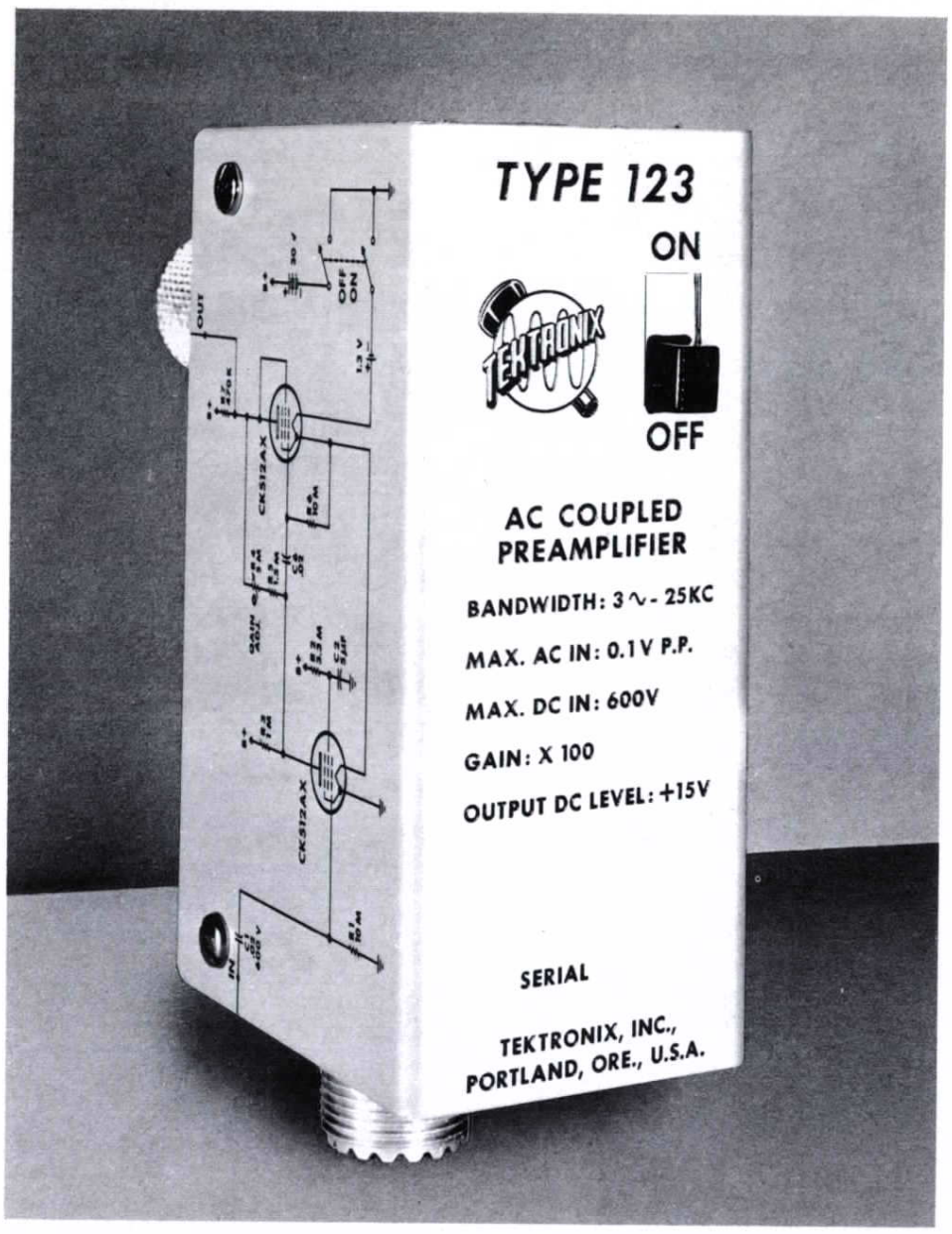
Recommended Additional Accessories

Type FA160 Adapter Frame adapts Type 122 Frame Mount to rack mounting. Mounts in standard rack and holds four of any combination of Type 122 Preamplifiers, Type 360 Indicators, and Type 160-Series Units . . . $5.00

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

TYPE 123 PREAMPLIFIER

Miniature Low-Level



Compact
3⅝" high, 1½" wide, 2-3/16" deep.

Weighs only 10 ounces.

Voltage Gain
Accurately set at 100 times.

Passband
Within 2% from 15 cycles to 6 kc.
Within 3 db from 3 cycles to 25 kc.

Maximum Input Signal
0.1 v peak-to-peak.

Hum-Free Low-Level Amplification
Powered by miniature batteries.

GENERAL DESCRIPTION

The Tektronix Type 123 Preamplifier is a compact, light-weight, battery-operated amplifier for use in applications where a gain of 100 without additional hum signal is desired. Passband is 3 cycles to 25 kc. Etched wiring, miniature tubes and small batteries are combined in a unit about the size of 2 king-size cigarette packages. Where reduced high-frequency response is permissible, ground-loop hum pickup can be virtually eliminated by mounting the Type 123 close to the circuit under observation. Coaxial uhf connectors permit the Type 123 to be connected directly to an oscilloscope or other instrument, and at reduced high-frequency response, in a connecting cable, or even for use as a probe. Shock-mounted chassis reduces the effects of microphonics, shift, and drift.

Applications of the Type 123 include practically anything in the audio range; for example, observing hum levels, transducer preamplifier, and other low-level applications where a gain of 100 is desired.

CHARACTERISTICS

Voltage Gain—Gain is 100, adjustable with screwdriver calibration control.

Passband—Within 3 db from 3 cycles to 25 kc. Within 2% from 15 cycles to 6 kc.

Battery Powered—A small mercury cell supplies the filament voltage and a miniature 30 v battery is the source of plate voltage. Life of the mercury cell is approximately 100 hours. Low plate current, 75 microamps, assures plate-supply battery life of more than 100 hours.

Noise Level—The maximum noise level with the input grounded is less than 7.5 microvolts, rms.

Output Signal Level—DC level of output is approximately +15 v.

Maximum Input Signal—Maximum input signal for linear amplification is 0.1 v, peak-to-peak.

Input Impedance—10 megohms.

Effective Output Impedance—31 kilohms.

Vacuum Tube Complement—Two Type 512AX sub-miniature filament-type pentodes.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy cover and etched-wiring chassis.

Finish—Photo-etched anodized front panel.

Dimensions—3⅝" high, 4⅛" including uhf connector; 1½" wide; 2-3/16" deep, 3¾" including uhf connector.

Weight—10 ounces.

Power Requirements—One 1.345 v mercury cell and one 30 v miniature battery, included with the instrument.

Price **$50**
Includes: 1—Mercury cell
1—B battery

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

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

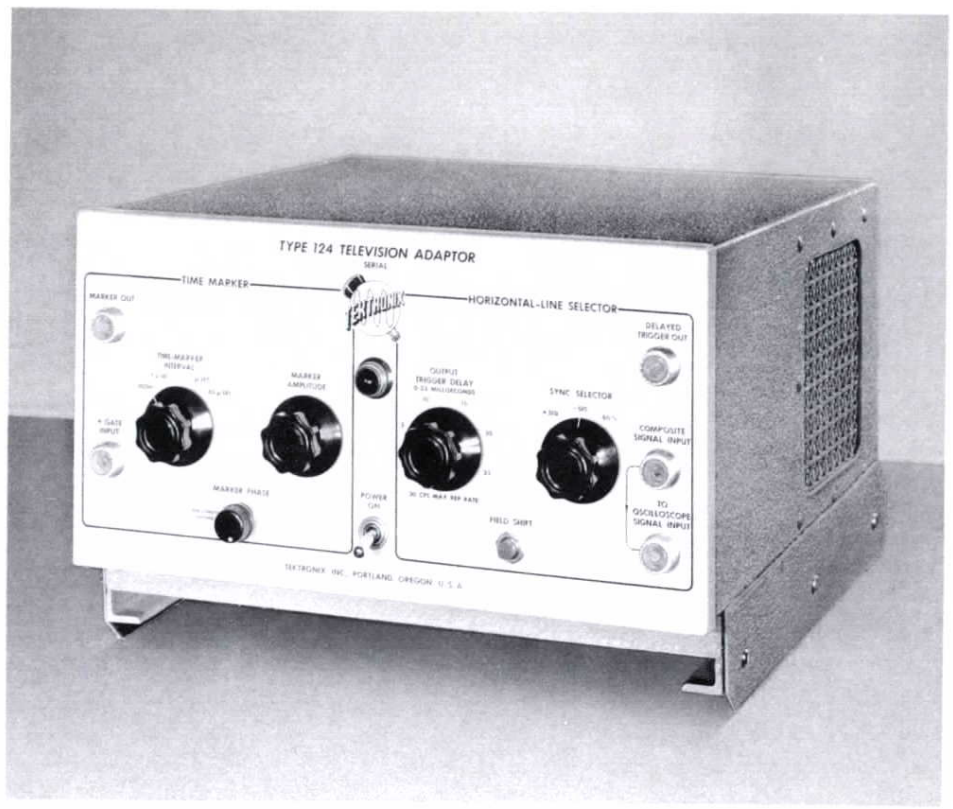
Sync separator and delayed trigger circuitry permit triggering the oscilloscope at any selected line of a field.

Field Shift

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

Gated Time Markers

Intensity markers of 1 μsec, 0.1 μsec, 0.05 μsec 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 μsec, 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 μsec, 0.1 μsec, 0.05 μsec, 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

MECHANICAL SPECIFICATIONS

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—6¾" high, 12¾" wide, 12½" deep.

Weight—21 lbs.

Construction—aluminum alloy.

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

Power requirements—105-125 v or 210-250 v, 50-60 cycles, 120 watts.

Price $295

Includes: 1—FM124 Mounting frame (014003)
4—Connecting cables
1—Instruction manual

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

TYPE 130 L,C METER

Direct-Reading Inductance and Capacitance Meter

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

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.

Load Resistance Limits—The following loads will not appreciably alter the indication:

Capacitance, 0.1 megohm shunt.
Inductance, 20 k shunt, 10 ohms series.

A table included in the instruction manual provides corrections for increased loads.

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

MECHANICAL SPECIFICATIONS

Construction—Aluminum alloy.

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

Size—5" wide, 9" high, 8½" deep.

Weight—9 lbs.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 40 watts.

Price $195

Includes: 1—P93C probe (010003)
1—W130R lead (012015)
1—W130B lead (012014)
1—Instruction manual

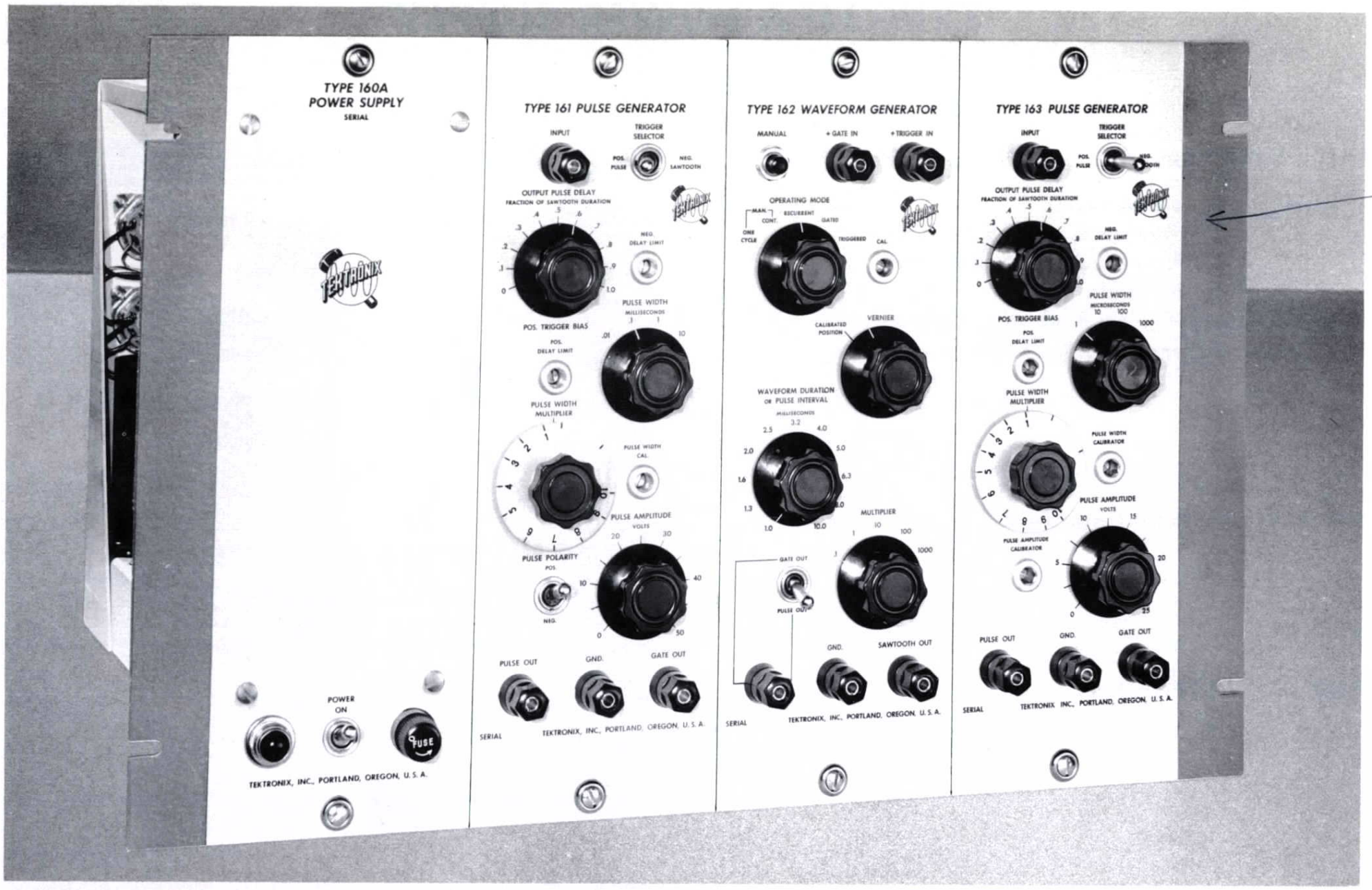
Recommended Additional Accessories

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.

TYPE 160-SERIES WAVEFORM GENERATOR

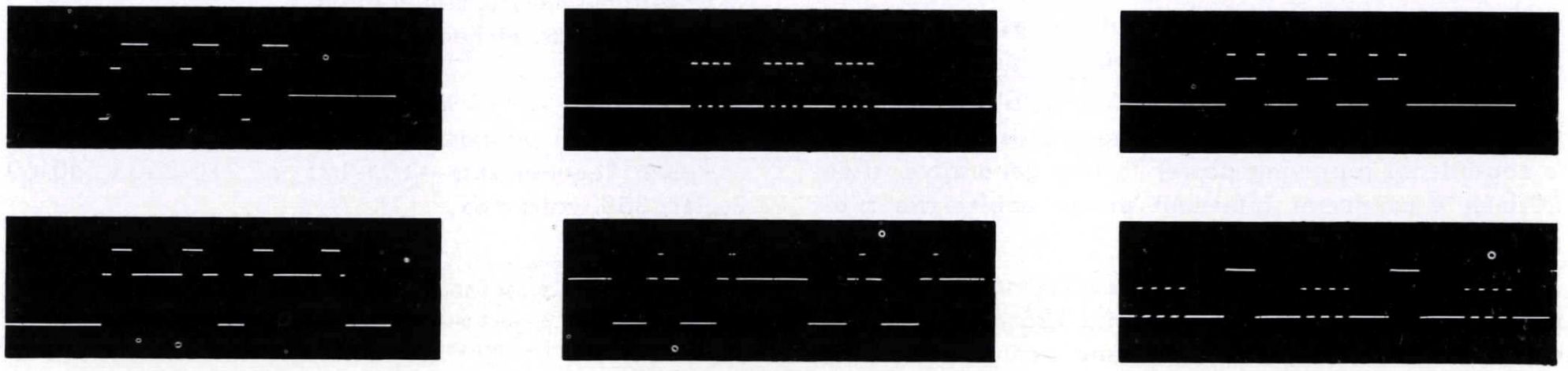


FA
160

The Tektronix Type 160-Series produces timed pulses of adjustable duration, amplitude and repetition rate, providing a convenient and flexible system of sequence control. By using several instruments together, complex waveform patterns can be obtained. Applications of the Type 160-Series are numerous. . .various combinations are being used for nerve stimulation in neurophysical experiments, timed gating devices for complex equipment, component testing, biophysical and geophysical applications. The Type 360 Indicator unit, described in the oscilloscope section, takes the place of an auxiliary oscilloscope and can be used to measure the response time and nature of the response to an electrical pulse generated by the Type 160-Series instruments.

The Type 160A Power Supply will supply power to one Type 360 Indicator unit along with a combination of four to six generators. The Type 161 or Type 163 Pulse Generators can be used to gate one or more Type 162 Waveform Generators, and the Type 162 can be used to trigger several Type 161 or Type 163 Pulse Generators. By using combinations of the generators, a wide variety of waveforms can be produced.

The Type 160-Series is adaptable to rack mounting by means of an adaptor frame. Any combination of four instruments can be placed in the frame at any one time.



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

TYPE 160-SERIES WAVEFORM GENERATOR

TYPE 160A POWER SUPPLY

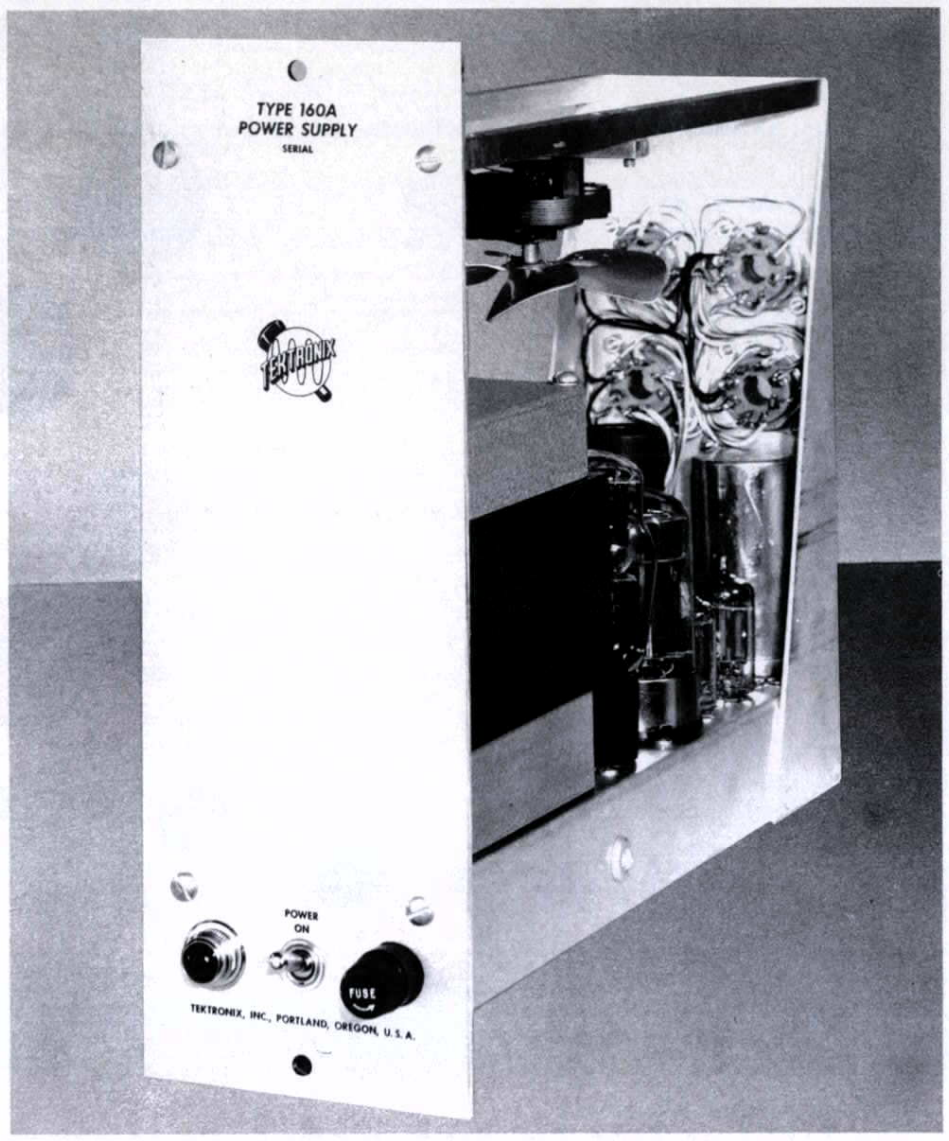
Large Load Capacity

+300 v dc, unregulated.
+225 v dc, regulated, at 225 milliamps.
+150 v dc, regulated, at 15 milliamps.
+ 80 v dc, unregulated.
—170 v dc, regulated, at 125 milliamps.
6.3 v ac, unregulated, at 20 amps.

Electronic Voltage Regulation

Four Output Terminals

Conveniently located at rear of chassis.



GENERAL DESCRIPTION

The Tektronix Type 160A Power Supply provides the required voltages and currents for one Type 360 Indicator unit and a combination of four to six generators. As many as seven Type 161, or seven Type 162, or five Type 163, or five Type 360 units can be supplied by one Type 160A.

The currents listed above for the +225 and —170 volt supplies are available only with series regulator external shunt resistors as provided in the individual units.

The output terminals consist of four octal sockets, conveniently located at the rear of the chassis. Each socket is capable of supplying power to two generators. Two 20-inch 8-conductor inter-unit power cables are supplied.

Electronic voltage regulation compensates for line-voltage variations between 105 and 125 v, and for current-demand differences of generators connected to the power supply.

VACUUM TUBE COMPLEMENT

Rectifiers	3	5V4
Regulator amplifiers		6AU6
Amplifier and series regulator		6AW8
Series regulator		6080
Series regulator	2	12B4
Amplifier and series regulator		6U8
Voltage reference		5651

MECHANICAL SPECIFICATIONS

Ventilation—Forced air cooling.

Mounting—Adapted to rack mounting by Tektronix Type FA160 Mounting Frame.

Construction—Aluminum alloy.

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

Dimensions—4 1/8" wide, 12 1/4" high, 13 3/4" deep.

Weight—21 pounds.

Power Requirements—105-125 or 210-250 v, 50-60 cycles, 350 watts max.

Price $140

Includes: 2—W160-20 connecting cables (012016)
1—Set mounting screws and cup washers
1—Instruction manual

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

TYPE 160-SERIES WAVEFORM GENERATOR

TYPE 161 PULSE GENERATOR

Output Waveforms

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

Output Characteristics

Duration—calibrated, continuously variable, 10 μsec to 0.1 sec.
Delay—calibrated, continuously variable, 0 to 100% of triggering sawtooth waveform.
Risetime—less than 0.5 μsec, overshoot less than 5%.

Amplitude

Gate—fixed, 50 v positive, peak-to-peak.
Pulse—calibrated, continuously variable, 0 to 50 v, peak-to-peak.

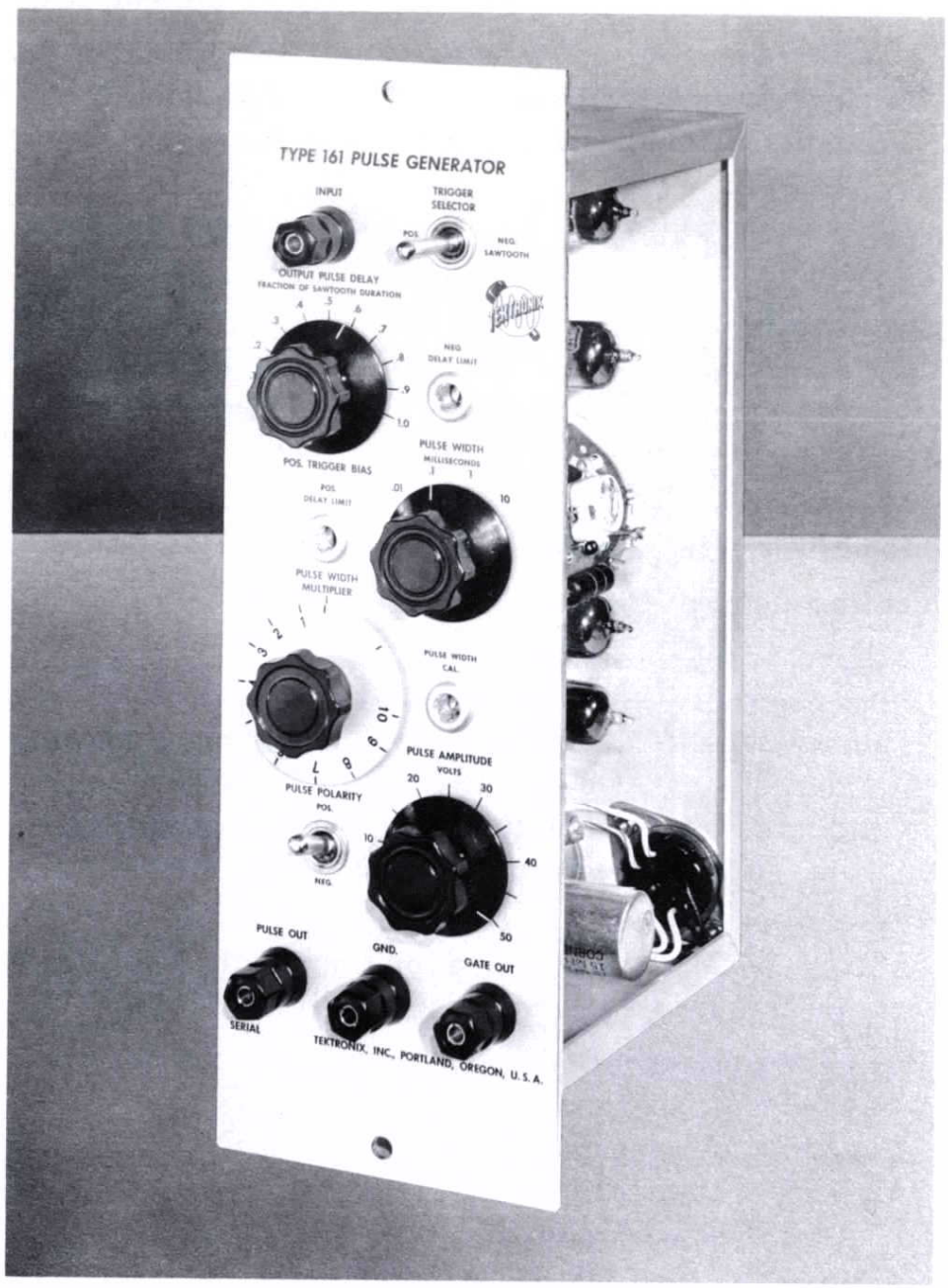
Cathode-Follower Outputs

Trigger Requirements

Positive pulse, 2-volt peak-to-peak minimum. Negative-going positive sawtooth, with a minimum rate of change of 15 v/sec. Maximum repetition rate, 50 kc.

Power Requirements

—170 v dc at 17 ma.
+225 v dc at 22 ma.
6.3 v dc at 1.1 amps.



GENERAL DESCRIPTION

The Tektronix Type 161 Pulse Generator produces calibrated rectangular output pulses of adjustable duration and amplitude 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 161.

When triggered by a negative-going sawtooth, the time of occurrence of the output pulse and gate can be adjusted to any point throughout the duration of the sawtooth. A calibrated control indicates the output delay as a fraction of the triggering sawtooth duration. Pulse and gate width in milliseconds, and pulse amplitude in volts are also indicated by calibrated controls.

When a positive pulse is used to trigger the generator, the same output waveforms are available, and the delay control functions as a triggering-level control.

Voltages necessary to operate the Type 161 can be obtained from a Tektronix Type 160A Power Supply. As many as seven 161 units can be powered by a single Type 160A unit.

VACUUM TUBE COMPLEMENT

Comparator	12AU7
Regenerative amplifier	12AT7
Coupling diode and one-half monostable multivibrator	12AT7
Second-half multivibrator and positive pulse amplifier	12AT7
Negative pulse amplifier	6J6

MECHANICAL SPECIFICATIONS

Mounting—Adapted to rack mounting by the Tektronix Type FA160 Mounting Frame.
Construction—Aluminum alloy.
Finish—Photo-etched anodized panel, etched chassis.
Dimensions—4 1/8" wide, 12 1/4" high, 7 1/2" deep.
Weight—5 pounds.

Price $95

Includes: 1—W160-10 connecting cable (012017)
1—Set mounting screws and cup washers
1—Instruction manual

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

TYPE 160-SERIES WAVEFORM GENERATOR

TYPE 162 WAVEFORM GENERATOR

Output Waveforms

Positive pulse, positive gate, and negative-going sawtooth.

Output Characteristics

Repetition Rate—0.1 cycles to 10 kc for recurrent operation.

Duration—pulse, 10 μsec to 0.05 sec, gate and sawtooth, 100 μsec to 10 sec.

Amplitude

Pulse and gate—50 volts positive from ground.

Sawtooth—decreases uniformly with time from +150 volts to +20 volts.

Risetime

Pulse—1 μsec, approximately, minimum.

Cathode-Follower Outputs

Trigger Requirements

Positive pulse—8 volts peak-to-peak minimum.

Sine wave—6 volts rms, frequency between 5 cycles and 50 kc. At frequencies below 5 cycles, the product of rms voltage times frequency must exceed 10.

Gate—8 volts, peak-to-peak minimum.

Triggering Means

Externally derived electrical pulse or gate, front-panel push button, or automatic recurrent operation.

Power Requirements

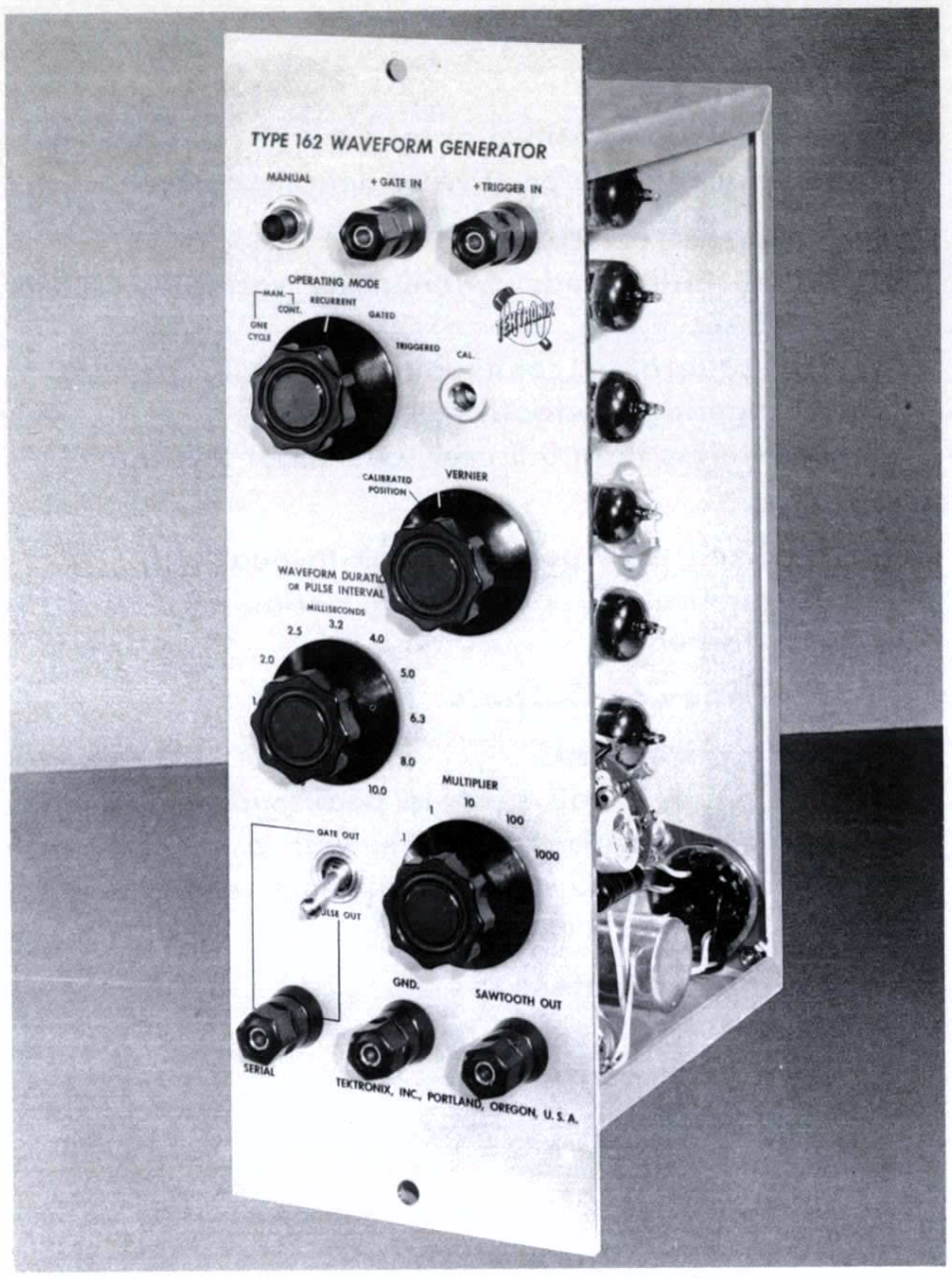
−170 v dc at 7 ma.
+150 v dc at 1 ma.
+225 v dc at 28 ma.
6.3 v dc at 1.7 amps.

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 by means of an externally derived electrical impulse, or by front-panel push button. The Tektronix Type 161 or 163 Pulse Generator is an excellent source for the triggering signal.

The output pulse and gate waveforms have an amplitude of 50 volts with a minimum risetime of approximately one microsecond. The sawtooth waveform is a positive voltage decreasing uniformly from +150 volts to +20 volts. Waveform duration is measured by a calibrated control and the shortest pulse duration is approximately 10 μsec.

The Type 162 is designed to operate as a delay generator in conjunction with the Type 161 or Type 163 Pulse Generator and to supply a sweep voltage for the Type 360 Indicator unit. It is useful for initiating chains of events electrically, and for controlling the duration of their occurrence and repetition rate. When generating waveforms recurrently it functions as a stable repetition-rate generator.



Voltages necessary to operate the Type 162 can be obtained from a Type 160A Power Supply. As many as seven Type 162 units can be powered by a single Type 160A unit.

VACUUM TUBE COMPLEMENT

Regenerative trigger	12AU7
Trigger amplifier and one-half multivibrator	12AU7
Multivibrator and pulse and gate shaper	12AU7
Phantastron	6BH6
Pulse and gate amplifier and sawtooth cathode follower	12AU7
Pulse and gate cathode follower and catching diode	12AU7

MECHANICAL SPECIFICATIONS

Mounting—Adapted to rack mounting by Tektronix Type FA160 Mounting Frame.

Construction—Aluminum alloy.

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

Finish—Photo-etched anodized panel, etched chassis.

Weight—5 pounds.

Price **$95**

Includes: 1—W160-10 connecting cable (012017)
1—Set mounting screws and cup washers
1—Instruction manual

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

TYPE 160-SERIES WAVEFORM GENERATOR

TYPE 163 FAST-RISE PULSE GENERATOR

Output Waveforms

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

Output Characteristics

Risetime—less than 0.2 μsec (without load capacitance).
Decay Time—0.2 μsec (without load capacitance).
Overshoot—can be adjusted to zero.
Duration—calibrated, continuously variable, 1 μsec to 10,000 μsec.
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

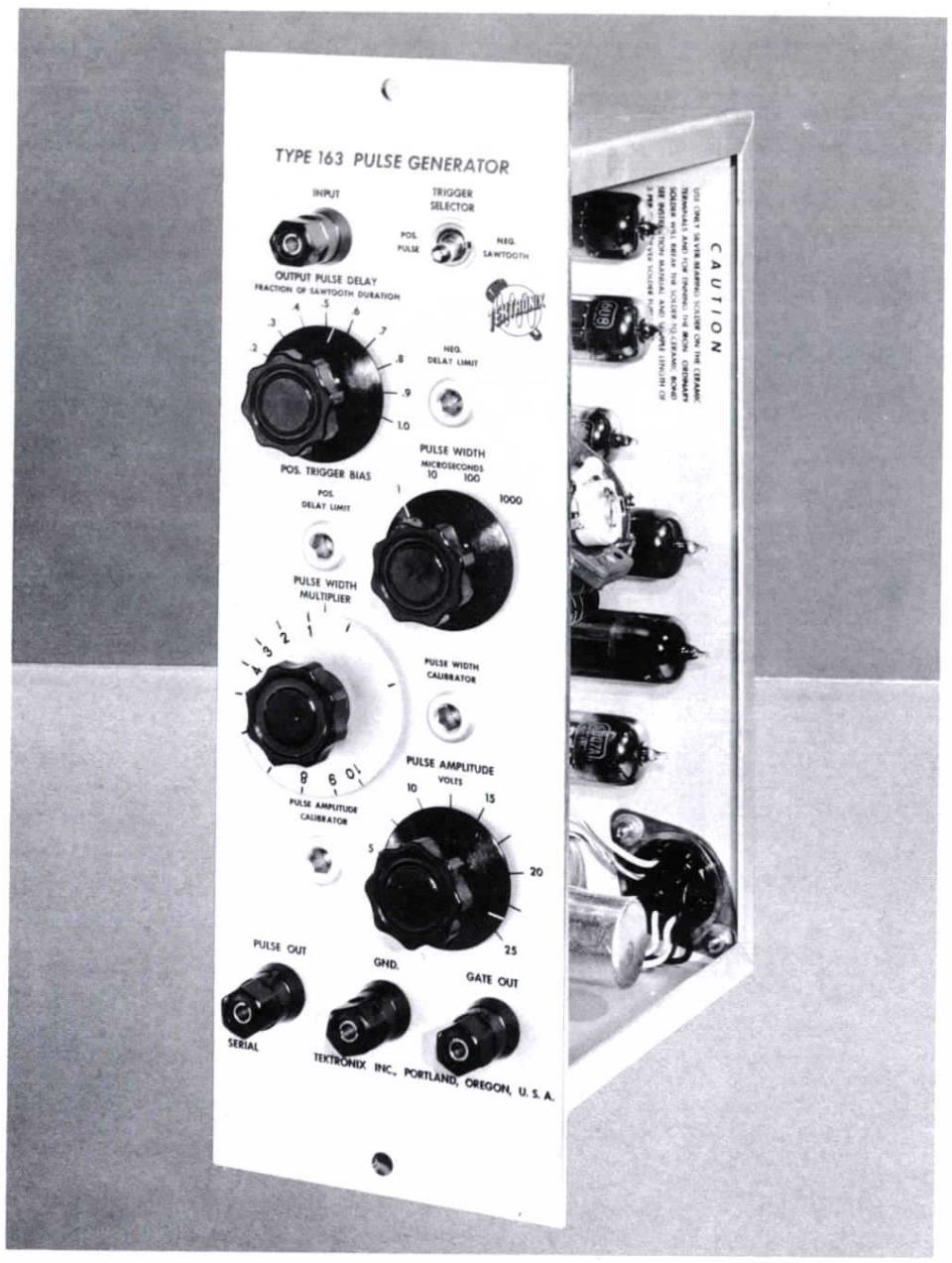
Pulse—from arm of variable cathode resistor.
Gate—from top of same resistor.

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 dc at 26 ma..
+225 v dc at 45 ma.
6.3 v ac at 3.6 amp.



GENERAL DESCRIPTION

The Tektronix Type 163 Pulse Generator produces rectangular pulses of less than 0.2 μsec 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-μsec duration is generated.

Voltages necessary to operate the Type 163 may be obtained from a Tektronix Type 160A Power Supply. As many as five Type 163 units can be powered by a single Type 160A 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		6BQ7A

MECHANICAL SPECIFICATIONS

Mounting—Adapted to rack mounting by the Tektronix Type FA160 Mounting Frame.
Construction—Aluminum alloy.
Finish—Photo-etched anodized panel, etched chassis.
Dimensions—4 1/8" wide, 12 1/4" high, 7 1/2" deep.
Weight—5 pounds.

Price $95

Includes: 1—W160-10 connecting cable (012017)
1—Set mounting screws and cup washers
1—Instruction manual

Recommended Additional Accessories

Type FA160 Adaptor Frame adapts Type 160 Series to rack mounting. Holds four Type 160-Series Units. .$5.00

Type FAP160 Blank Panel, 4 1/8" x 12 1/4", covers openings in frame-mounted sets of Type 160-Series instruments $3.00

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

TYPE 180 TIME-MARK GENERATOR

Versatile Timing Source

13 Time-Mark Intervals
Two per decade from 1 μsec to 1 sec, available separately or in various combinations as a timing comb.

Three Sine-Wave Frequencies
5 mc, 10 mc, and 50 mc.

Six Trigger-Rate Frequencies
1, 10, 100 cycles, 1, 10, 100 kc.

Accuracy Within 0.03%
Stability of 2 ppm available in Type 180-S1.

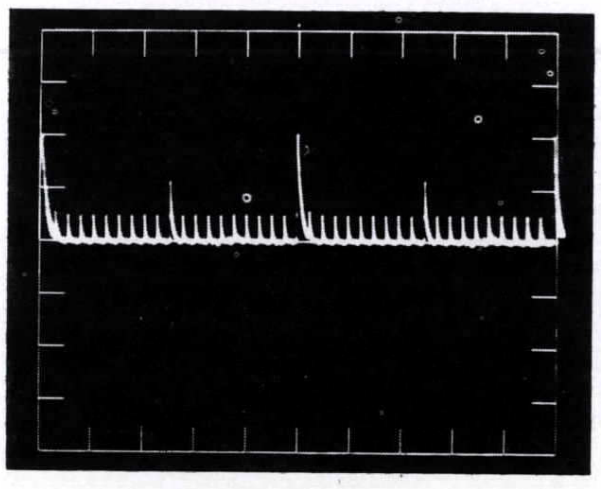
GENERAL DESCRIPTION

The Type 180 Time-Mark Generator is a high-quality source of time markers, sine waves and trigger impulses. Thirteen time markers, 3 sine-wave frequencies and 6 trigger-rate frequencies provide instrument versatility for countless numbers of applications in the laboratory or on the production line. With its frequency accuracy of 0.03%, the Type 180 is an ideal calibrating source for oscilloscope sweeps, oscillators, counters. It can also be used as a time-measuring instrument and as a trigger-rate generator. Markers can be presented separately or mixed into a timing-comb combination. For applications requiring a frequency stability of 2 ppm over a 24-hour period, the Type 180-S1 is available.

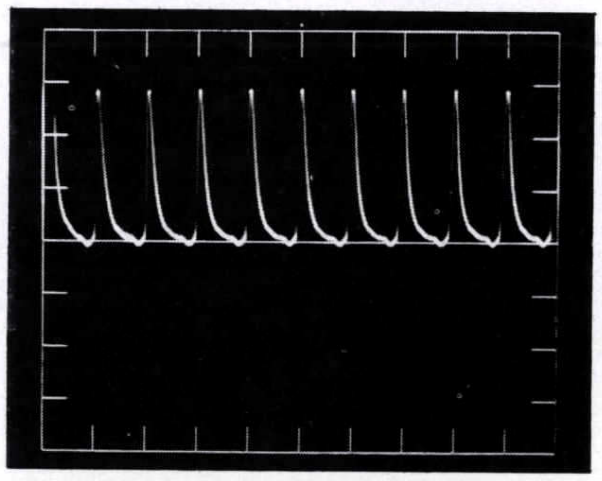
CHARACTERISTICS

Time Markers—Time markers occur at intervals of 1, 5, 10, 50, 100, 500 μsec, 1, 5, 10, 50, 100, 500 millisec, and 1 sec. Markers are available separately and simultaneously through pin jacks at 15 to 30 v amplitude, or mixed into a timing combination through a toggle-switch arrangement and available at a coaxial connector at 1 to 3 v.

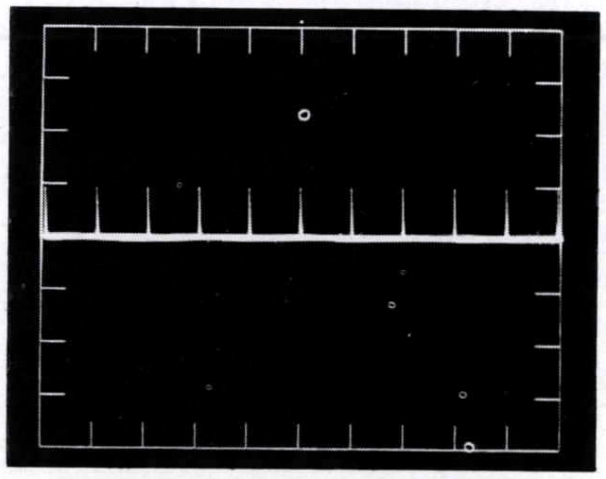
Sine Waves—The SIGNAL SELECTOR switch connects the sine-wave frequencies of 5 mc, 10 mc or 50 mc to the output connector. Each sine wave is also available at a separate coaxial connector. Output is approximately 3 volts.



Timing Comb



1-μsec Marker



1-msec Marker

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

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 μsec	1 v	300 ohms	0.04 μsec	20 v	400 ohms
5 μsec to 50 μsec	1 v	600 ohms	0.08 μsec	15 v	400 ohms
100 μsec to 1 sec	3 v	600 ohms	0.3 μsec	30 v	600 ohms
Trigger Pulses					
1, 10, 100 cycles,					
1, 10 kc	9 v	200 ohms	0.2 μsec		
100 kc	3 v	200 ohms	0.2 μsec		
Sine Waves	(across 52 ohms)				
5, 10, 50 mc	3 v	30 ohms			

Trigger-Rate Generator—Trigger-rate frequencies of 1, 10, 100 cycles, 1, 10, and 100 kc are derived from the dividing multivibrators. Output is through a front-panel coaxial connector.

Stability—All outputs are derived from a 1-mc crystal-controlled oscillator with a frequency tolerance of about 0.03% and a short-time stability, after initial warmup, of about 0.005% per hour. For applications requiring greater stability, the Type 180 is available with the crystal mounted in a temperature-stabilized oven. (The Type 180 is then designated Type 180-S1.) Stability is within 2 parts per million over a 24-hour period.

Regulated Power Supply—Electronically-regulated dc supplies insure stable operation over line variations from 105-125 v, 50-60 cycles.

VACUUM TUBE COMPLEMENT

Oscillator and buffer		6U8
Frequency multipliers	3	6AH6
Cathode follower		12AU7
Clamp and clipper diode		6AL5
Amplifier and CF		12AT7
Divider multivibrators	2	12AT7
Divider multivibrators	10	12AU7
Coupling diode and clamp	12	6AL5
Marker cathode follower	3	12AU7
Marker cathode follower	10	6C4
Trigger shaper and CF		12AU7
Rectifier		6X4
Series regulator	2	6AQ5
Series regulator		6AS7
Regulator amplifier	3	6AU6
Voltage comparator		12AX7
Voltage reference		5651

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures safe operating temperature.

Construction—Aluminum-alloy chassis and cabinet.

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

Dimensions—10 1/8" wide, 16 1/2" high, 14 7/8" deep.

Weight—37 pounds.

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

Price **$575**

Includes: 2—P93 output cables
1—A100 clip-lead adapter
1—Instruction manual

Type 180-S1—The 1-mc crystal is mounted in a temperature-stabilized oven. Frequency stability over a 24-hour period is within 2 parts per million.

Price **$625**

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

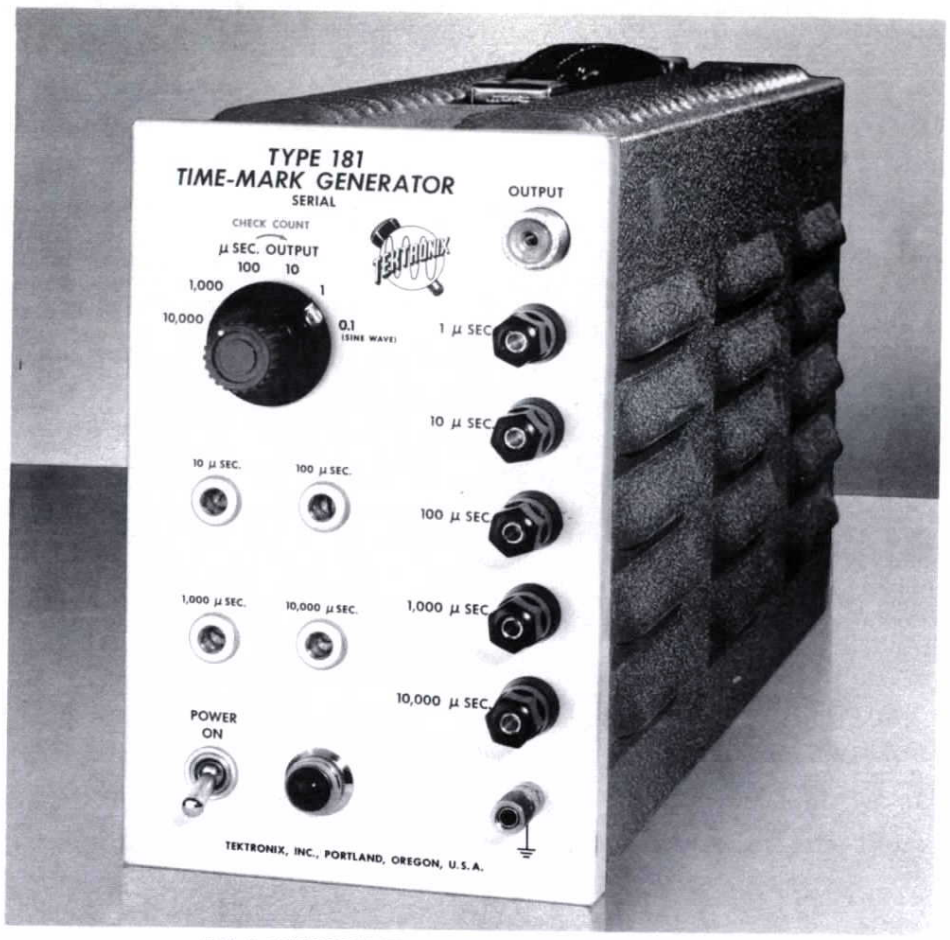
TYPE 181 TIME-MARK GENERATOR

A Portable, Accurate Time-Mark Source

Five Time-Mark Intervals
1, 10, 100, 1000, and 10,000 microseconds, plus 10-mc sine wave.

Small Size
8 ¾ " high, 5 ⅝ " wide, 17 ½ " deep.

Low Weight
Only 17 ½ pounds.



GENERAL DESCRIPTION

The Type 181 provides accurate markers that can be displayed on an oscilloscope for sweep calibration or comparison time measurements. All six outputs are available at a common coax connector through use of a selector switch. The five time-markers are also available separately at front-panel binding posts for convenient utilization as trigger impulses, or for other purposes.

All outputs are derived from a 1-mc crystal-controlled oscillator with a frequency tolerance of about 0.03% and a short time stability, after initial warmup, of about 0.005% per hour. For applications requiring greater stability, a directly interchangable crystal is available. This plug-in accessory crystal is mounted in a temperature-controlled oven, and provides a stability of 2 parts per million over a 24-hour period. When this Type CO181 crystal-oven combination is installed at the factory, the instrument is designated Type 181-S1.

OTHER CHARACTERISTICS

Nominal Output Values

Marker	Amplitude	Risetime	Impedance
0.1 μsec	2 v	sine wave	150 ohms
1 μsec	2 v	0.05 μsec	80 ohms
10 μsec	2 v	0.13 μsec	80 ohms
100 μsec	2 v	0.2 μsec	80 ohms
1000 μsec	2 v	0.4 μsec	80 ohms
10,000 μsec	2 v	0.4 μsec	80 ohms

Regulation—DC voltages are electronically regulated.

Power Requirements—105 to 125 or 210 to 250 volts, 50 to 60 cycles, 100 watts.

VACUUM TUBE COMPLEMENT

Oscillator		6AU6
Shaper and multiplier		6AN8
Buffer and amplifier		6AN8
Disconnect and limiting diodes	4	6AL5
Frequency dividers	4	6BQ7A
Output CF	2	12AU7
Rectifier		6AX5
Rectifier		6X4
Voltage reference		5651
Regulator amplifiers	2	6AU6
Series regulators	2	12B4

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel, gray wrinkle cabinet.
Size—8 ¾ " high, 5 ⅝ " wide, 17 ½ " deep.
Weight—17 ½ pounds.

Type 181 ..... **$225**
Includes: 1—P93 output cable
1—W130B lead (012014)
1—W130R lead (012015)
1—Instruction manual

Type 181-S1 (Type CO181 Crystal-oven Combination installed) **$245**

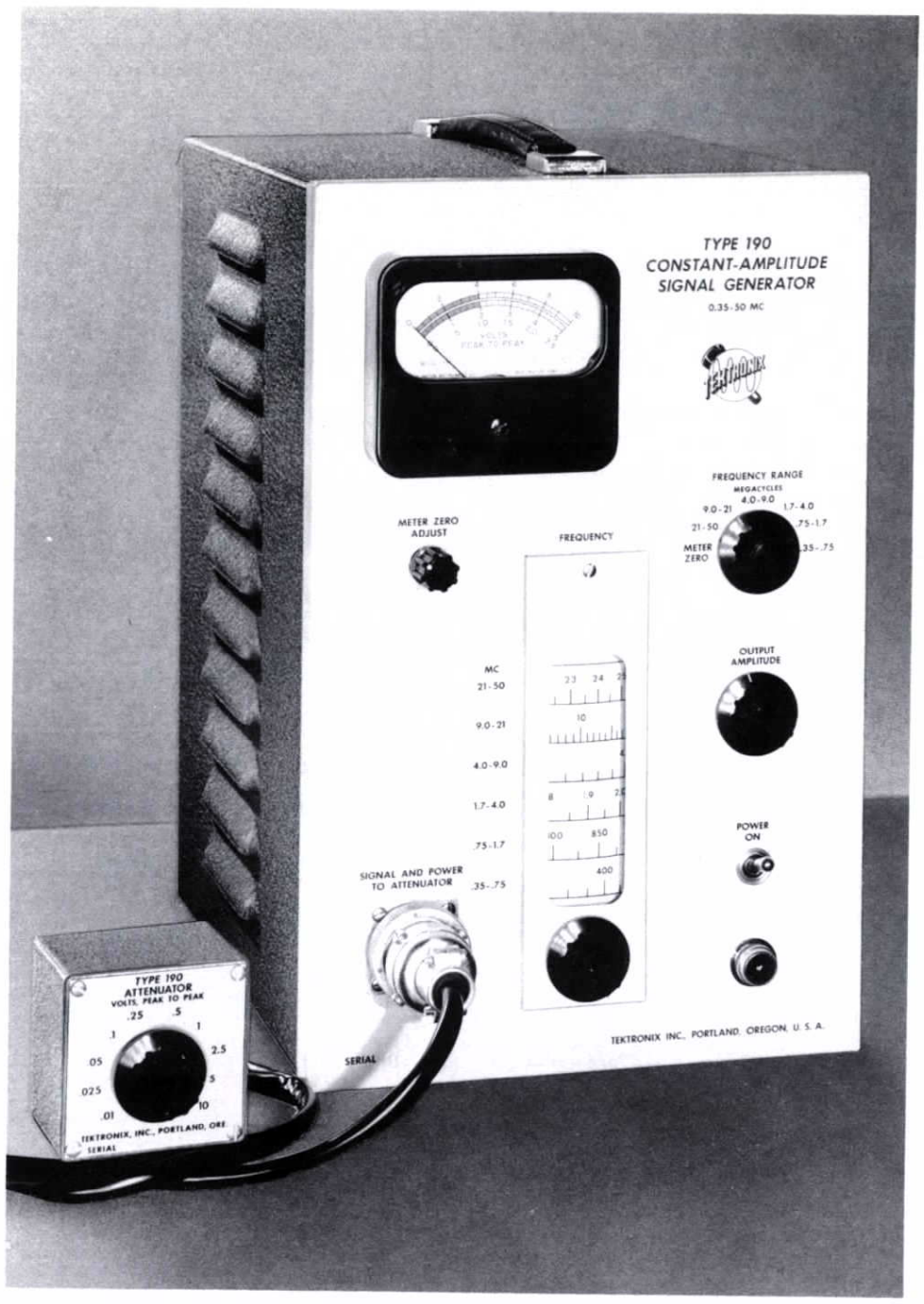
Recommended Additional Accessories

Type CO181 Crystal-Oven Combination—A 1-mc crystal mounted in a temperature-stabilized oven. Directly interchangeable with standard crystal. Plugs into crystal socket of the Type 181—no wiring changes necessary. Provides a frequency stability of 2 ppm over a 24-hour period $27.00

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

TYPE 190 SIGNAL GENERATOR

Constant-Amplitude Signal Generator



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.

Distortion

At attenuator settings of 5 volts or lower, less than 5% total harmonic content; less than 3% above 2 mc.

Output Impedance

52 ohms.

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 wide-band 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.

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

MECHANICAL SPECIFICATIONS

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—105-125 v, or 210-250 v, 50-60 cycles, 100 watts.

Price $275

Includes: 1—Attenuator unit
1—36" connecting cable
1—Instruction manual

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

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 310 OSCILLOSCOPE

DC-Coupled Portable Cathode-Ray Oscilloscope

Designed for Easy Handling
Small—10" x 6¾" x 17".
Weighs only 23½ pounds.

Transient Response
Risetime—0.09 μsec.

Sensitivity
DC to 4 mc—0.1 v/div.
2 cycles to 3.5 mc—0.01 v/div.

Sweep Range
0.1 μsec/div to 0.6 sec/div.

Versatile Triggering
Internal, external, line. . . ac or dc-coupled, and AUTOMATIC TRIGGERING.

GENERAL DESCRIPTION

The Tektronix Type 310 is fully capable of performing much of your laboratory work, yet has the physical characteristics desirable for work away from your bench. It handles easily and fits into tight spots, simplifying field maintenance of complex electronic equipment. The high performance of the Type 310 can help you speed up your field work. . . its low weight and small size can ease your equipment handling problem.

Complete accessibility to tubes and components is maintained by a unique step-chassis construction, hinged at the rear. Accurate calibration and excellent linearity permit reliable quantitative measurements—you read time and amplitude directly from the screen. Functional panel design and versatile control system contribute to operator convenience, making this new oscilloscope an easy-to-use field and laboratory instrument.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—Main amplifier passband is dc to 4 mc at calibrated sensitivities of 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 v/div. Low-frequency response is limited to 2 cycles when the AC-DC switch is in the AC position. An ac-coupled preamplifier switched in by the sensitivity control provides three additional calibrated sensitivities of 0.01, 0.02, and 0.05 v/div, at a frequency response of 2 cycles to 3.5 mc. A 3-to-1 variable control provides for continuously-variable sensitivity from 0.01 v/div to 150 v/div. Vertical amplifier is factory-adjusted for optimum transient response. Risetime is less than 0.09 μsec. Input impedance is 1 megohm paralleled by approximately 40 μμf.

Calibration Accuracy—An adjustment is provided for setting the vertical-amplifier gain. When accurately set on any one step, all other steps will be within 3% of the panel reading.

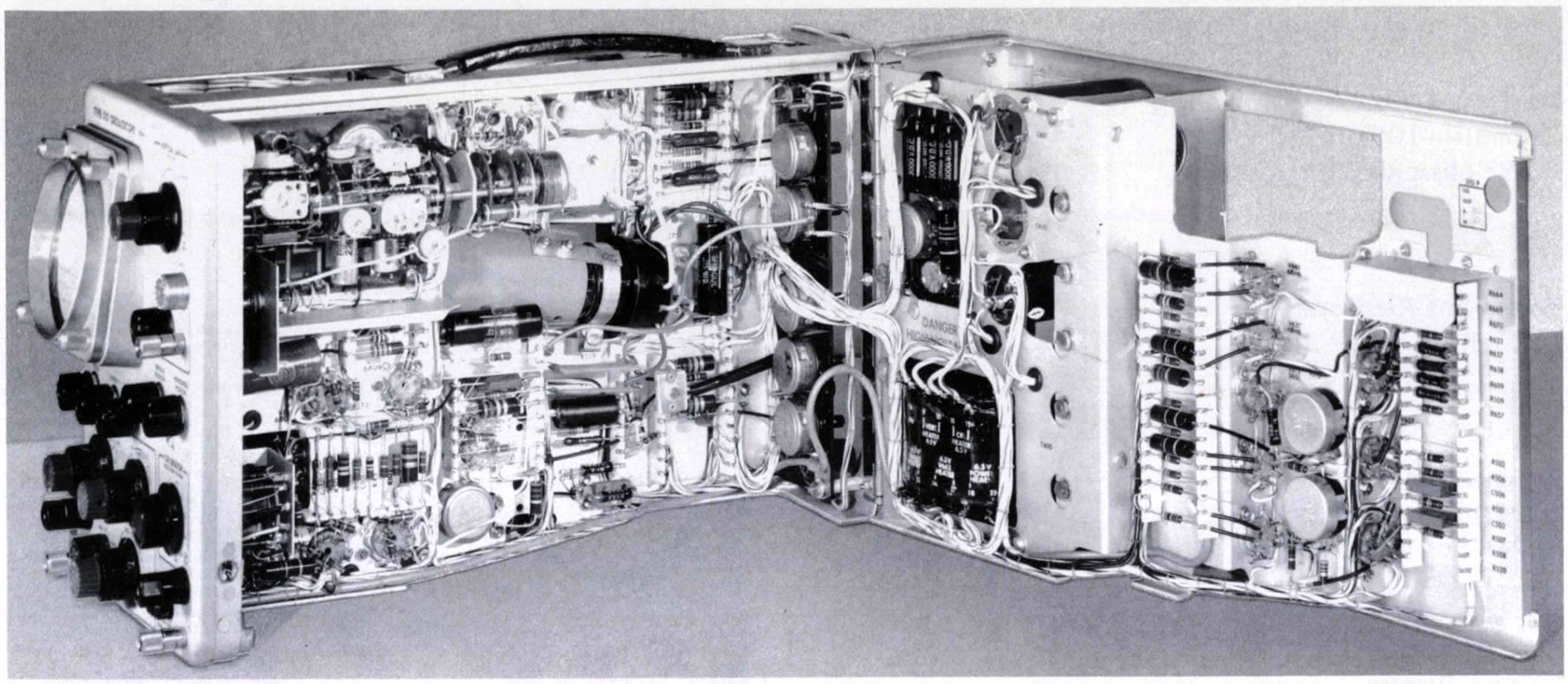
Probe—The vertical sensitivity is reduced by a factor of ten by use of the small, insulated, 10x attenuator probe furnished with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 13 μμf.

HORIZONTAL DEFLECTION SYSTEM

Wide Sweep Range—18 calibrated, fixed sweeps, accurate within 3%, are provided. Calibrated sweeps are: 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500 μsec/div, . . . 1, 2, 5, 10, 20, 50 millisec/div, . . . 0.1, 0.2 sec/div. A variable uncalibrated control provides a continuous sweep range from 0.5 μsec/div to 0.6 sec/div.

Sweep Magnifier—Sweep magnification is obtained by increasing the gain of the sweep-output amplifier

TYPE 310 OSCILLOSCOPE



by a factor of 5. The center 2-division portion of the trace is expanded to 10 divisions. The HORIZONTAL POSITION control has sufficient range to display any one-fifth of the magnified sweep. The 5x magnifier applied to the 0.5-μsec/div sweep extends the calibrated range to 0.1 μsec/div. Accuracy of the 5x sweep magnifier is within 3% on all ranges except the 0.5 μsec/div range where accuracy is within 5%.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the control grid of the cathode-ray tube. This assures uniform bias for all sweep speeds and repetition rates.

Automatic Triggering—With the control in the 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 approximately a 50-cycle rate, providing a reference trace on the screen.

Trigger Selection—A concentric control permits triggering from either the positive or negative slopes of internal, external, or line-voltage signals; and selection of ac or dc-coupling through the triggering circuits, or automatic triggering.

Triggering Level—The TRIGGERING LEVEL control selects the amplitude level where triggering occurs. It permits triggering the sweep at a selected level on simple or complex waveforms.

Trigger Requirements—Internal triggering—a signal large enough to produce a one-half division deflection. External—a signal of 0.2 v to $\pm$20 v.

Horizontal Input—A back-panel terminal permits use of an external signal to drive the horizontal amplifier. Sensitivity is 1.2 v/div.

OTHER CHARACTERISTICS

Voltage Calibrator—A square-wave voltage is available through a front-panel binding post. Eleven fixed voltages—0.05, 0.1, 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 about 1 kc.

Accelerating Potential—1.85 kv accelerating potential, electronically regulated, is applied to the flat-faced 3WP2 cathode-ray tube.

Regulated Power Supply—Electronically-regulated dc supplies insure stable operation over line variations between 105-125 v, 60 to 800 cycles..

Illuminated Graticule—The edge-lighted graticule has 8 vertical and 10 horizontal ¼-inch divisions. Illumination is controlled by a front-panel knob. An appropriate filter is provided to increase contrast when viewing in a brightly-lighted room.

Hinged Chassis—The Type 310 opens up to permit easy accessibility to all tubes and components.

Front-Panel Light—A jewel light indicates when the vertical-sensitivity and sweep-speed controls are set in uncalibrated positions.

VACUUM TUBE COMPLEMENT

Vertical preamplifier		6AU6
Pre-amp cathode follower		6BH6
Vertical input amplifier	2	6AU6
Driver cathode follower		6BQ7
Vertical output amplifier	2	6CL6
Internal trigger cathode follower		6BH6
Trigger amplifier		6U8
Trigger shaper		6U8
Holdoff cathode followers		12AT7
Minus multivibrator		6BH6
Plus multivibrator	½	6BQ7

TYPE 310 OSCILLOSCOPE

Unblanking cathode follower	½	6BQ7
Disconnect diodes		6AL5
Sweep generator	½	6AN8
Sweep generator cathode follower	½	6AN8
Horizontal amplifier cathode follower	½	6BQ7
Horizontal output amplifier		6BQ7
External horizontal input cathode follower	½	6BQ7
Calibrator multivibrator		6AN8
Calibrator output cathode follower		6BH6
Voltage reference		5651
Regulator amplifiers	3	6BH6
Series regulators	3	12B4
High-voltage oscillator		6AQ5
High-voltage regulator		12AT7
High-voltage rectifiers	2	5642
Cathode-ray tube		3WP2

MECHANICAL SPECIFICATIONS

Construction—Self-contained, cabinet and chassis made of aluminum alloy. New mechanical techniques improve accessibility to components and tubes.

Finish—Photo-etched anodized front panel, shadow blue hammertone finished cabinet.

Dimensions—10" high, 6¾" wide, 17 long.

Weight—23½ pounds.

Power Requirements—105-125 v, 60 to 800 cycles, 175 watts.

Type 310 (105-125 v, 60 to 800 cycles) **$595**

Includes: 1—P510A attenuator probe
1—A510 binding-post adapter
1—Green filter (378509)
1—Instruction manual

Type 310-S1—Operates on 105-125 or 210-250 v, 50 to 800 cycles. Weight 25½ pounds.

Price **$595**

Currently Available Extras

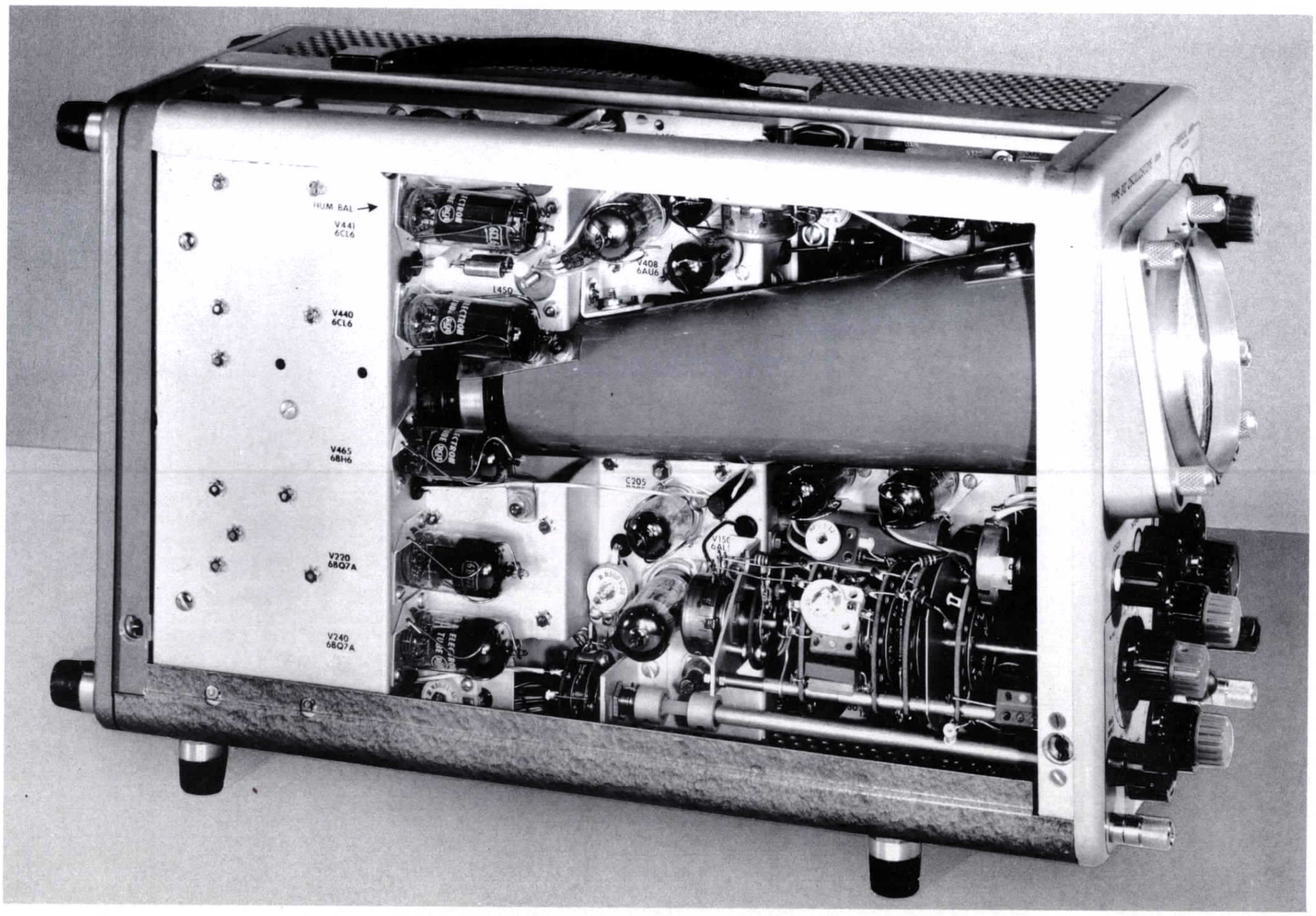
P2 crt phosphor normally furnished.
P1, P7, P11 optional. . . . . .No extra charge

Recommended Additional Accessories

FB 310 Fan Base—Provides filtered forced-air ventilation to assure safe operating temperature when the Type 310 is being used continuously over long periods, or in a hot or limited-ventilation area. The fan base tilts the oscilloscope to a convenient viewing angle. For use on 105-125 v, 60 cycle only. $25.00

FB 310-S1 Fan Base—For use on 210-250 v, 50 to 60 cycles only $25.00

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



TYPE 315D OSCILLOSCOPE

DC-Coupled Portable Cathode-Ray Oscilloscope

Passband

DC-Coupled—dc to 5 mc.
AC-Coupled—5 cycles to 5 mc.

Transient Response

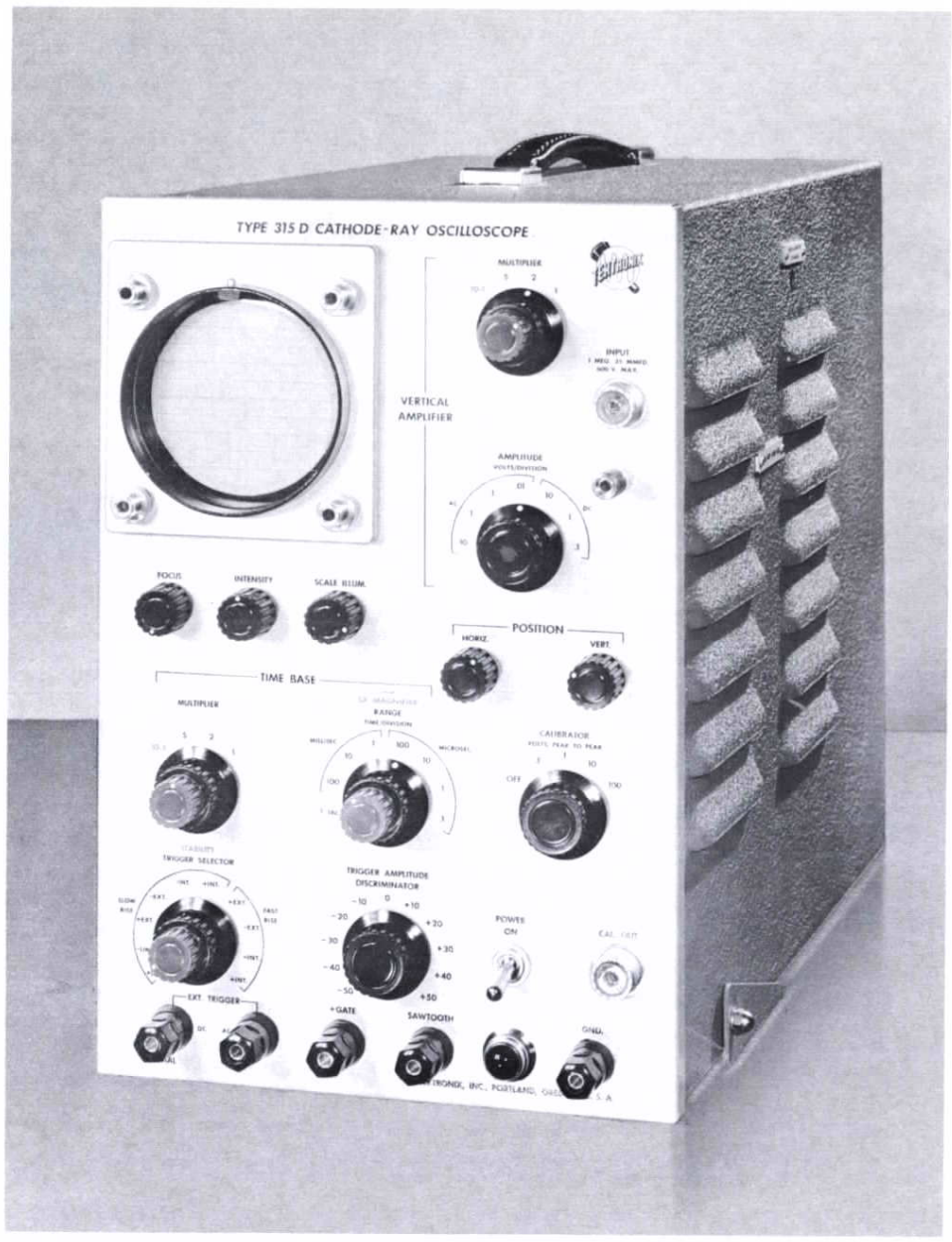
Risetime—0.07 μsec

Calibrated Sensitivity

DC-Coupled—0.1 v/div to 50 v/div.
AC-Coupled—0.01 v/div to 50 v/div.

Calibrated Sweep Range

0.1 μsec/div to 5 sec/div.



GENERAL DESCRIPTION

The Tektronix Type 315D combines small size with laboratory-oscilloscope capabilities. Wide sweep range adapts it to a great many applications, including those requiring very slow sweeps. Pulse observation is facilitated by the less than 0.07-μsec risetime of the vertical amplifier, the 0.25-μsec signal delay, and high-speed sweeps. Sensitivity and sweeps are calibrated for accurate amplitude and time readings directly from the screen. A 3" flat-faced cathode-ray tube displays a sharp image of sufficient size for easy interpretation. The Type 315D is an excellent general-purpose laboratory oscilloscope that is easily transported to temporary setups and remote installations.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—A seven-position vertical-input switch covers the calibrated ranges of 0.01, 0.1, 1, 10 v/div ac-coupled and 0.1, 1, 10 v/div dc-coupled. AC-coupled passband is 5 cycles to 5 mc, dc-coupled passband is dc to 5 mc. Multipliers of 1, 2, and 5 provide 9 calibrated dc-coupled and 12 calibrated ac-coupled ranges. Continuously variable sensitivity from 0.01 v/div to 100 v/div is provided by a 10-to-1 variable control. The vertical amplifier is factory adjusted for optimum transient response. Risetime is less than 0.07 μsec and input impedance is 1 megohm paralleled by approximately 35 $\mu\mu$f.

Calibration Accuracy—A front-panel screwdriver adjustment sets the vertical amplitude calibration. When accurately set on any one range, all other steps will fall within 3% of the panel reading.

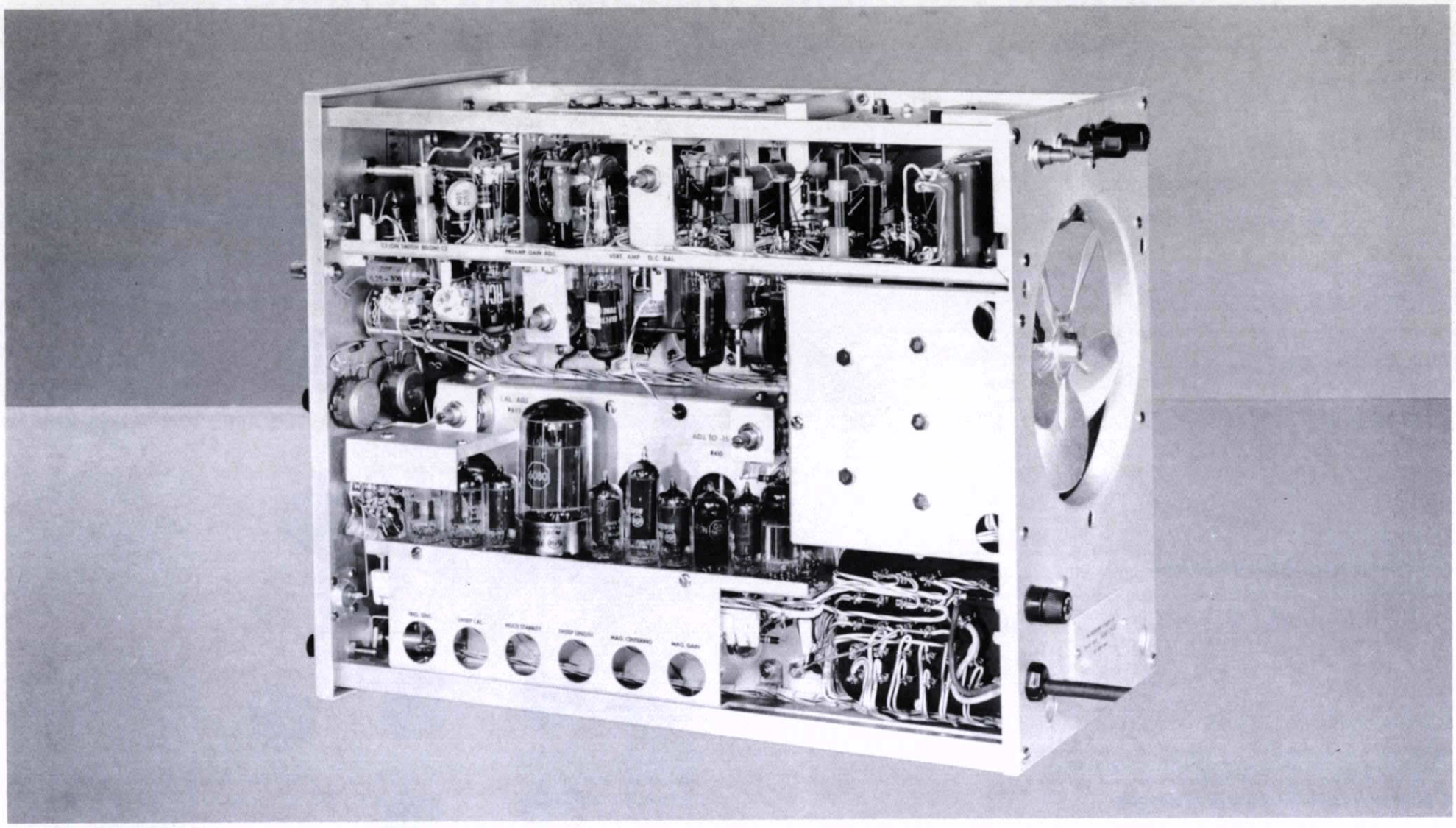
Probe—The vertical sensitivity is reduced by a factor of ten by use of the small, insulated 10x attenuator probe furnished with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 13 $\mu\mu$f.

Signal-Delay Network — Delays vertical signal 0.25 μsec. Permits observation of the waveform that triggers the sweep.

HORIZONTAL DEFLECTION SYSTEM

Wide Sweep Range—An 8-position range switch and a 1, 2, 5, multiplier switch provide 24 calibrated time bases, 3 per decade, from 0.1 μsec/div to 5 sec/div. A 10-to-1 variable control fills in between steps, providing a continuous uncalibrated sweep range from 0.1 μsec/div to 10 sec/div. Calibration accuracy is within 3% on all ranges except 0.1, 0.2, 0.5 μsec/div, 1, 2, 5 sec/div ranges where the accuracy is within 5%.

TYPE 315D OSCILLOSCOPE



Sweep Magnifier—Sweep magnification is obtained by increasing the gain of the output amplifier by a factor of 5. The center 2-division portion of the trace is expanded to the left and right of center to 10 divisions. The HORIZONTAL POSITION control has sufficient range to display any one-fifth of the magnified sweep. Sweep magnification of 5x is accurate for all settings of the sweep-speed controls slower than 0.5 μsec/div.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the control grid of the cathode-ray tube, assuring uniform bias for all sweep speeds and repetition rates.

DC-Coupled Trigger Amplitude Discriminator—The amplitude level on a waveform where triggering occurs is selected by the TRIGGER AMPLITUDE DISCRIMINATOR control. The sweep can be triggered at various levels on simple or complex waveforms. The flexibility of this system permits the sweep to 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 waveform portion to trigger the sweep, either from the signal under observation or from an external source; and use of either a fast or slow-rise waveform for a trigger. Selection of either the positive or negative-going portion of the line-voltage waveform is also available.

Trigger Requirements—Internal triggering—a signal large enough to produce a one-half division deflection. External—a signal of 0.2 v to ±20 v.

OTHER CHARACTERISTICS

Voltage Calibrator—A square-wave voltage is available through a front-panel uhf connector. Four fixed voltages—0.1, 1, 10 and 100 volts peak-to-peak—are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

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

Accelerating Potential—1.85-kv accelerating potential, electronically regulated, is applied to the flat-faced 3WP2 cathode-ray tube.

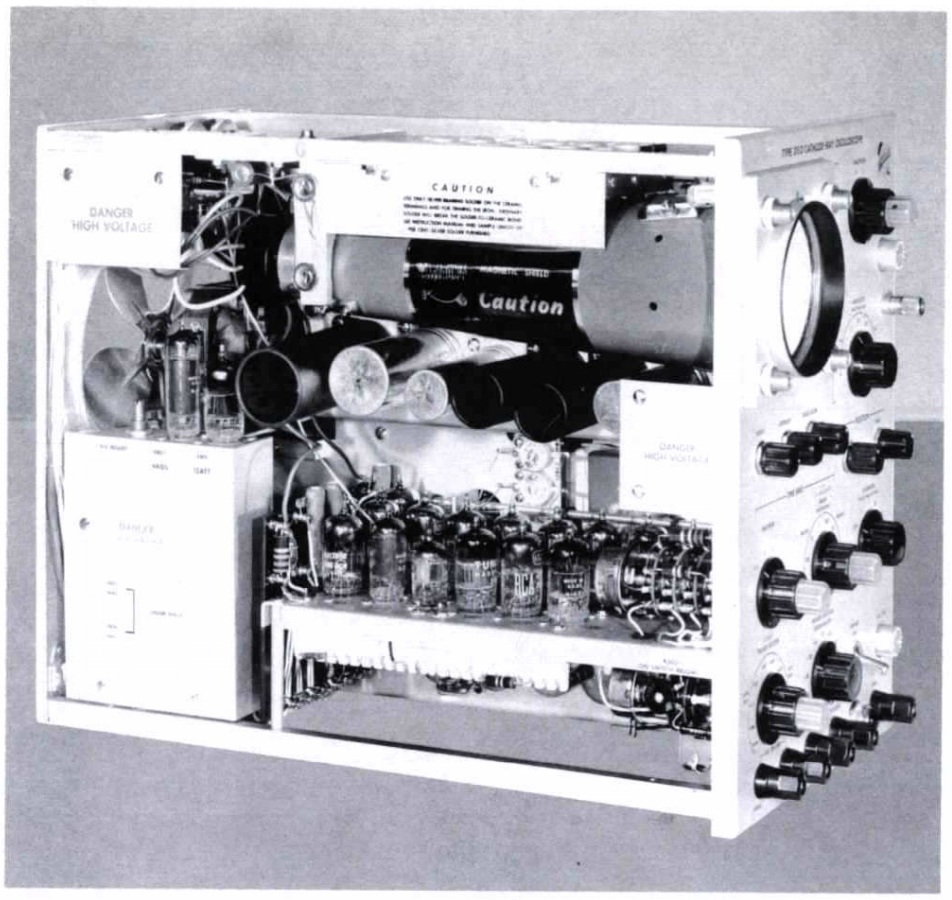
Regulated Power Supply—All dc voltages are electronically regulated to insure stable operation over line variations from 105 to 125 v.

Illuminated Graticule—The edge-lighted graticule has 8 vertical and 10 horizontal quarter-inch divisions. Illumination is controlled by a front-panel knob. An appropriate filter is provided to increase contrast when viewing in a brightly-lighted room.

VACUUM TUBE COMPLEMENT

Vertical input preamplifier		6BQ7A
Preamplifier and cathode follower		6BQ7A
Vertical amplifier input		6CL6
Amplifier, delay line driver		6CL6
Cathode followers		6BQ7A
Vertical output amplifiers	4	12BY7
Trigger phase inverter		12AT7

TYPE 315D OSCILLOSCOPE



Trigger shaper multivibrator		6U8
Trigger amplifier		6BQ7A
Trigger CF and holdoff CF		6BQ7A
Clamp diode and trigger holdoff		12AT7
Unblanking CF and buffer CF		6BQ7A
Cascode multivibrators	2	6BQ7A
Multi reverting CF and constant current tube		12AT7
Gate out CF and sweep clamping CF		6U8
Disconnect diodes		6AL5
Sweep generator		6AK6
Sweep out CF and sweep position CF		6BQ7A
Driver CF and sawtooth out CF		6BQ7A
Sweep amplifier and sweep out CF	2	6BQ7A
Cal multivibrator		12AU7
Cal clipper and output CF		12AT7
Voltage reference		5651
Regulator amplifiers	4	6AU6
Series regulators	2	12B4
Series regulator		6AS5
Series regulator		6080
High-voltage oscillator		6AQ5
High-voltage regulator		12AT7
High-voltage rectifiers	2	5642
Cathode-ray tube		3WP2

MECHANICAL SPECIFICATIONS

Construction—Self-contained, chassis and cabinet made of aluminum alloy.

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

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

Dimensions—12 3/8" high, 8 5/8" wide, 15 7/8" deep. Maximum depth including knobs and air filter, 18 1/4".

Weight—36 pounds.

Power Requirements—105-125 or 210-250 volts, 50-60 cycles, 375 watts. The ability of the Type 315D to operate on power-line frequencies up to 800 cycles is limited only by the type of ventilating fan used. The Type 315D 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 advantage of being quieter and requiring very little maintenance. For operation on power-line frequencies of 50 to 800 cycles, a dc ventilating fan motor and selenium rectifier are used in place of the shaded-pole ac motor. The Type 315D then carries the additional designation of S1. When the Type 315D is ordered for use on power-line frequencies from 50 to 800 cycles (designated Type 315D-S1), it must be stated on the order.

Type 315D Cathode-Ray Oscilloscope—For use on 105-125 or 210-250 v, 50-60 cycles only. . . . **$770**

Includes: 1—P510A attenuator probe
2—A510 binding-post adapters
1—F310-5 green filter (378505)
1—Instruction manual

Type 315D-S1 Cathode-Ray Oscilloscope—For use on 105-125 or 210-250 v, 50-800 cycles. **$785**

Type 315D-S2 Cathode-Ray Oscilloscope—For use in PTM systems. Includes a front-panel controlled trigger circuit permitting direct, stable triggering from the sync pulse group with these general characteristics:

Rep rate. . . . . 9 to 17 kc (12 or 24 channels)
Sync group. . 4 pulses, 0.5 μsec wide, spaced 0.8 μsec
Channel pulses. . . . . 0.5 μsec wide, spaced 3.85 μsec

Type 315D-S2 . . . . . $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

P2 crt phosphor normally furnished.
P1, P7, P11 crt phosphor optional. . . . No extra charge

Recommended Additional Accessories

MU15 Fan Motor Kit—For converting Type 315D for use on 50-800 cycle line frequency (Type 315D-S1). Contains brackets, selenium rectifier, dc fan motor, and fan blade. Price. $22.50

MS15 Fan Motor Kit—For converting Type 315D-S1 for use on 50-60 cycle line frequency (Type 315D). Contains brackets, ac fan motor and fan blade.

Price $7.50

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

TYPE 315R OSCILLOSCOPE

Rack-Mounting 3-Inch Oscilloscope

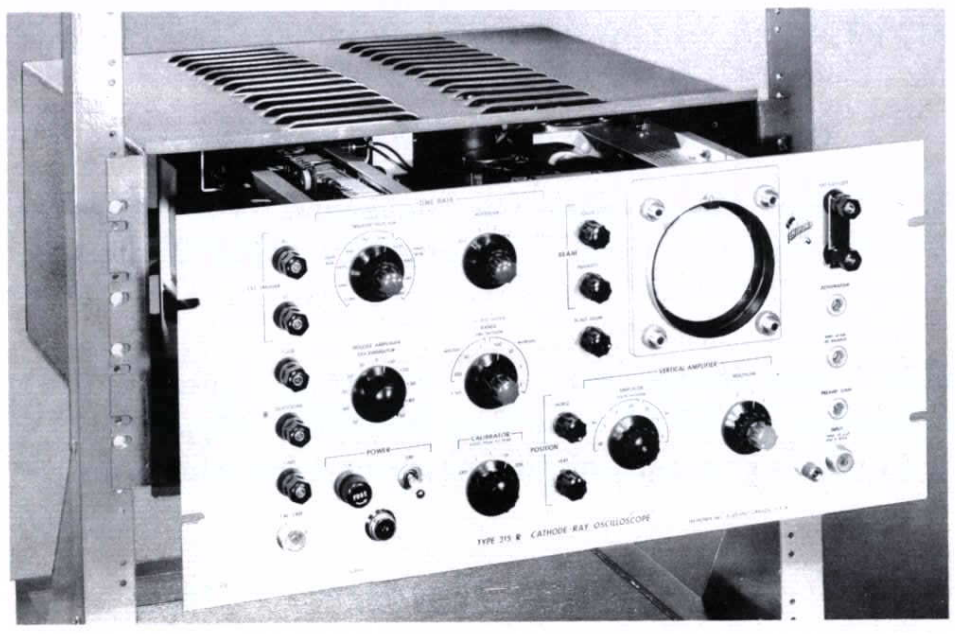
The Type 315R is a mechanically rearranged form of the Type 315D, for mounting in five vertical units of a standard 19-inch rack. Dimensions are: 18-31/32" wide, 8-23/32" high, 15-3/4" rack depth, 17" overall depth.

The cabinet of the Type 315R fastens to the rack with four mounting screws on each side. The chassis slides into the cabinet on two horizontal rails, providing firm support over its full length, and permitting easy access for servicing by sliding the chassis partly out of the cabinet. The chassis can be secured in place by four screws at the front, or by two fasteners at the rear of the instrument.

Rear mounted controls and terminals have been relocated on the front panel. Electrical specifications remain unchanged. All special models of the Type 315D are available in rack-mount form.

Type 315R **$795**
Type 315R-S1 ..... **$810**
Type 315R-S2 ..... **$815**

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



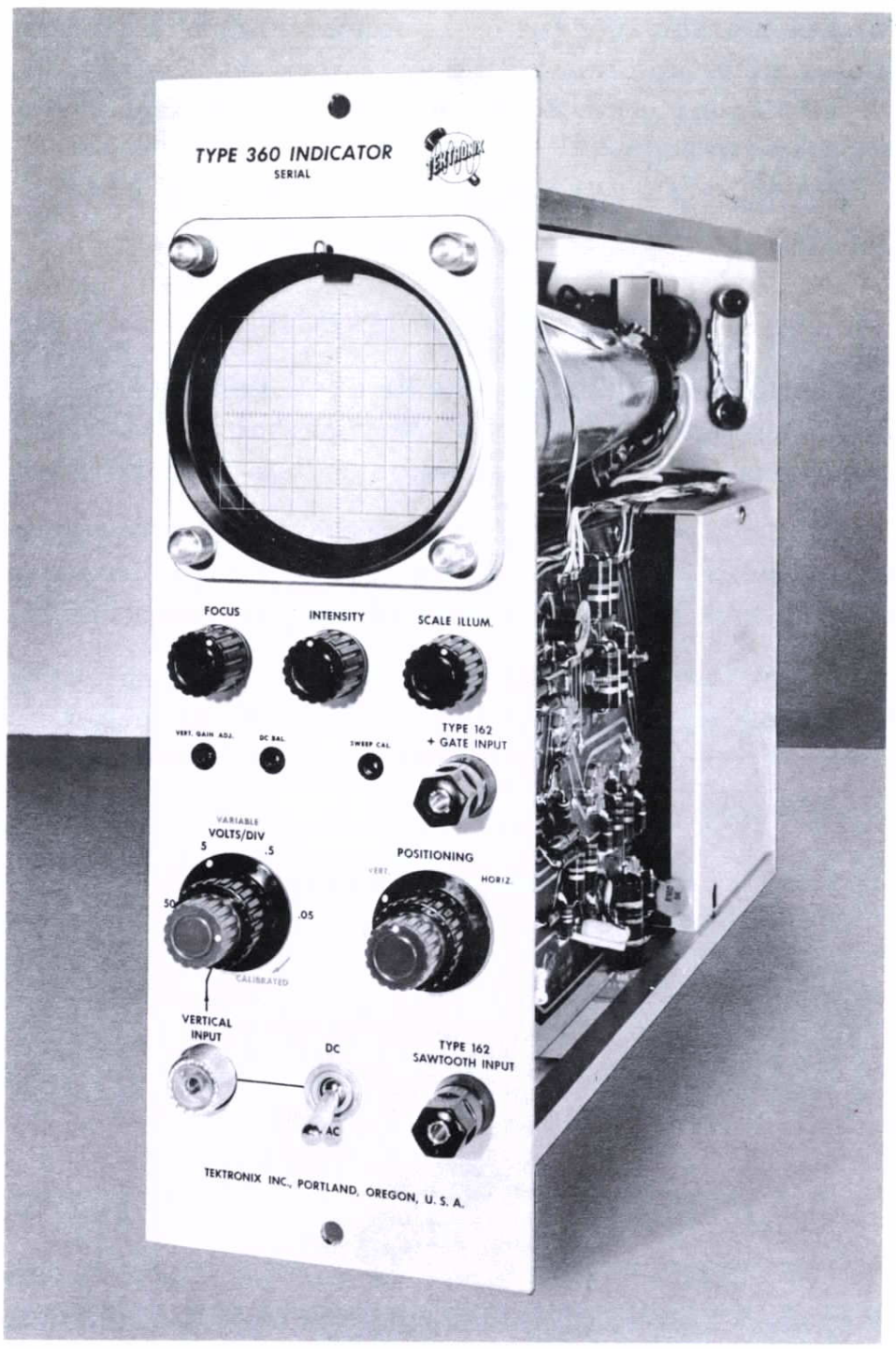
TYPE 360 INDICATOR

Vertical Passband
DC to 500 kc.

Calibrated Vertical Sensitivity
0.05 v/div to 50 v/div.

Waveform Requirements
50-v positive unblanking pulse, and a sawtooth of either polarity with amplitude from 110 to 150 v and extreme voltage limits at —90 v and + 170 v.

Power Requirements
+ 300 v dc unregulated at 20 ma.
+ 225 v dc regulated at 35 ma.
— 170 v dc regulated at 23 ma.
6.3 v ac at 3 amps.



GENERAL DESCRIPTION

The Tektronix Type 360 Indicator contains a 3" flat-faced crt, accelerating voltage supply, vertical amplifier with a sensitivity of 0.05 v/div and a calibrated vertical attenuator. It is designed to be powered by a Tektronix Type 160 or Type 160A Power Supply and to receive its sweep and unblanking voltages from a Tektronix Type 162 Waveform Generator or from any Tektronix oscilloscope; it can, however, be operated from any source of the proper voltages and waveforms. A Type 360 is well adapted to take the place of a bulkier general purpose oscilloscope in single monitoring applications; or several can be used along with Tektronix Type 160 Units as building blocks in a complex sequence-control and monitoring system. Several Type 360 Indicators can be driven by a single Type 162 Unit, and a simple Type 161-Type 162 hookup provides calibrated sweep delay. For low-level applications a Tektronix Type 122 Preamplifier provides increased sensitivity to 50 microvolts/div. A single Type 160A can supply power to five Type 360 Units. Three Type 360 Units can be powered by a Type 160 (predecessor to Type 160A) Power Supply.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Amplifier—Frequency response of the calibrated vertical amplifier is dc to 500 kc. An AC-DC switch is provided to insert a blocking capacitor in the input when ac-coupling is desired.

Calibrated Sensitivity—Four positions . . 0.05, 0.5, 5, and 50 v/div. A variable attenuator fills in between steps, making the sensitivity continously variable from 0.05 v/cm to 500 v/cm.

Signal Input—A front-panel uhf connector is provided for the input signal. Input impedance is 1 megohm paralled by by approximatley 40 $\mu\mu$f.

HORIZONTAL DEFLECTION SYSTEM

Input Waveforms—A sawtooth waveform of either polarity can be used to drive the horizontal amplifier. The sawtooth waveform can have an overall amplitude from 110 to 150 v with the extreme voltage limits at —90 v and + 170 v. A 50-volt positive pulse waveform having the same time duration as the sweep waveform

TYPE 360 INDICATOR

is necessary for unblanking the crt. The Type 162 Waveform Generator, any Tektronix oscilloscope, or any other source of waveforms at the necessary dc levels is required to supply the horizontal deflection system of the Type 360 Indicator.

Horizontal Calibration—A screwdriver adjustment provides a means of calibrating the sweep.

OTHER CHARACTERISTICS

Cathode-Ray Tube—Accelerating potential of 1.5 kv is supplied to the 3WP crt. A P2 phosphor is normally furnished, but others are available upon request.

DC-Coupled Unblanking—The external unblanking waveform is dc-coupled to the grid of the crt, assuring uniform bias for all sweep speeds and repetition rates.

Illuminated Graticule—An edge-lighted graticule is marked in 10-horizontal, 8-vertical quarter-inch divisions. Illumination is controlled by a front-panel knob.

VACUUM TUBE COMPLEMENT

Vertical input amplifiers	2	6AU6
Vertical output amplifiers	2	6AU6
Voltage setting CF and horizontal amplifier		6AN8
Horizontal feedback amplifier		6AU6
High-voltage oscillator		6AQ5
High-voltage regulator		12AT7
High-voltage rectifiers	2	5642
Cathode-ray tube		3WP2

MECHANICAL SPECIFICATIONS

Mounting—Adapted to rack mounting by Tektronix Type FA160 Mounting Frame.

Construction—Aluminum alloy.

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

Dimensions—4 ⅛" wide, 12 ¼" high, 16" deep.

Weight—9 pounds.

Price **$195**

Includes: 1—P510A attenuator probe
1—W160-10 connecting cable (012017)
1—Instruction manual

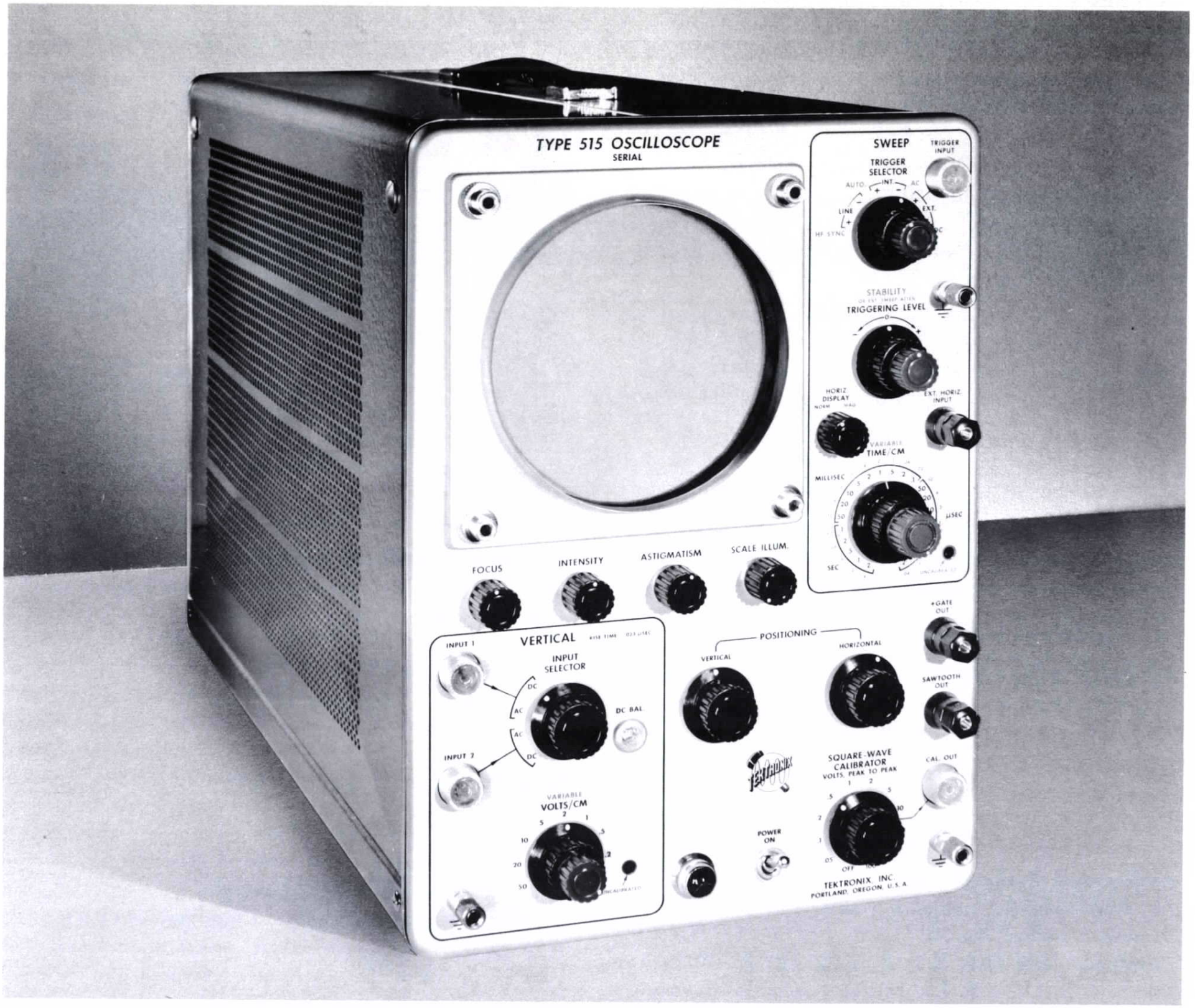
Currently Available Extras

P2 crt phosphor normally furnished.
P1, P7, P11 optional. . . . . No extra charge

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

TYPE 515 OSCILLOSCOPE

DC-Coupled General Purpose



Wide Sweep Range

22 calibrated steps from 0.2 μsec/cm to 2 sec/cm.
0.04 μsec/cm to 6 sec/cm, continuously variable.
5x magnifier, accurate on all ranges.

Vertical Sensitivity

9 calibrated steps from 0.1 v/cm to 50 v/cm.
0.1 v/cm to 125 v/cm, continuously variable.

Transient Response—0.023-μsec risetime.

Frequency Response—DC to 15 mc.
(3 db down ± ½ db at 15 mc)

Versatile Triggering Circuitry

Internal, external, line . . . .ac or dc-coupled, automatic triggering, and high-frequency sync.

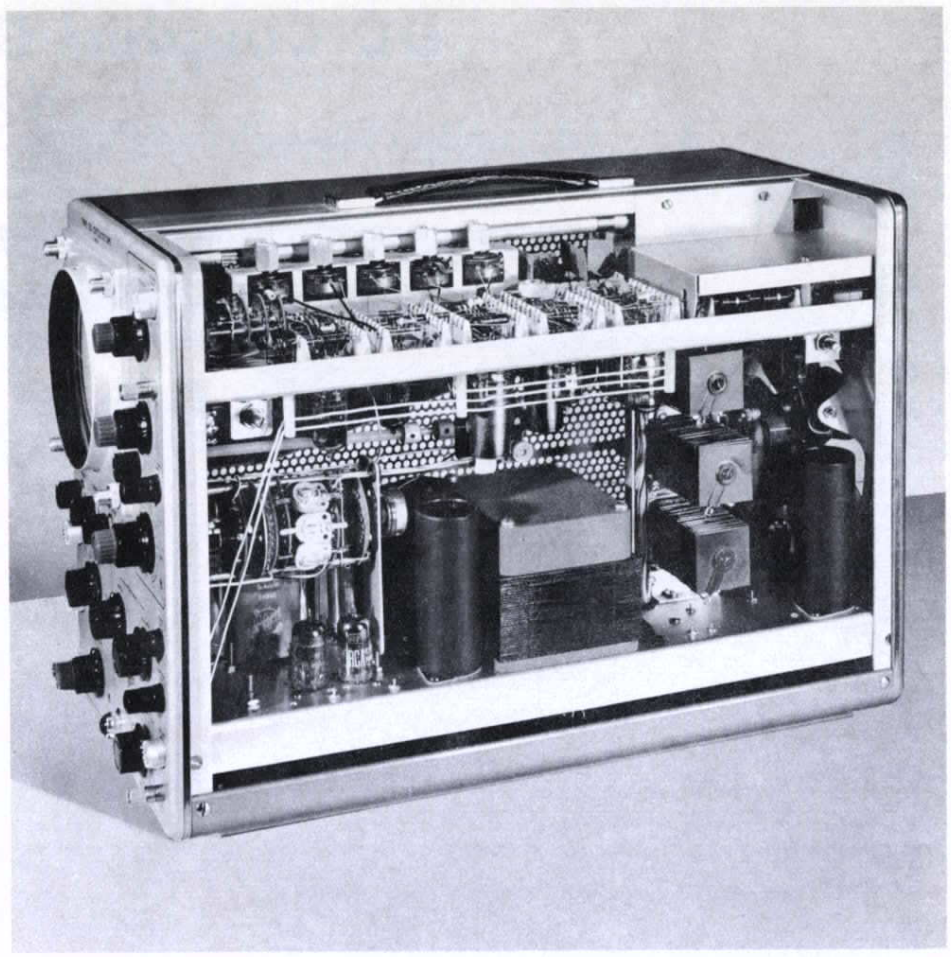
Balanced 0.25 μsec Delay Network

GENERAL DESCRIPTION

The Tektronix Type 515 is a dc-coupled general-purpose cathode-ray oscilloscope combining the latest Tektronix oscilloscope circuitry in a compact moderately-priced instrument. Wide sweep range of 0.04 μsec/cm to 6 sec/cm, dc to 15 mc passband, and vertical sensitivity to 0.1 v/cm qualify the Type 515 for general-purpose laboratory work. Reduced size requires less bench space and permits its use for many field applications.

Other outstanding features include dc-coupled unblanking, a new Tektronix flat-faced 5" cathode-ray tube, and versatile triggering circuitry. Accurate calibration of both sweep and vertical amplifier permits reliable quantitative measurements directly from the screen. Functional panel arrangement and versatile control system makes the Type 515 an easy-to-use oscilloscope for the field and laboratory.

TYPE 515 OSCILLOSCOPE



VERTICAL DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—The vertical amplifier has a passband of dc to 15 mc for all sensitivities. Calibrated sensitivities are 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 v/cm. A variable uncalibrated attenuator fills in between steps, making the sensitivity continuously variable from 0.1 v/cm to 125 v/cm. Risetime of the amplifier is less than 0.023 μsec.

Calibration Accuracy—An adjustment is provided for setting the vertical-amplifier gain. When accurately set on any one step, all other steps will fall within 3% of the panel reading.

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

Input Impedance—1 megohm paralleled by approximately 30 $\mu\mu$f.

Probe—The vertical sensitivity is reduced by a factor of 10 by use of a 10x attenuator probe supplied with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 13 $\mu\mu$f.

Balanced Delay Network—A signal delay of 0.25 μsec is introduced by the balanced (push-pull) delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

HORIZONTAL DEFLECTION SYSTEM

Calibrated Sweeps—The Type 515 has 22 calibrated fixed sweeps, accurate within 3% of full scale. Calibrated sweeps are 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 millisec/cm . . . 0.1, 0.2, 0.5, 1, 2 sec/cm. A variable uncalibrated control provides a continuously sweep range from 0.2 μsec/cm to 6 sec/cm.

Sweep Magnifier—Twenty-two additional calibrated sweeps are available when the 5x magnifier is connected into the sweep circuitry. These sweeps are 0.04, 0.1, 0.2, 0.4, 1, 2, 4, 10 μsec/cm . . . 0.02, 0.04, 0.1, 0.2, 0.4, 1, 2, 4 millisec/cm . . . 0.02, 0.04, 0.1, 0.2, 0.4 sec/cm. The center two-centimeter portion of the normal sweep is expanded to the left and right of center during the magnified display to fill 10 centimeters. The HORIZONTAL POSITION control has sufficient range to display any one-fifth of the magnified sweep. Accuracy of the magnifier is within 3% of full scale on all ranges except the 0.04 μsec/cm range, where the accuracy is within 5% of full scale.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the control grid of the crt assuring uniform grid bias for all sweep speeds and repetition rates.

Trigger Selection—A concentric control permits triggering from either the positive or negative slopes of an internal, external, or line voltage signal; and selection of ac or dc-coupling through the triggering circuits, or automatic triggering.

Automatic Triggering—With the control in 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 approximately a 50-cycle rate, providing a reference trace on the screen.

High-Frequency Sync—When the TRIGGER SELECTOR switch is in the HF SYNC position, the sweep will synchronize with the sine-wave signals in the frequency range of 5 mc to better than 20 mc.

Triggering Level—The TRIGGERING LEVEL control selects the amplitude level where triggering occurs. It permits triggering the sweep at a selected level on simple or complex waveforms.

Trigger Requirements—Internal triggering—a signal large enough to cause 2 mm deflection. External triggering—a signal of 0.2 v to 100 v.

Horizontal Input Amplifier—Dc-coupled external connection to the sweep amplifier is through a front-panel connector. A variable attenuator control makes the horizontal input sensitivity continuously variable.

OTHER CHARACTERISTICS

Voltage Calibrator—A square-wave voltage is available through a front-panel uhf connector. Eleven fixed voltages—0.05, 0.1, 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 about 1 kc.

TYPE 515 OSCILLOSCOPE

Cathode-Ray Tube—4-kv accelerating potential is applied to a new Tektronix 5" flat-faced precision tube, T55P, with a helical post-accelerating anode. A P-2 phosphor is normally supplied. Other phosphors are available upon request.

Output Waveforms—A positive-gate waveform of the same time duration as the sweep, and the positive-going sweep sawtooth waveform are available at front-panel connectors.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, 50 to 60 cycles.

Illuminated Graticule—An edge-lighted graticule is marked in 6 vertical and 10 horizontal centimeter divisions with 2-millimeter baseline divisions. Illumination is controlled by a front-panel knob.

Warning Indicators for Uncalibrated Settings—Separate front-panel neon lights indicate when the variable vertical-sensitivity and sweep-speed controls are in uncalibrated settings.

VACUUM TUBE COMPLEMENT

Vertical input CF	2	6AU6
Input amplifiers	2	12BY7
Amplifier CF		6BQ7A
Output amplifiers	2	6CL6
Internal trigger CF		6BQ7A
Trigger phase inverter		6U8
Regenerative amplifier		6U8
Holdoff cathode followers		12AT7
Minus multivibrator and unblanking CF		6AN8
Plus multivibrator and cathode follower		6BQ7A
Disconnect diodes		6AL5
Sweep generator and sweep generator CF		6AN8
Positioning CF and feedback CF		6BQ7A
Sawtooth out CF and + gate out CF		6BQ7A
Horizontal output amplifiers	2	6BQ7A
Calibrator multivibrator		6U8
Calibrator CF		6BQ7A
Voltage reference		5651
Regulator amplifiers	3	6AU6
Series regulator		6080
Series regulator		6AU5
High-voltage oscillator		6AQ5
High-voltage rectifiers	3	5642
High-voltage regulator		12AT7
Cathode-ray tube		T55P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Cabinet and chassis are made of aluminum alloy.

Finish—Photo-etched anodized panel, shadow blue hammertone-finished cabinet.

Dimensions—9 ¾" wide, 13 ½" high, 21 ½" deep.

Weight—40 pounds.

Power Requirements—105 to 125 v or 210 to 250 v, 50-60 cycles, 275 watts.

Price **$750**

Includes: 1—P510 attenuator probe
2—A510 binding-post adapters
1—F510-5 green filter (378503)
1—Instruction manual

Currently Available Extras

P2 crt phosphor normally furnished.
P1, P7, P11 optional . . . . . No extra charge

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

TYPE 517A OSCILLOSCOPE

for High-Speed Pulse Application

Excellent Transient Response
7-millimicrosecond risetime.

Sweep Range
0.01 μsec/cm to 20 μsec/cm.

Vertical Amplifier Sensitivity
0.05 v/cm maximum.

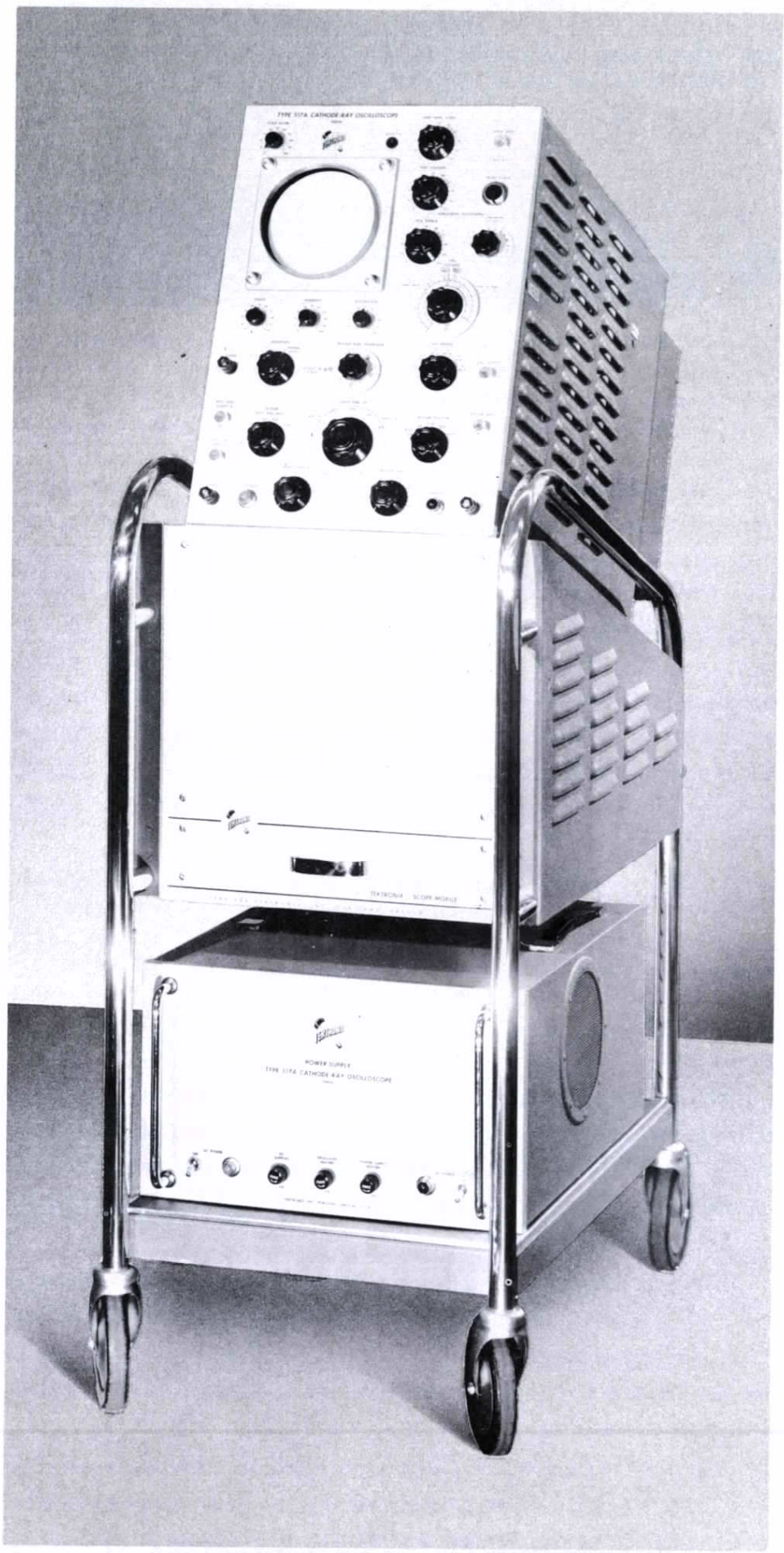
24-kv Accelerating Potential
Writing Rate—1100 cm/μsec.
Recorded on 35 mm TRI-X film at f1.9 with 4.2 to 1 reduction, developed 26 minutes in D-19 at 68°F. Trace density 0.1 above film fog.

Sweep-Displacement Error
Less than 1% of 8 cm.

Signal-Displacement Error
Less than 2% of 2 cm.

Full 4-cm x 8-cm Deflection

Highly Mobile
Indicator unit and power supply mounted on Scope-Mobile.



GENERAL DESCRIPTION

The Tektronix Type 517A Cathode-Ray Oscilloscope is a wide-band, high-voltage instrument for the observation and photographic recording of very-fast-rising waveforms having low duty cycle. With its risetime of 7 millimicroseconds, 24-kv accelerating potential, and high-speed sweeps, the Type 517A is especially well suited to single-sweep applications involving transients of very short duration. Use of the new Tektronix metallized cathode-ray tube, T54PH, increases the maximum vertical deflection to a full 4 cm and improves the linearity of the horizontal sweep. Basic vertical sensitivity of the Type 517A is 0.05 volts/cm.

Both indicator and power-supply units are mounted on a Type 500 Scope-Mobile, making the Type 517A a convenient, mobile unit. If desired, the indicator and power-supply units can be easily removed from the Scope-Mobile for bench use.

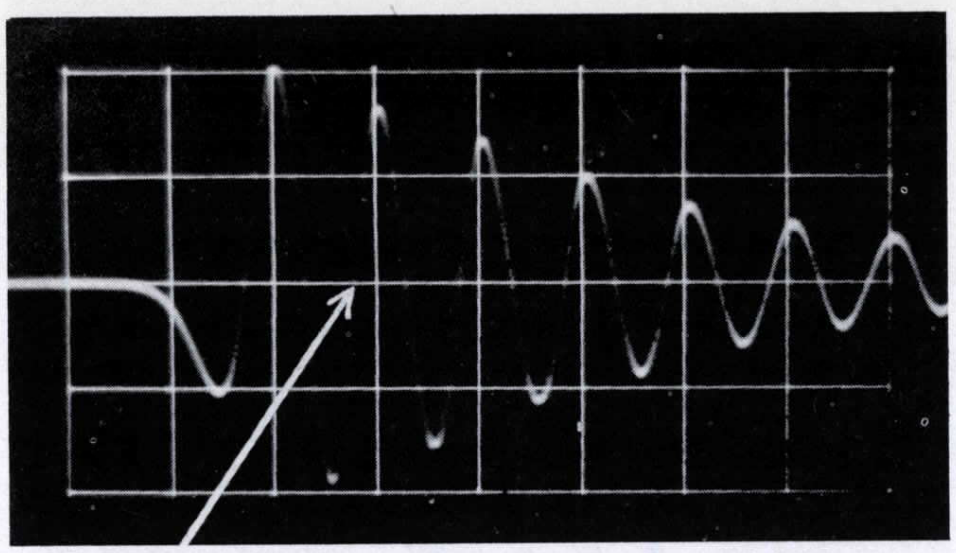
VERTICAL DEFLECTION SYSTEM

Distributed Amplifier—A 5-stage distributed amplifier is used to derive a transient-response risetime of 7 millimicroseconds.

Sensitivity—Basic sensitivity is 0.05 v/cm with 24-kv accelerating potential. A front-panel variable attenuator control can decrease the sensitivity by a factor of 2.

Input—The input of the vertical amplifier is connected through a uhf coaxial connector directly to the 170-ohm first-stage grid line.

TYPE 517A OSCILLOSCOPE



Arrow indicates 1100 cm/μsec writing-rate point on 100-cm damped oscillation, displayed on single 0.01 μsec/cm sweep of Type 517A Oscilloscope with T54P11H crt. Recorded on 35-mm TRI-X film at f1.9 with 4.2 to 1 reduction, developed 26 minutes in D-19 at 68°F.

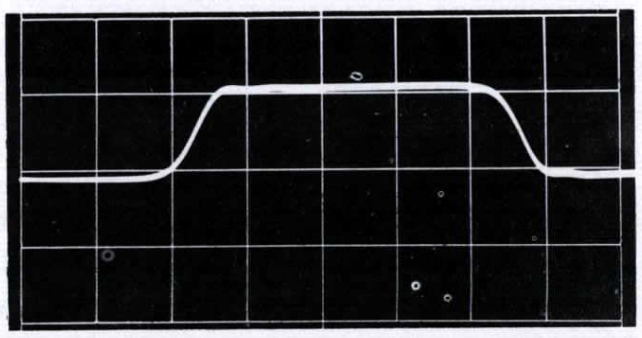
Cathode-Follower Probe—To provide higher input impedances, a cathode-follower probe and three capacitive attenuator heads are supplied with the Type 517A. The input impedance of the probe alone consists of 12 megohms paralleled by approximately 5 μμf. Each attenuator head will present a different input capacitance, decreasing with higher attenuation ratios. Each attenuator head is adjustable over a ten-to-one range by means of a screwdriver adjustment in the nose of the head, making the following sensitivities and attenuator ranges available:

	Voltage Sensitivity of Type 517A at 24-KV Accelerating Potential	Total Attenuation at CRT
Scope Input	0.05 to 0.1 v/cm	1:1 to 2:1
Probe Body Alone	0.1 to 0.2 v/cm	2:1 to 4:1
Probe with Attenuator I	0.2 to 4 v/cm	4:1 to 80:1
Probe with Attenuator II	2 to 40 v/cm	40:1 to 800:1
Probe with Attenuator III	20 to 400 v/cm	400:1 to 8000:1

Auxiliary Power—A front-panel socket is provided to supply power 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 are available.

Signal Delay—Approximately 65 millimicroseconds of delay cable is incorporated in the vertical amplifier. This delay, along with an inherent 55 millimicroseconds delay in the amplifier, permits the sweep to start before the signal reaches the vertical deflection plates.

Direct Input CRT—An aperture in the side of the cabinet permits direct connection to the crt deflection plates for observation of extremely high-speed transients.



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

HORIZONTAL DEFLECTION SYSTEM

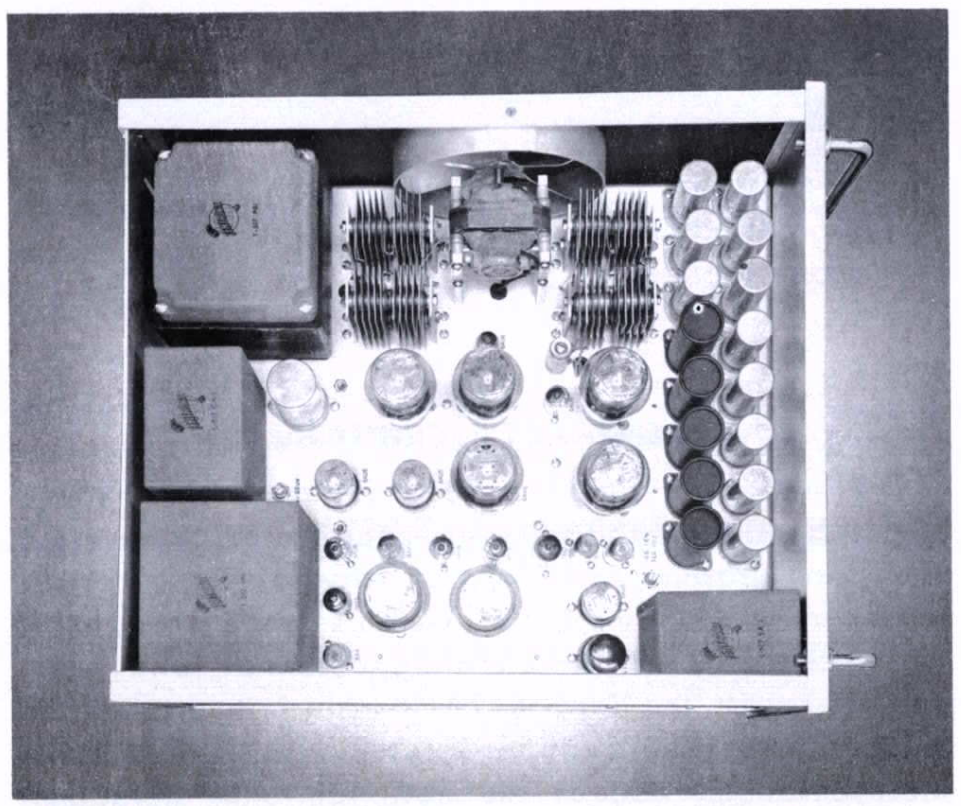
Calibrated Sweeps—The basic sweep waveform is generated by a boot-strap circuit with an inverter stage for balanced deflection. Eleven fixed, calibrated sweeps accurate within 2% . . . 10, 20, 50, 100, 200, 500 millimicrosecond/cm, 1, 2, 5, 10, 20 μsec/cm are available at 24-kv accelerating potential; and 5, 10, 25, 50, 100, 250 millimicrosecond/cm, 0.5, 1, 2.5, 5, 10 μsec/cm at 12 kv.

Trigger Selection—A front-panel switch selects a trigger from an observed signal of either polarity, an external trigger source of either polarity, or the internal trigger generator.

Trigger Requirements—The Type 517A uses a distributed amplifier in the trigger circuitry to handle fast-rise trigger signals. An internal trigger giving a 2-mm deflection will trigger the Type 517A. External trigger requirements are 0.3 to 15 v.

Trigger-Rate Generator — Internal trigger-rate generator is continuously variable from 15 to 15,000 cycles in three ranges with accuracy within 5% of full scale. Two cathode-follower outputs are available. . . 20 v at 50 ohms internal impedance and 60 v at 200 ohms internal impedance. Risetime is approximately 0.15 μsec.

Automatic Duty-Cycle Limiter—The maximum duty cycle of the sweep system is automatically limited to about 15% to avoid exceeding the dissipation limits of some of the sweep circuit components.



POWER SUPPLY

Low Voltage—The low-voltage power supply is separate from the indicator unit, supplying power to it by an inter-connecting cable. All dc supplies are electronically regulated and heaters in the indicator unit are regulated by a saturable-reactor method to insure stable operation over line-voltage variations from 105 to 125 v.

High Voltage—Accelerating potentials for the crt are obtained from an oil-filled oscillator-type supply, all

TYPE 517A OSCILLOSCOPE

voltages electronically regulated to insure stable operation for both load and line changes. A front-panel switch on the indicator unit changes the accelerating voltage from 24 kv to 12 kv by changing the sampling voltage in the regulator circuit.

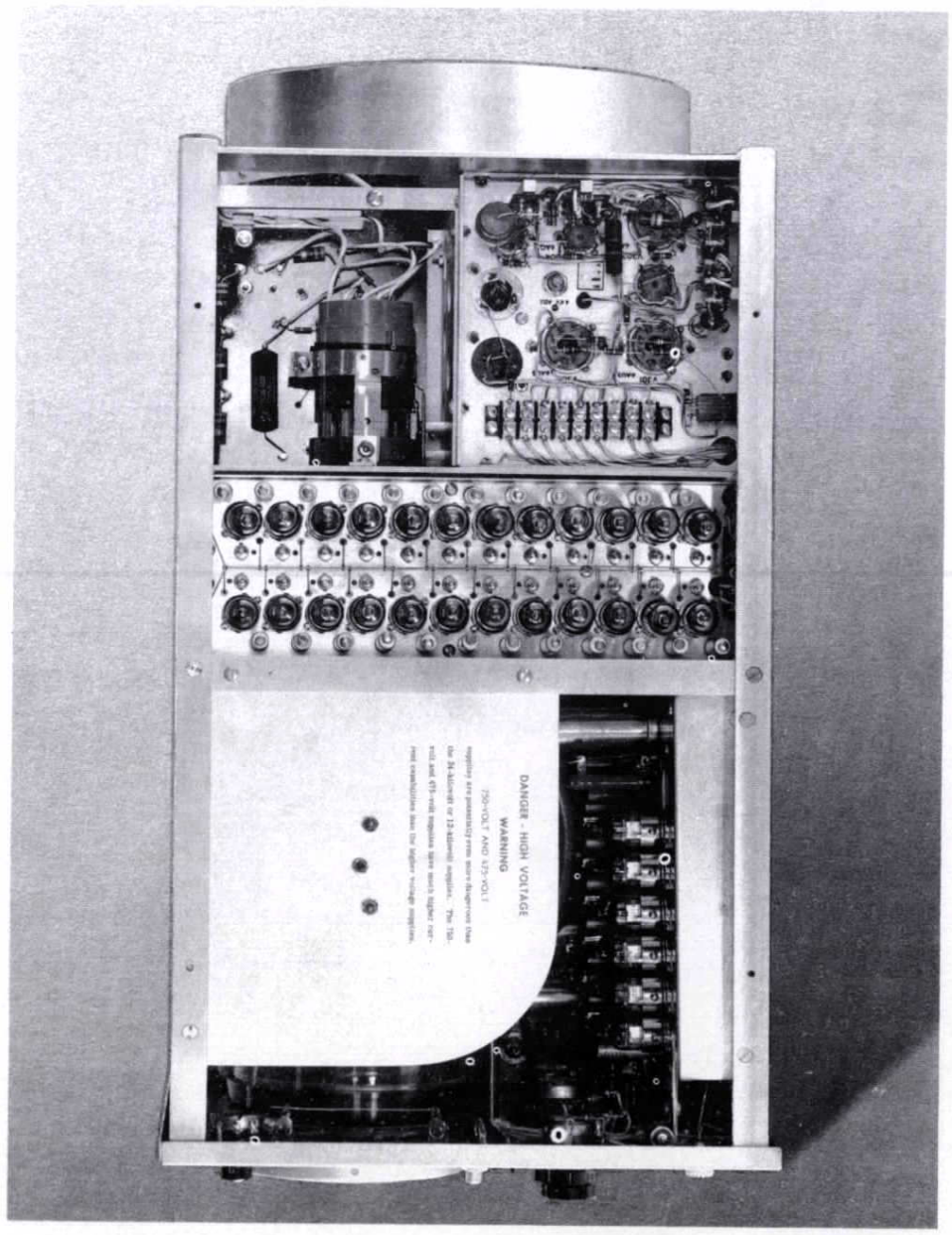
OTHER CHARACTERISTICS

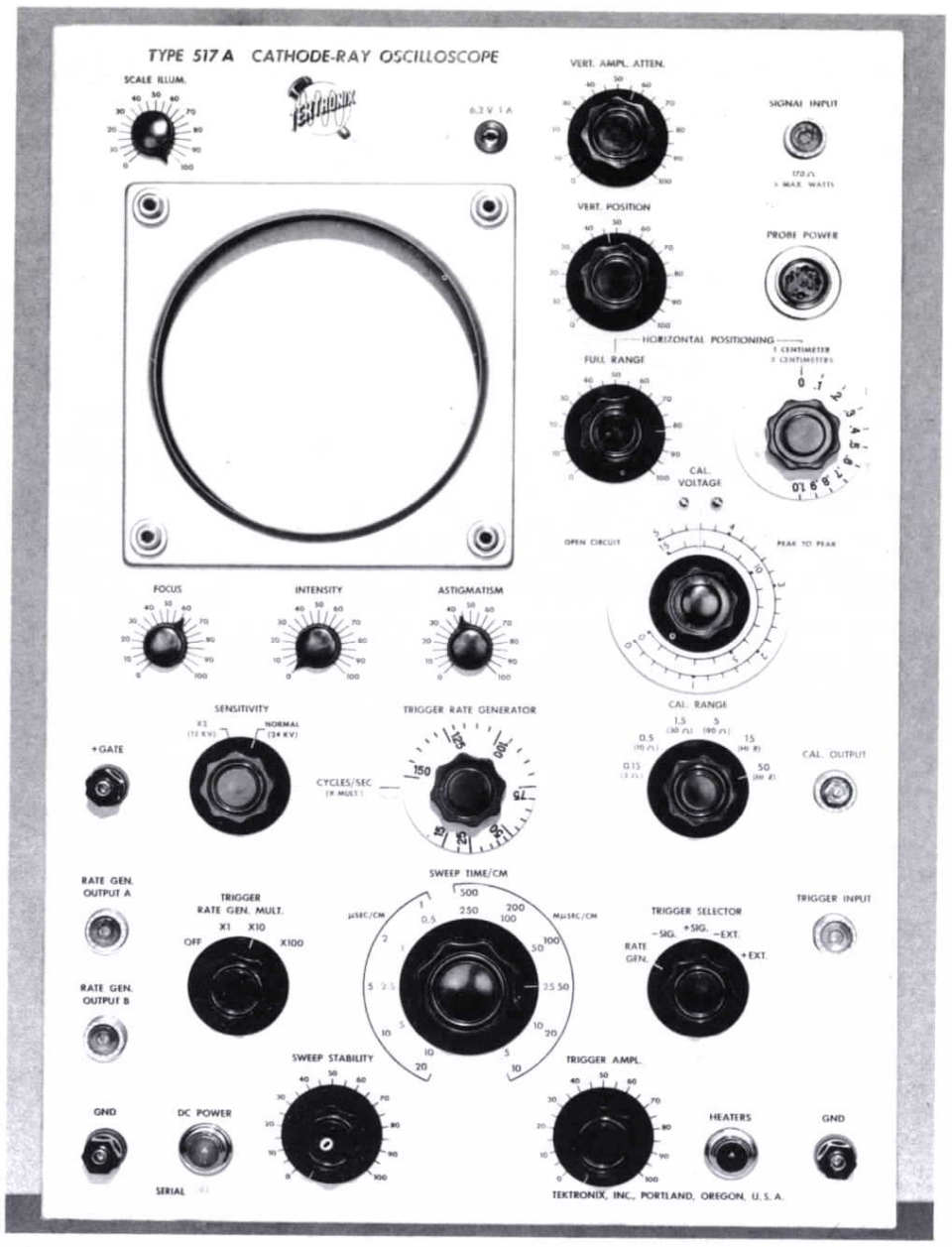
Amplitude Calibrator—A pulse-type calibrator is used in the Type 517A and is available at the front-panel through a uhf connector. The output voltage is continuously variable from 0.15 v to 50 v peak full scale in 6 ranges with accuracy within 4% of full scale. Frequency is approximately 25 kc.

Horizontal-Position Vernier—In addition to the normal horizontal-position control, a vernier control calibrated in millimeters provides accurate measurements over a range of 1 cm (24-kv accelerating potential) for use in measuring risetimes, etc.

Metallized Cathode-Ray Tube—The Type 517A uses a new Tektronix crt, T54PH. The T54PH is a 5" flat-faced metallized precision tube with helical post-accelerating anode. It provides a full 4-cm x 8-cm viewing area when operated at 24-kv accelerating potential. Position of the high-voltage connector permits bringing the tube face flush with the panel. A P11 phosphor is normally furnished unless otherwise specified.

Output Waveforms—In addition to the two trigger-rate generator outputs and calibrator output, a +GATE





waveform of 25 volts amplitude is available. Its duration is approximately equal to the sweep being generated. Risetime is 0.03 μsec, from a cathode-follower source impedance of 200 ohms.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares, 4 vertical and 8 horizontal, for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.

VACUUM TUBE COMPLEMENT

First distributed amplifier	6	6AK5
Second distributed amplifier	6	6AK5
Third distributed amplifier	7	6CB6
Phase inverter stage	3	6CB6
Driver amplifier	12	6CB6
Output amplifier	24	6CB6
Internal trigger coupling		6CB6
Trigger phase-splitter		6J6
Trigger amplifier	6	6AK5
Trigger limiter		6AG7
Trigger switch		6AG7
Coupling diode		6X4
Multivibrator	2	6AG7
Duty-cycle limiter		6AN8
Sweep clamp	2	6AG7
Bootstrap cathode followers	2	12BH7
Decoupling diode		6X4
Positive sweep out CF		12BH7

TYPE 517A OSCILLOSCOPE

Sweep inverter		6AG7
Voltage regulator CF		12AU7
Negative sweep clamp		6AL5
Sweep out dc restorer		6AL5
Unblanking amplifiers	2	6AG7
Voltage regulator CF		6AS5
Unblanking cathode follower		6J6
+Gate out cathode follower		6J6
Cal multivibrator		12AU7
Clipper		6J6
Cal voltage adjust CF		6J6
Cal out CF		6J6
Trigger rate phantastron generator		6BH6
Trigger coupling and recharging CF		12AU7
Plate catcher		12AU7
Blocking oscillator		12AU7
Output cathode followers	2	12AU7
Astigmatism and probe voltage CF		12AU7
Low-voltage rectifiers	4	6X4
Rectifier		5R4GY
Voltage reference		5651
Comparator		12AX7
Regulator amplifiers	5	6AU6
Series regulators	2	6AU5
Series regulators	6	6AS7
Heater voltage control diode		2AS-15
Heater-regulator amplifier		6AU5
High-voltage rectifiers	5	1X2
High-voltage oscillator		6AU5
Regulator amplifier		12AU7
Series regulator	2	6AU5
High-voltage time delay		6C4
High-voltage rectifier filament oscillator		6AQ5
Astigmatism and probe power CF		12AU7
Cathode-ray tube		T54P11H

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures safe operating temperature.

Construction—Aluminum-alloy chassis and cabinet.

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

Dimensions—Indicator unit: 18 3/8" high, 13" wide, 27" deep. Power supply unit: 9 5/8" high, 13" wide, 19 3/4" deep.

Weight—Indicator unit: 76 pounds. Power supply unit: 72 pounds. Scope-Mobile: 42 pounds.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 1250 watts.

Type 517A Cathode-Ray Oscilloscope. . . . $3500

Includes: 1—Type 500 Scope-Mobile
1—P170CF cathode-follower probe
1—B170A step attenuator
1—H510 viewing hood
1—BE510 bezel
1—Instruction manual
1—P170 coaxial cable

CRT T54

Currently Available Extras

P11 phosphor normally furnished.

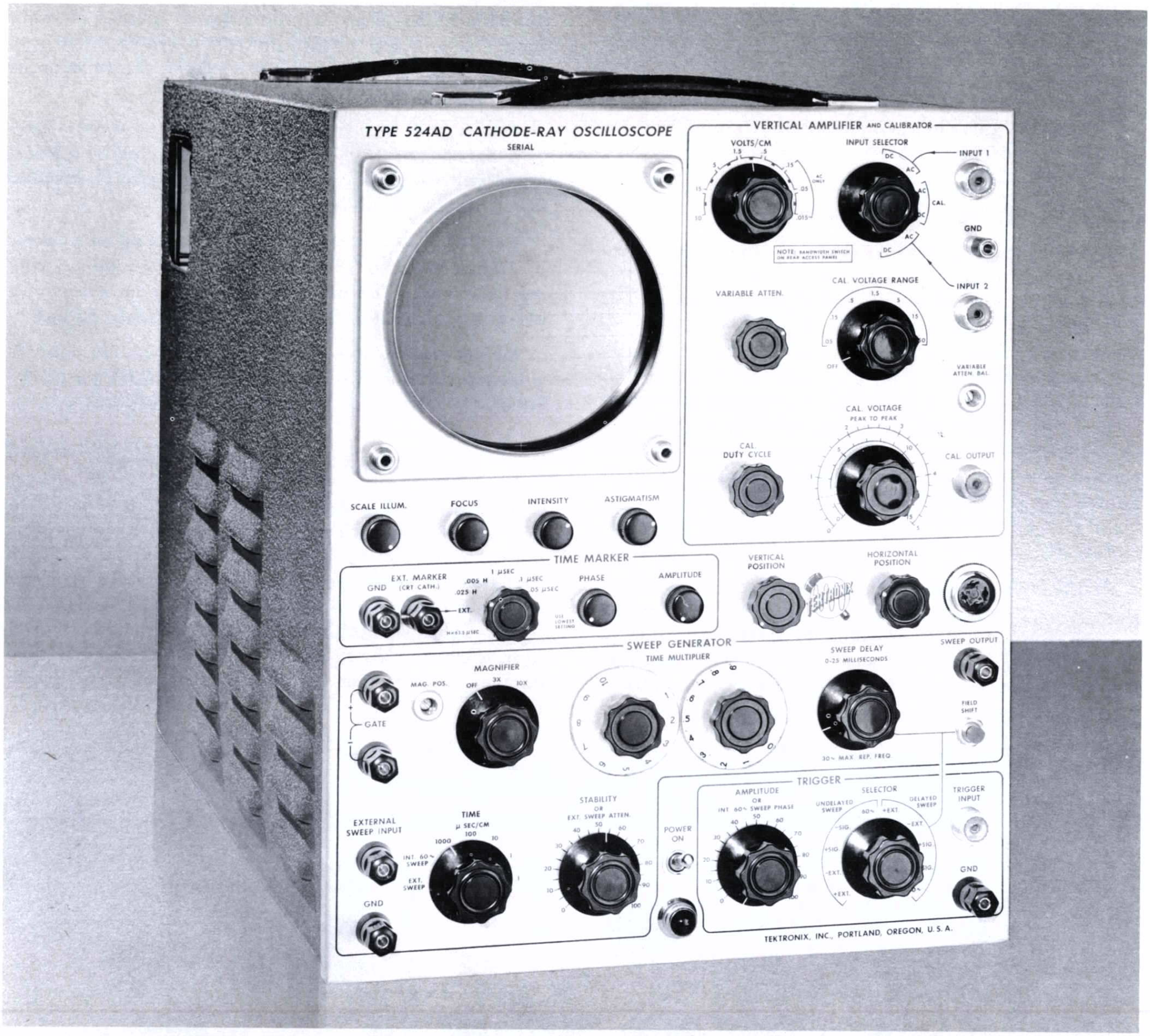
P1, P2, P7 optional. . . . . .No extra charge

Other phosphors can be furnished on special order.

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

TYPE 524AD OSCILLOSCOPE

Television Cathode-Ray Oscilloscope



Frequency Response
Normal—dc to 10 mc from 0.15 v/cm to 50 v/cm.
2 cycles to 10 mc from 15 mv/cm to 50 v/cm.
Flat—within 1% from 60 cycles to 5 mc.
IRE—meets IRE standards for level measurements.

Transient Response—0.035-μsec risetime.

Sweep Range
Continuously variable, 0.1 μsec/cm to 0.01 sec/cm.

Time Markers
Five markers—0.05 μsec, 0.1 μsec, 1.0 μsec, 200 pips per television line, and 40 pips per television line.

Sweep Delay
Permits detailed observation of any portion of a single television line.

DC-Coupled Unblanking

Variable Duty-Cycle Amplitude Calibrator

GENERAL DESCRIPTION

The Tektronix Type 524AD Oscilloscope is a self-contained instrument with the characteristics desirable for maintenance and adjustment of television transmitter and studio equipment. The Type 524AD will prove it-

TYPE 524AD OSCILLOSCOPE

self invaluable in enabling the engineer to observe any portion of the television picture — from complete frames to small portions of individual lines.

Features contributing to the versatility of this oscilloscope include—accurate time markers to facilitate sync-pulse timing, normal response of dc to 10 mc, flat response within 1% from 60 cycles to 5 mc for color-television work, variable-duty-cycle amplitude calibrator, and two steps of sweep magnification, 3x and 10x, for detailed observations.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—The main vertical amplifier has a passband of dc to 10 mc for sensitivities from 0.15 v/cm to 50 v/cm. Low-frequency response is 3 db down at 2 cycles when the AC-DC switch is in the AC position. An ac-coupled preamplifier switched in by the sensitivity control provides additional sensitivities from 0.015 v/cm to 0.15 v/cm. A variable attenuator control fills in between steps and provides continuously variable sensitivity from 0.015 v/cm to 50 v/cm. The vertical amplifier is factory adjusted for optimum transient response. Risetime is less than 0.035 μsec and the input impedance is 1 megohm paralleled by approximately 45 $\mu\mu$f.

Frequency Response—A switch on the access panel selects the desired bandwidth of the vertical amplifier. The NORMal position provides a passband of dc to 10 mc. The FLAT position provides a vertical-amplifier response flat within 1% from 60 cycles to 5 mc. About 5% overshoot will occur on extremely sharp waveforms when the switch is in the FLAT position; however, TV signals within the 5 mc passband are not affected. Response of the amplifier meets the IRE standards for level measurements when the access-panel switch is in the IRE position. EXTernal position provides ac-coupled external connections to the vertical-deflection plates, bypassing the main vertical amplifier but retaining the function of the vertical-position control.

Two Signal Inputs—Two uhf signal-input connectors with more than 50-db isolation are controlled by a front-panel switch. Each input can be either ac or dc-coupled to the vertical amplifier.

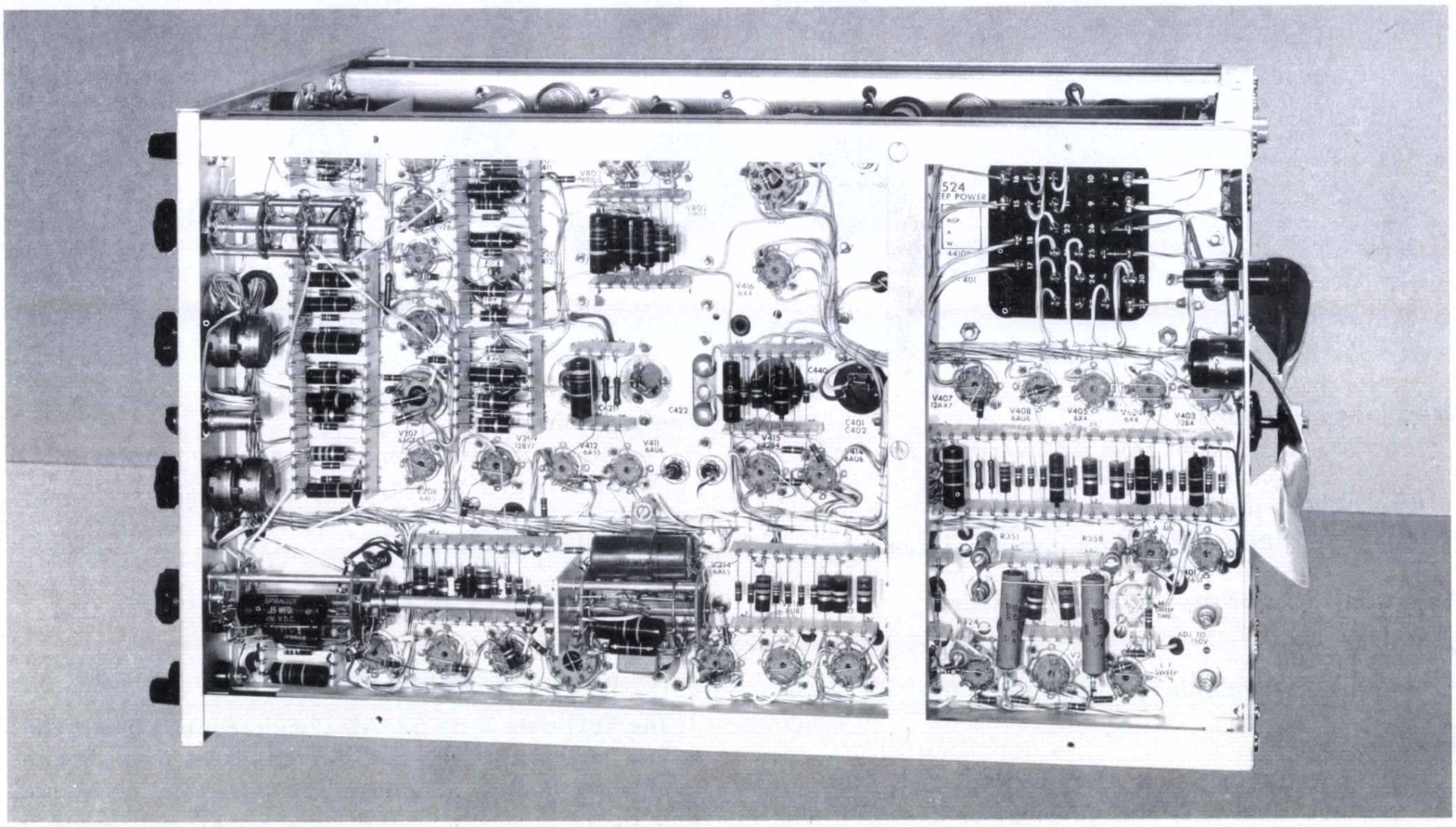
Probe—The vertical sensitivity is reduced by a factor of 10 by use of a 10x attenuator probe supplied with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 15 $\mu\mu$f.

Delay Network—A 0.25 μsec signal-delay network is incorporated in the vertical amplifier to permit observation of the waveform that triggers the sweep.

HORIZONTAL DEFLECTION SYSTEM

Calibrated Sweeps—The Type 524AD has a continuously variable, linear, triggered time base covering the range of 0.1 μsec/cm to 0.01 sec/cm in five fixed-range steps. Dual sweep-time multiplier dials cover the range between steps. Calibration accuracy is within 5%.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the grid of the cathode-ray tube assuring uniform bias for all sweep speeds and repetition rates.



TYPE 524AD OSCILLOSCOPE

Sweep Delay—Detailed observation of any portion of the television picture is accomplished by continuous sweep delay from 0 to 25 milliseconds. After the desired delay, the sweep is triggered by one of the line sync pulses. The sweep delay is adjustable with a 3-turn potentiometer through about 1½ fields, and operates at the frame rate of 30 cycles so only consecutive lines of one field are observed at any time. A field-shift button permits switching to the corresponding interlaced lines in the other field.

Sweep Magnifier—Sweep magnification is obtained by increasing the drive to the sweep-output amplifier by a factor of either 3 or 10. The center portion of the sweep is expanded equally to left and right of center. The 3-turn horizontal-position control has sufficient range to cover the entire magnified sweep. Accuracy is within 5%.

Trigger Selector—Both normal and delayed sweeps can be triggered by an external signal of either polarity, or internally by either the positive or negative portion of the signal under observation, or by the power-line frequency.

Trigger Requirements—Internal triggering—a signal large enough to produce a one-half centimeter deflection. External—a signal of 0.5 v to 50 v. Composite waveform—a signal large enough to produce a 1.5-centimeter deflection.

OTHER CHARACTERISTICS

Voltage Calibrator—A variable-duty-cycle square-wave calibration voltage is continuously variable from zero to 50 volts in seven ranges. Full-scale calibration is accurate within 3%; variable control is linear within 1% of full scale. Square-wave frequency is approximately 1 kc, but the frequency will vary somewhat as duty cycle is varied to 1% or 99%.

Time-Mark Generator—Time markers are inserted as intensification pips on the crt trace at time intervals of 0.025H, 0.005H, 1.0 μsec, 0.1 μsec, and 0.05 μsec. Since H is 63.5 μsec, 0.025H will give 40 pips per television line and 0.005H will give 200 pips per television line. These markers provide a means of accurately timing the sync pulses of a composite signal. Pips spaced at 40 or 200 per television line are useful for adjusting both color and monochrome equipment.

A phasing control permits markers to be positioned on any desired point of the waveform under observation.

Output Waveforms—Positive and negative-gate waveforms of the same time duration as the sweep, and the sweep sawtooth waveform are available at front-panel connectors.

Line-Indicating Video—When a picture monitor is connected to the uhf connector at the rear of the cabinet, the picture appearing on the monitor will be brightened during the time of the oscilloscope sweep. This technique is useful when it is desired to know what portion of the picture is being displayed on the oscilloscope.

60-Cycle Sweep—A 60-cycle sweep with variable amplitude and phasing through approximately 150° is provided to facilitate bandwidth measurements with a video sweep generator.

Cathode-Ray Tube—A flat-faced 5ABP cathode-ray tube with 4-kv electronically-regulated accelerating potential is used in the Type 524AD. A P-1 phosphor is normally supplied although other phosphors are available upon request.

Regulated Power Supply—All dc supplies are electronically regulated to insure stable operation over line variations between 105-125 v or 210-250 v, 50 to 60 cycles.

Illuminated Graticule—An edge-lighted graticule is marked in centimeters. Illumination is controlled by a front-panel knob. A graticule marked for modulation measurements is also supplied with the instrument.

Probe Power Socket—A front-panel socket will provide power for a cathode-follower probe or auxiliary amplifier circuitry. 6.3 v ac at 1 amp and 120 v regulated dc at 15 ma are available at the socket.

VACUUM TUBE COMPLEMENT

Preamplifier	2	6U8
Cathode follower		12AT7
Cathode-coupled amplifier	2	6CL6
Cathode follower		6BQ7A
Driver	2	6CL6
Cathode follower, constant-current triode		6BQ7A
Output amplifier	6	6AG7
Voltage regulator		6AS5
Cal multivibrator		12AU7
Cal clipper amplifier and CF		12AT7
Trigger inverter and clamp diode		6BQ7A
Sync amplifier		12BZ7
Sync separator and coupling diode		12BZ7
Phantastron		6BH6
Trigger delay comparator		12BZ7
Trigger amplifier		6AG7
Coupling diode		6AL5
Negative multivibrator		12BY7
Positive multivibrator		12BY7
Gate amplifier and astigmatism CF		12AU7
Unblanking amplifier		12AT7
Clamp tube		6AG7
DC restorer		6AL5
Cathode follower		12AT7
Decoupling diode and CF		12AT7
Feedback amplifier		6U8
Clamp and CF		12AT7
Sweep-output amplifier	2	6AH6
Sweep-output cathode follower		6BQ7A
Voltage reference		5651

TYPE 524AD OSCILLOSCOPE

Regulator amplifier	4	6AU6
Regulator series tube	2	12B4
Rectifiers	3	6X4
Voltage-comparator amplifier		12AX7
Regulator series tube		6AS7
Regulator series tube		6AS5
Time-mark pulse shaper and CF		6BQ7A
Marker phase multivibrator		6U8
Time-mark oscillator		6AK5
Pulse amplifier		6BQ7A
High-voltage regulator amplifier		12AU7
High-voltage oscillator		6AQ5
High-voltage rectifier	3	5642
Cathode-ray tube		5ABP1

MECHANICAL SPECIFICATIONS

Construction — Self-contained, cabinet and chassis made of aluminum alloy.

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

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

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

Weight—61 pounds.

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

Price $1180

Includes: 1—P510A attenuator probe
2—A510 binding-post adapters
1—TV RMA style graticule (331009)
1—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

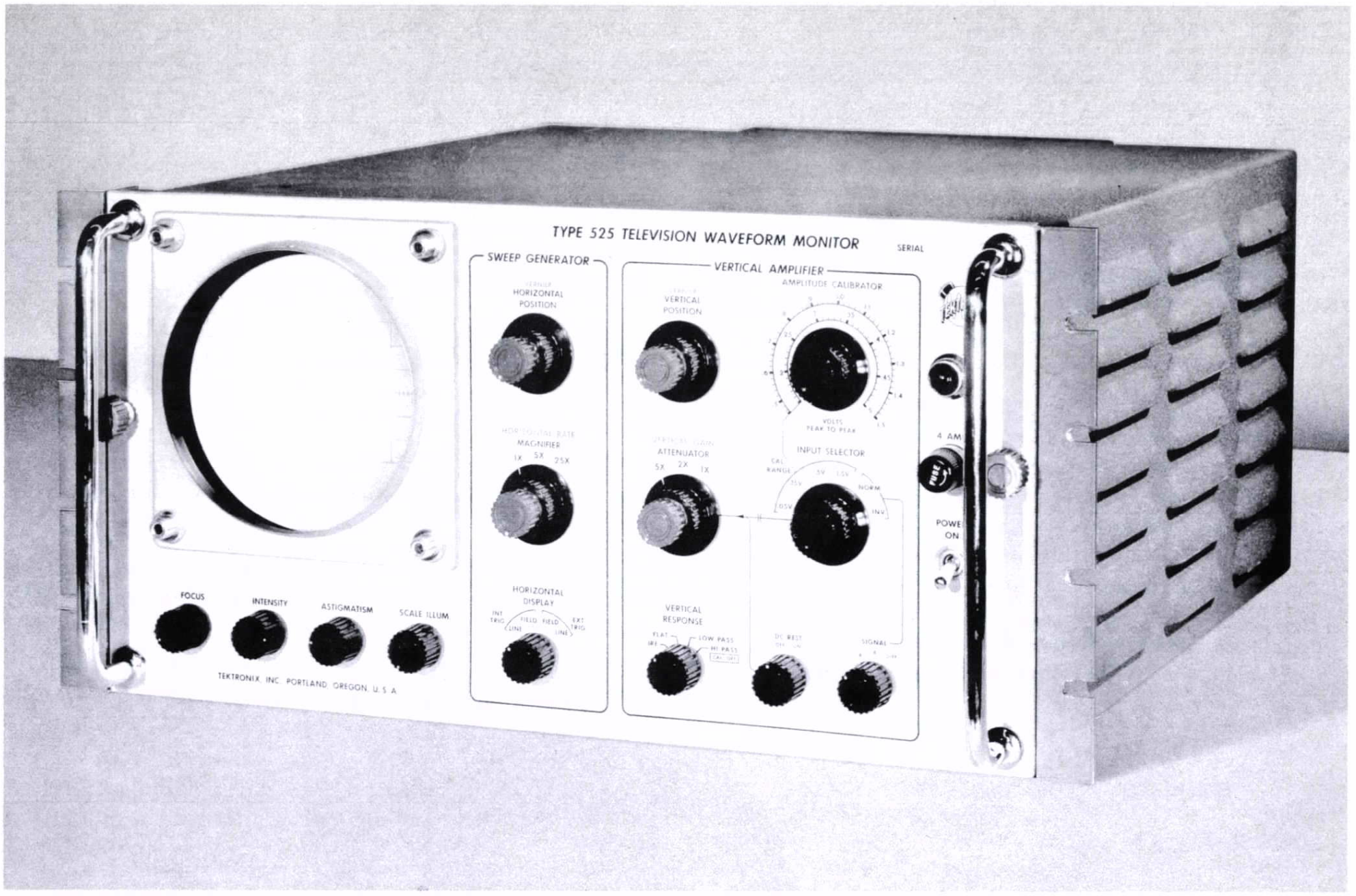
P500CF Cathode-Follower Probe has input impedance of 40 megohms paralleled by 4 $\mu\mu$f and gain of 0.8 to 0.85. With 10x attenuator head, input impedance is 10 megohms paralleled by 2 $\mu\mu$f. Amplitude distortion is less than 3% on undirectional signals up to 5 v. . $64.00

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

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

TYPE 525 TELEVISION WAVEFORM MONITOR

for Monochrome and Color Telecasters



Frequency Response

FLAT—within 1% between 60 cycles and 5 mc.

LOW PASS—passes stair steps, eliminating high frequencies.

HIGH PASS—passes high frequencies, eliminating stair steps.

IRE—meets IRE standards for level measurements.

Excellent Linearity

Insures accurate color signal linearity measurements.

Automatically-Synchronized Sweeps

Both field and line rates.

Keyed Clamp-Type DC Restorer

Gain Stability Within 1%

GENERAL DESCRIPTION

The Tektronix Type 525 Television Waveform Monitor displays the composite video waveform with the precision required for all television broadcasting. Exacting demands of the color-television broadcaster for an accurate display of signal linearity, level, and bandwidth are fulfilled with the Type 525.

Special features of the Type 525: Four vertical-amplifier response characteristics, automatically-synchronized sweeps at line or field rate, bridging, or terminating, or differential signal inputs, keyed dc restorer, stable gain characteristics. Simplicity of controls aids in easy monitor operation.

VERTICAL DEFLECTION SYSTEM

Frequency Response—A response selector switch selects any one of four characteristics: IRE, with high-frequency cutoff about 2 mc in accordance with IRE standards for level measurements; FLAT, within 1%, between 60 cycles and 5 mc; LOW PASS, passes the stair steps but eliminates the high frequencies; HIGH PASS, with increase in gain adjustable to 5x, excludes the stair steps but passes the high frequencies for linearity tests.

Sensitivity—The basic sensitivity of the vertical amplifier is 0.015 v/cm. A three-step attenuator, 1x, 2x, 5x, and variable gain control can adjust the waveform to fill the graticule.

Stability—Electronic regulation of all dc power, and use of current stabilization in the amplifier, maintains

TYPE 525 TELEVISION WAVEFORM MONITOR

stability and constant gain. Minimum adjustment of the monitor is required after it is once set. Gain stability is within 1% over a ten-hour period.

Linearity—The vertical amplifier linearity is well above the requirements for highly accurate color-television video signal linearity measurements. Signals can be expanded to the equivalent of 35 cm, with any 7 cm accurately displayed on the screen.

DC Restorer—A clamp circuit, keyed by a pulse derived from the sync-separator circuit, restores the dc level of the display to the tip of the sync pulse at each line-frequency pulse. The restorer can be switched in or out as desired.

Vertical Input Connectors—All input connectors are located at the rear of the instrument. The vertical deflection system has push-pull input to permit two single-ended signals to be applied to the monitor at the same time. They can be independently selected, rapidly compared, or applied differentially, to cancel out in-phase unwanted signals, by a front-panel switch. Each input is paralleled with another coaxial connector to permit the monitor to bridge or terminate the video circuit. The 75-ohm terminating resistors are supplied with the instrument.

HORIZONTAL DEFLECTION SYSTEM

Sync Separator—A sync-separator circuit receives the composite video signal either internally from a point on the vertical amplifier, or through an external-trigger connector located at the rear of the instrument.

Field and Line Speeds—The sweep will synchronize automatically with either line or field pulses. Sweep frequencies correspond to 7875 cycles for line and 30 cycles for field frequencies. A front-panel switch selects one or the other sweep frequency through a relay, or connects an external circuit to the relay coil for remotely selecting one or the other sweep frequency.

Horizontal Rate, Magnifier—The variable HORIZONTAL RATE control adjusts the sweep-time rate so 2, 3, or 4 lines or fields can be displayed at one time. A three-position switch selects accurate magnification of the sweep by 1x, 5x, or 25x. Magnification expands the portion of the sweep that is centered, equally to right and left of screen center.

OTHER CHARACTERISTICS

Amplitude Calibrator—The calibrator provides pulses with a duty cycle of about 75%, and with amplitudes between .015 volts and 1.5 volts, peak-to-peak, continuously adjustable in four ranges, 0.05, 0.15, 0.5, and 1.5 volts. Accuracy is within 2% of full scale on all ranges. The continuously-adjustable interpolating control is linear within 1%.

Cathode-Ray Tube—The T52P, a Tektronix crt, is used in the Type 525. The T52P is a precision 5" flat-faced tube with a helical post-accelerating anode, providing 8 cm of linear vertical deflection. 4-kv accelerating potential provides a bright trace. P1 phosphor is provided, although other phosphors are available upon request.

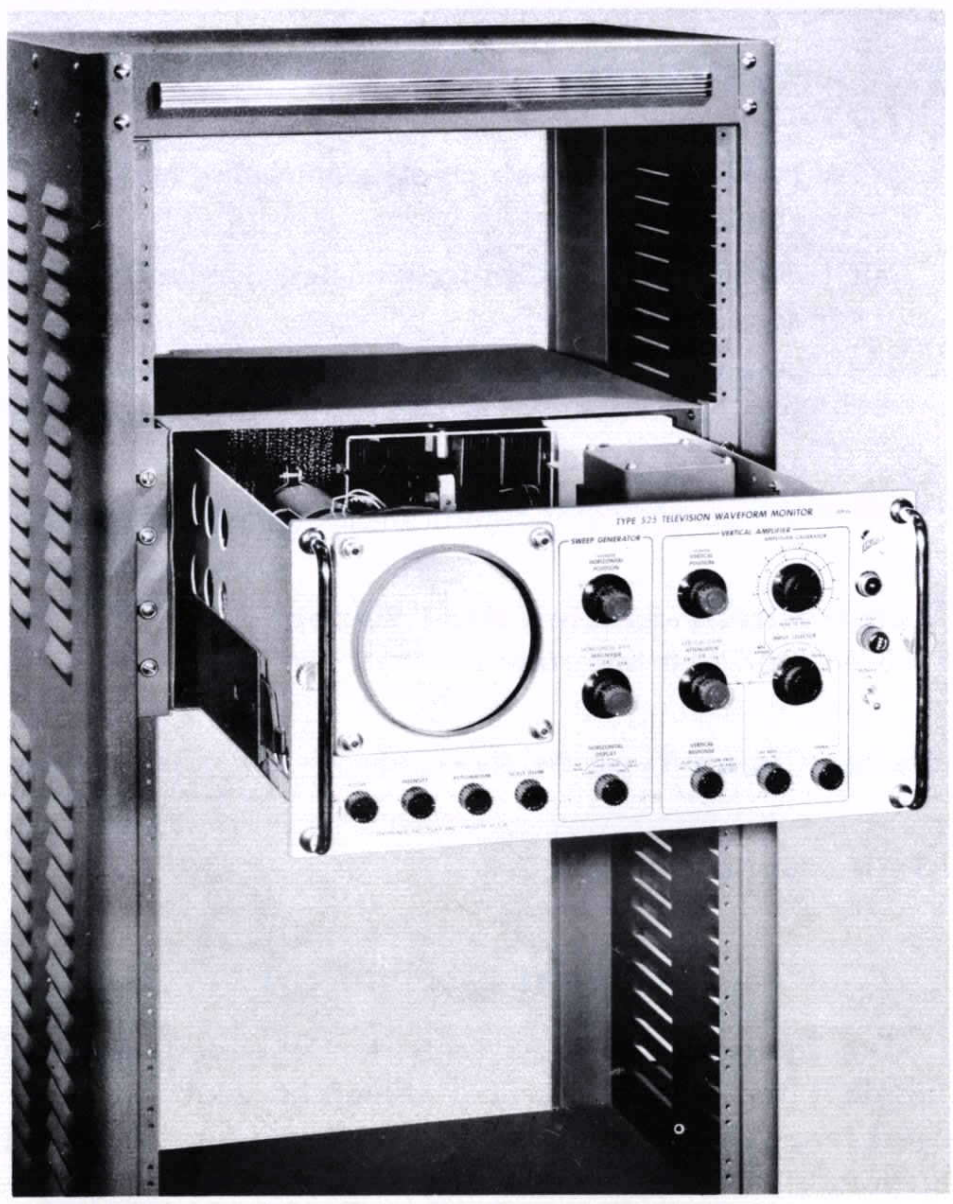
Regulated Power Supply—DC power supplies are regulated to maintain constant dc voltages for changes in load, and for ac input voltages between 105 and 125 volts, or 210 and 250 volts, 50 to 60 cycles.

Illuminated Graticule—An edge-illuminated graticule is marked in percentage, to +100 and −40. Each centimeter division equals 20%. Illumination is controlled by a front-panel knob.

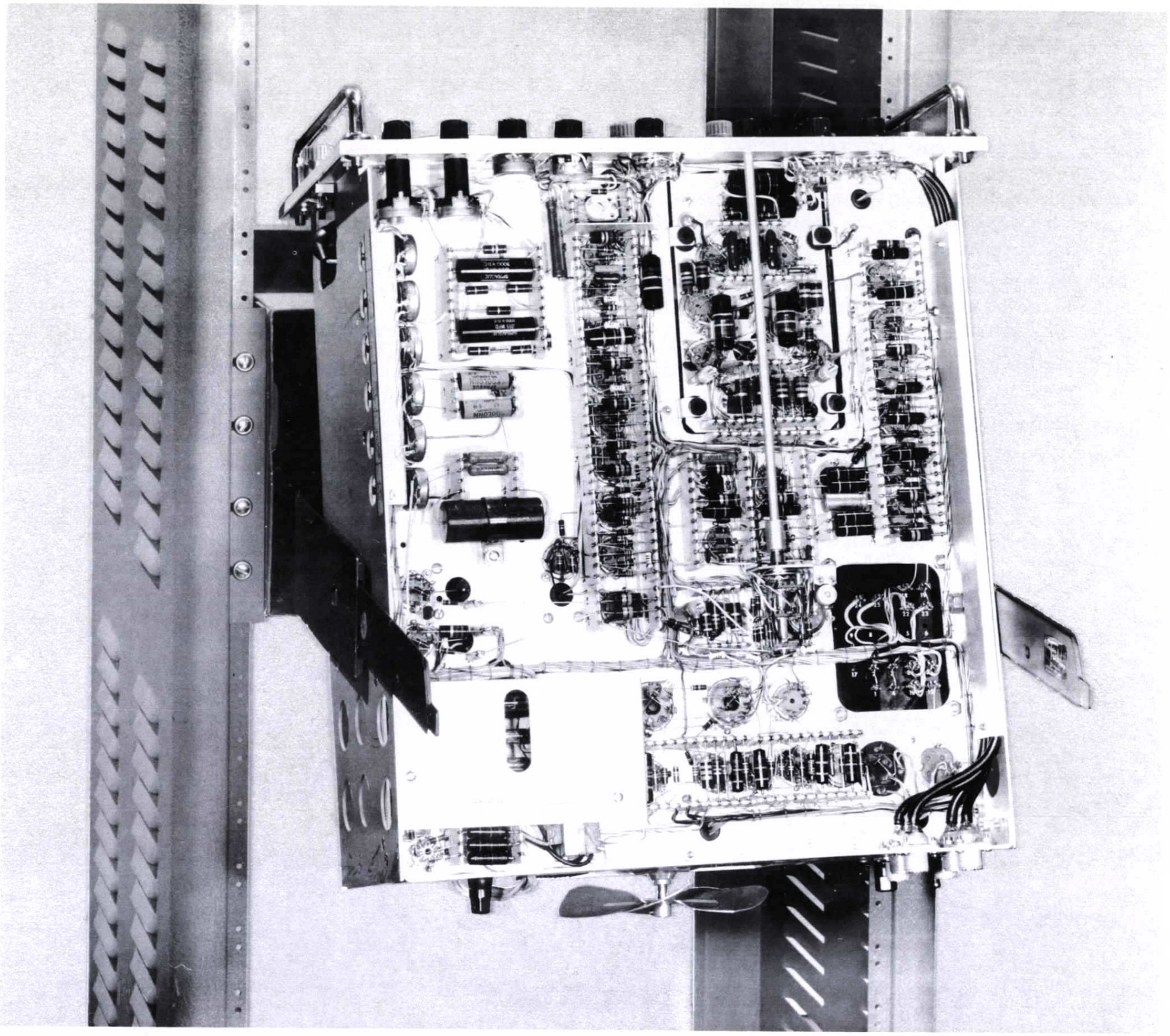
External Time Markers—A binding post, located at the rear of the instrument, is available for applying external time markers to the crt cathode.

Accessibility—The Type 525 cabinet is designed for standard rack mounting. Chassis is attached to the cabinet with a slide-out mounting that permits it to be tilted vertically, providing easy access to all components.

Internal Adjustments — Internal-adjustment controls, which may require readjustment occasionally, are mounted on the left of the chassis near the front, easily accessible to the operator from his position in front of the instrument by sliding the monitor partly out of the case.



TYPE 525 TELEVISION WAVEFORM MONITOR



VACUUM TUBE COMPLEMENT

Vertical input cathode followers		12AT7
Vertical phase splitter amplifier	2	6AU6
Cathode followers		6BQ7A
Preamplifier	2	6CL6
Preamplifier output CF		6BQ7A
Cathode followers		6BQ7A
Cathode followers		6BQ7A
Keyed-clamp diodes	2	6AL5
High-pass amplifier		6BQ7A
Cathode followers		6BQ7A
Output amplifier	2	6CL6
Internal trigger inverter		6U8
External trigger inverter		6U8
Sync-separator and relay control		6U8
Keying-pulse pickoff and shaper		6U8
Keying-pulse shaper and shaper-splitter		6BQ7A
Disconnect and clamp diode		6AL5
Clamp diode and unblanking CF		6BQ7A
Phantastron sweep generator		6AS6
Cathode followers		6BQ7A
Sweep amplifier		6BQ7A
Cathode followers		6BQ7A
Sweep output amplifier		6BQ7A
Cal multivibrator and CF		6BQ7A
Cal multivibrator and amplifier		6BQ7A
Calibrator clamp and CF		6BQ7A
Voltage reference tube		5651
Comparator		12AT7
Comparator		6U8
Regulator amplifier and CF		6U8
Series regulator		12B4
Series regulator		6080
High-voltage oscillator		6AQ5
Voltage reference CF and regulator		12AU7

TYPE 525 TELEVISION WAVEFORM MONITOR

Comparator		6U8
High-voltage rectifiers	3	5642
Cathode-ray tube		T52P1

MECHANICAL SPECIFICATIONS

Mounting—Cabinet designed to mount in a relay rack. Chassis slides forward out of the cabinet and tilts up for convenience in servicing.

Shock Mount—High-gain stages of the vertical amplifier are shock mounted to reduce vacuum-tube microphonics.

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

Construction—Aluminum-alloy cabinet and chassis.

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

Dimensions—8-23/32" high, 19" wide, 20¾" rack depth, 22¼" overall.

Weight—54 pounds.

Power Requirements—105-125 or 210-250 v, 50-60 cycles, 380 watts.

Type 525 . . . . . $1050

Includes: 1—F510-5 green filter (378503)
2—75-ohm termination resistors
1—Instruction manual

Currently Available Extras

P1 crt phosphor normally furnished.
P7, P11 optional . . . . . No extra charge

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

TYPE 530 SERIES OSCILLOSCOPES

TYPE 531 CATHODE-RAY OSCILLOSCOPE

Wide Range of Vertical-Amplifier Characteristics
Instant convertibility through changing plug-in preamplifiers.

Excellent Transient Response
Main-unit vertical-amplifier risetime—0.03 μsec.

600,000,000 to 1 Sweep Range
0.02 μsec/cm to 12 sec/cm.

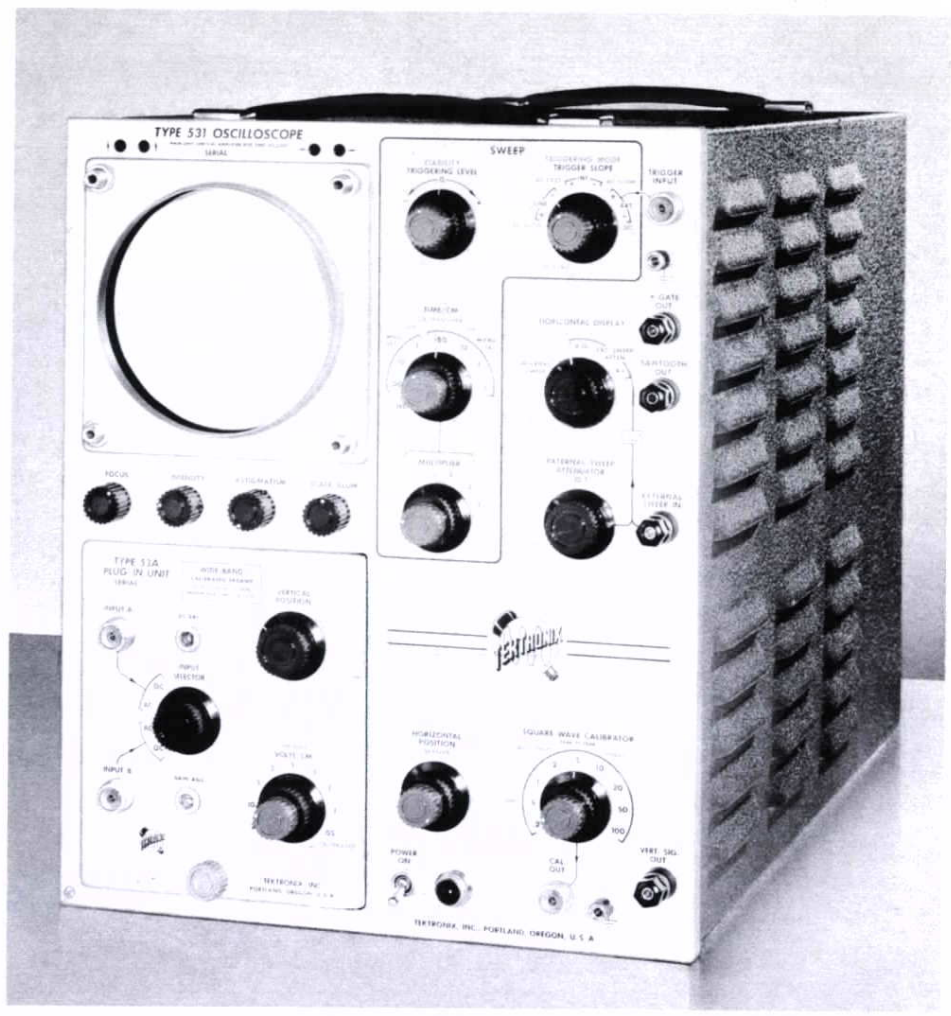
10-KV Accelerating Potential
Brighter display at low repetition rates.

Horizontal Input Amplifier
Sensitivity 0.2 v/cm to 20 v/cm, continuously variable.

DC-Coupled Unblanking

Balanced Delay Network

Beam-Position Indicators



GENERAL DESCRIPTION

The Type 531 Oscilloscope, with one of the wide-band plug-in units, is capable of a much greater range of applications than the ordinary general-purpose laboratory oscilloscope. Characteristics of the basic oscilloscope unit—wide calibrated sweep range (0.02 μsec/cm to 5 sec/cm), flexible triggering facilities, high accelerating potential (10 kv), and wide-band vertical amplifier—permit its conversion to widely differing applications through interchangeable plug-in vertical preamplifiers. Available plug-in units provide for dual-trace, high-gain differential, wide-band differential and micro-sensitive applications as well as the more usual wide-band high-gain applications. New developments in plug-in units promise future entry into other application areas with this versatile Tektronix oscilloscope.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Output Amplifier—The wide-band dc-coupled output amplifier with risetime of 0.03 μsec is 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 or Type 53/54 Plug-In Preamplifiers. In order to operate the Type 531, one of the preamplifiers must be plugged in.

Type 531 passband and risetime with the following plug-in units:

Type 53/54A — DC to 10 mc — 0.035 μsec.

Type 53/54B — DC to 10 mc — 0.035 μsec, at 0.05 v/cm to 50 v/cm. . . 2 cycles to 9 mc—0.04 μsec, at 5 v/cm to 0.05 v/cm.

Type 53/54C — DC to 10 mc — 0.035 μsec.

Type 53/54D — DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

Type 53/54E — 0.06 cycles to 60 kc.

Type 53/54G — DC to 10 mc — 0.035 μsec.

Type 53/54K — DC to 11 mc — 0.031 μsec.

Please refer to specifications of individual plug-in units for sensitivity and other characteristics. Description of the plug-in units can be found immediatley following the plug-in oscilloscopes.

Balanced Delay Network—A signal delay of 0.25 μsec is provided by the new balanced (push-pull) delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

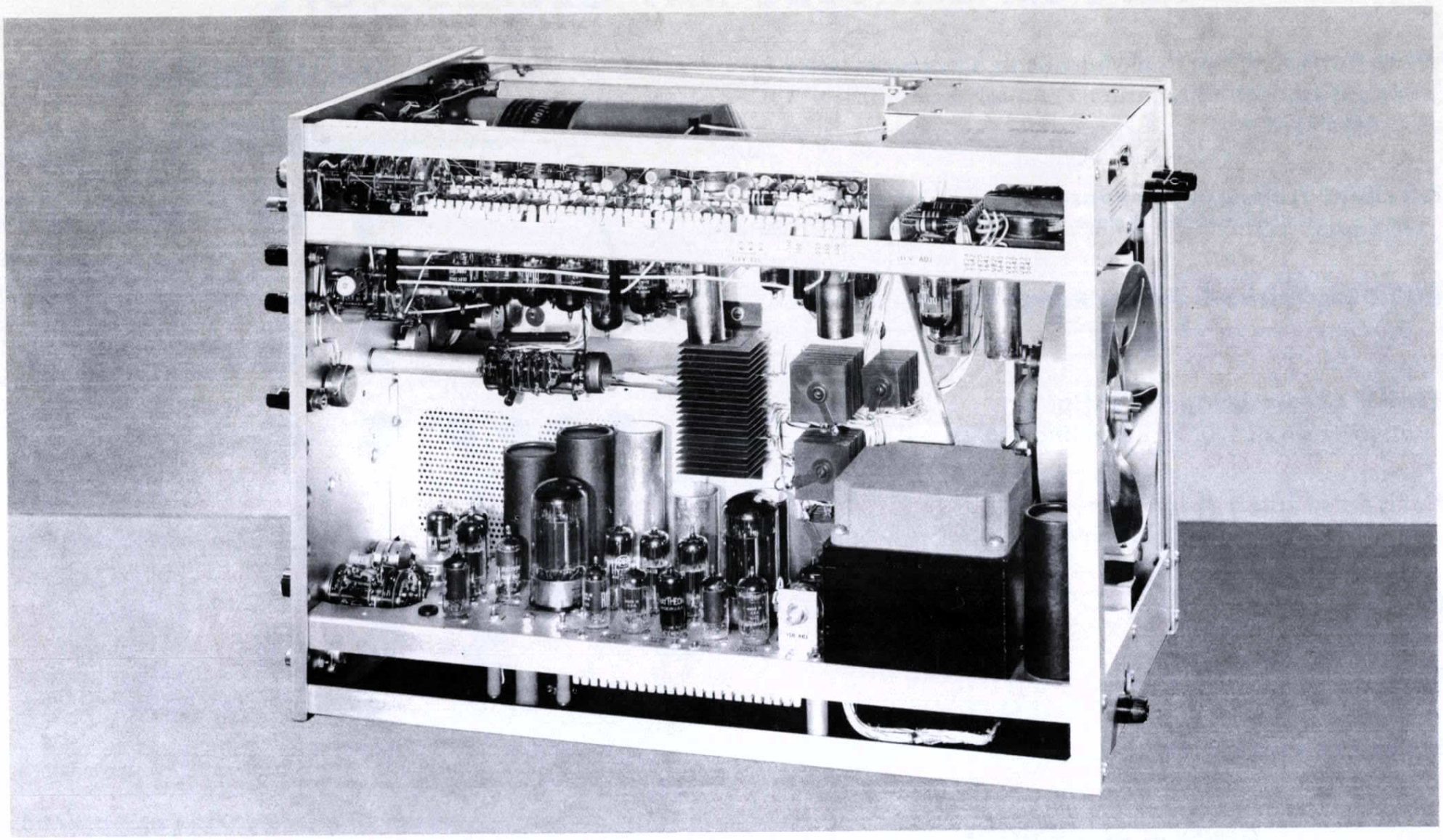
Direct input to CRT—An aperture in the side of the cabinet permits direct connection to the cathode-ray tube deflection plates.

HORIZONTAL DEFLECTION SYSTEM

A 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 μsec/cm to 12 sec/cm.

Calibrated Sweeps—The Type 531 has twenty-four calibrated sweeps, accurate within 3%. Main sweep

TYPE 530 SERIES OSCILLOSCOPES



control has eight positions—0.1, 1, 10, 100 μsec/cm . . . 1, 10, 100 msec/cm . . . 1 sec/cm. Multiplier positions of 1, 2 and 5 for each of the main sweep steps provide for a total of 24 calibrated sweeps, permitting better use of the total screen area. 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 μsec/cm to 12 sec/cm. The 5x magnifier applied to the 0.1-μsec/cm sweep extends the calibrated sweep range to 0.02 μsec/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 5x magnification is obtained on all ranges, providing an additional 24 calibrated sweeps.

DC-Coupled Unblanking—DC coupling is provided for the unblanking waveform, assuring uniform bias on the cathode-ray tube for all sweep times and repetition rates.

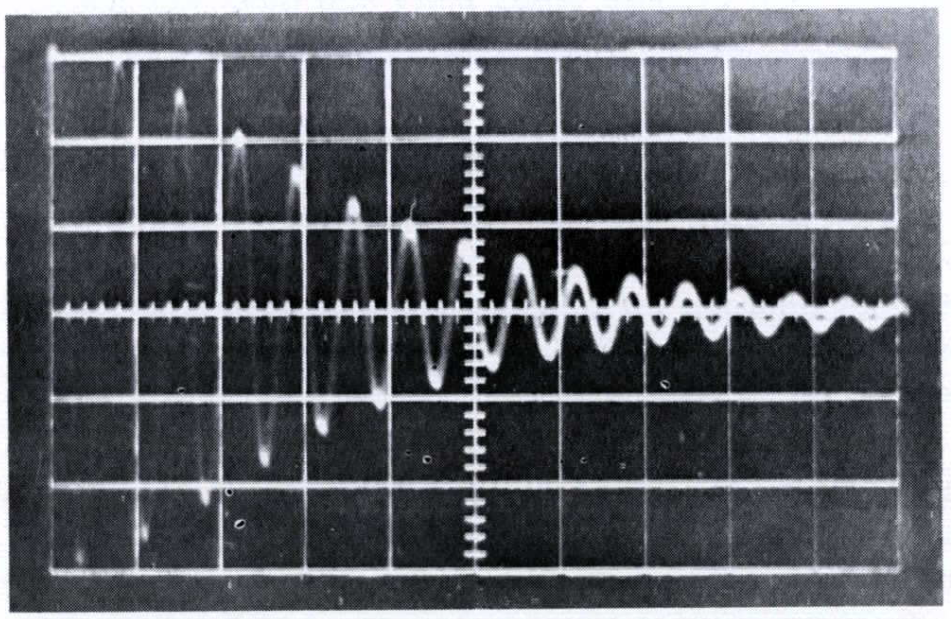
Triggering Level—The amplitude level where triggering occurs can be selected with the TRIGGERING LEVEL control. Permits triggering the sweep at a selected level on simple or complex waveforms.

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.

High-Frequency Sync—When the TRIGGER MODE switch is in the HF SYNC position, the sweep will synchronize with sine-wave signals in the frequency range of about 5 mc to about 30 mc.

Trigger Requirements—Internal triggering—a signal large enough to cause 2-mm deflection. External triggering—a signal of 0.2 v to 100 v.

Single-Sweep Recording



15-megacycle damped oscillation on single 0.1-μsec sweep shows 250-cm/μsec writing rate of the Type 531 Oscilloscope with a T51P11A crt. Recorded on 35-mm TRI-X film at f1.9 with 4.2 to 1 reduction, developed 26 minutes in D-19 at 68°F.

TYPE 530 SERIES OSCILLOSCOPES

Trigger Selection—The TRIGGER SELECTOR is a concentric 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, automatic triggering, or high-frequency sync.

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 240 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 T51PA, a Tektronix cathode-ray tube, is used in the Type 531. The T51PA is a 5" flat-faced metallized precision tube with a helical post-accelerating anode. It provides a full 6-cm x 10-cm viewing area—50% more vertical deflection than previous high-voltage tubes. For best results over the wide sweep range of the Type 531, a P2 phosphor is normally furnished with the instrument.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v, and for current-demand differences among the plug-in 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. The vertical signal is brought out to a front-panel terminal for external applications.

Beam Position Indicators—Two pairs of indicator lights show 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	6CL6
Vertical amplifier CF	2	6BQ7A
Vertical amplifiers	2	12BY7
Internal trigger amplifier		6U8
Internal trigger CF		6BQ7A
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		6CL6
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		T51P2A

MECHANICAL SPECIFICATIONS

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

Construction—Aluminum-alloy cabinet and chassis.

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

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

Weight—61 ½ pounds.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 475 watts with Type 53/54C unit plugged in.

Type 531, without plug-in units **$995**

Includes: 2—P510A probes
2—A510 binding-post adapters
1—W530B test lead (012013)
1—F510-5 green filter (378503)
1—Instruction manual

Currently Available Extras

Rack mounting . . . . . Price on request

P2 crt phosphor normally furnished,
P1, P7, P11 optional . . . . . No extra charge

Several other phosphors can be furnished on special order.

Recommended Additional Accessories

P400-Series Low-Capacitance Probes — For complete specifications please see Accessory Section.

For special test accessories for this instrument, please see the Test Accessory Section.

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

TYPE 530 SERIES OSCILLOSCOPES

TYPE 535 CATHODE-RAY OSCILLOSCOPE with Flexible Sweep Delay

GENERAL DESCRIPTION

The Type 535 Cathode-Ray Oscilloscope is essentially 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 μsec to 0.1 sec, continuously variable.

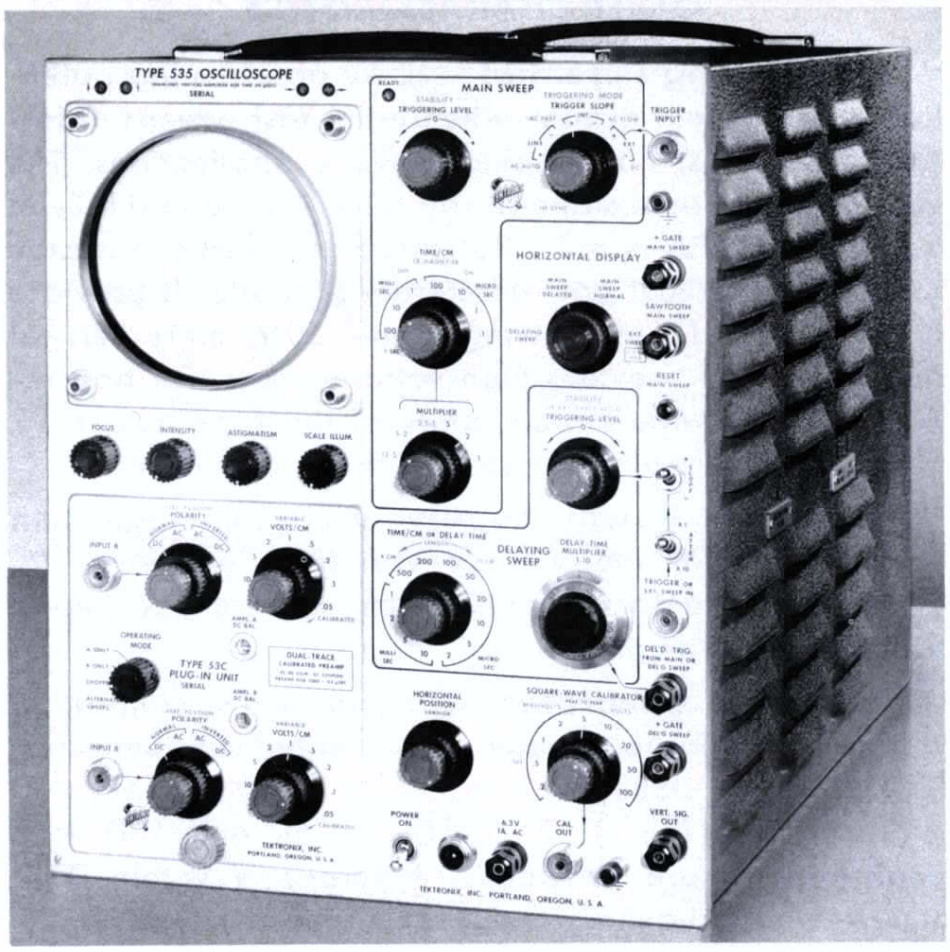
Conventional Operation
Time-jitter less than 1 part in 20,000.

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

Accuracy
Range accuracy within 1%, incremental accuracy within 0.2% of full scale.

Trigger-Rate Source
10 cycles to 40 kc, continuously variable.

ALL OTHER MAJOR SPECIFICATIONS SAME AS TYPE 531



A turn of the HORIZONTAL DISPLAY switch returns the main sweep to the screen, delayed by the selected amount.

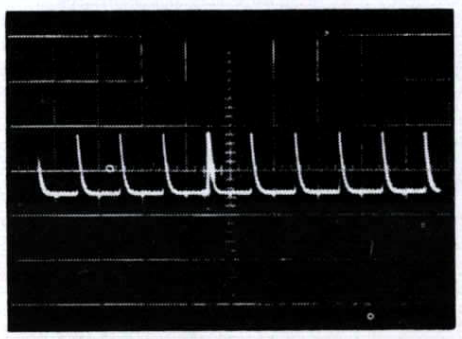
DELAYED SWEEP

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. In triggered operation the delayed sweep is started by the signal under observation, resulting in a steady display even in the presence of jitter in the incoming signal.

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.

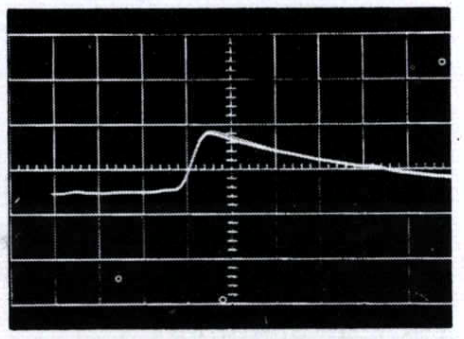
Calibration—A calibrated step control and a ten-turn precision control cover the sweep delay continuously from 1 microsecond to 0.1 second. Twelve steps—2, 5, 10, 20, 50, 100, 200, 500 μsec/cm, 1, 2, 5, and

Delaying Sweep



10-μsec/cm delaying sweep displayed on the screen. The 0.2-μsec/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-μsec/cm time base. The start of the main sweep was delayed 40 μsec.

10 msec/cm—are accurate within 1%. Incremental accuracy of the precision variable control is within 0.2%. Delay time can be read either from the screen in time per centimeter, or from the calibrated controls in total time. For extreme accuracy, any of the twelve steps can be adjusted to the accuracy of an external standard.

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.

For automatic reset operation, the delaying sweep can be adjusted to rearm the main sweep to fire on the next trigger received.

Trigger-Rate Source—Triggered sweep rates of 10 cycles to 40 kc are obtained by adjusting the duration of the free-running delaying sweep, and using it to trigger the main sweep internally, or to trigger an external device.

Delayed-Trigger Source—The delayed trigger, amplitude approximately 5 v, is derived from the main sweep or delaying sweep, depending upon the position of the HORIZONTAL DISPLAY switch. The delay is calibrated and is adjustable over the duration of the sweep sawtooth.

Other Available Waveforms—A positive gate from the delaying sweep at approximately 20-v amplitude is available at the front panel. The vertical signal is brought out from the main amplifier to a front-panel connector for use in triggering the delaying sweep or other external applications. Peak-to-peak level is about 1.5 v/cm of vertical deflection on the crt screen.

For extra convenience, 6.3 v ac at 1 amp is available at another front-panel connector.

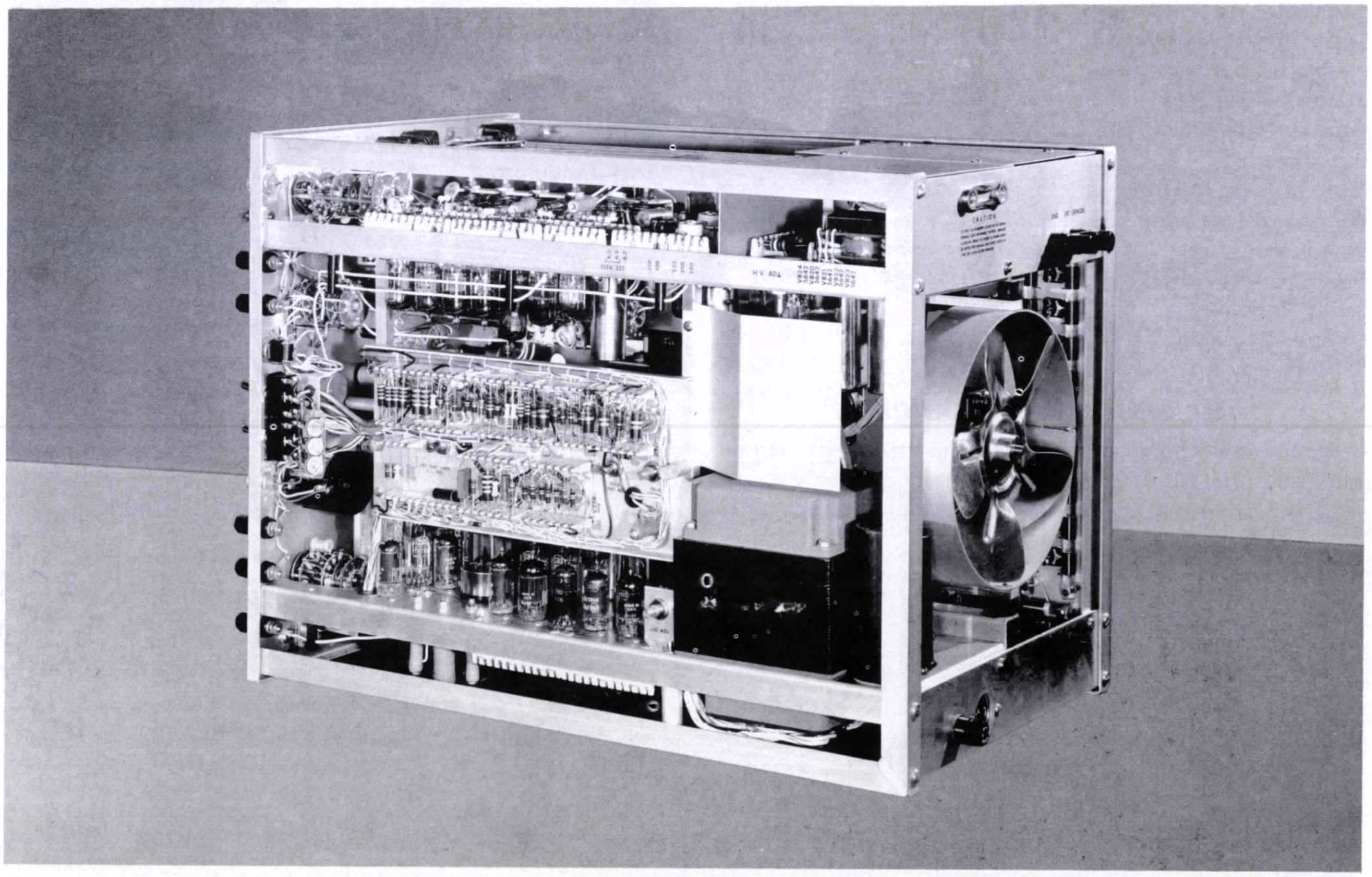
Trigger Requirements—The delaying sweep requires a trigger from 0.1 v to ±100 v fed into its TRIGGER terminal. A switch permits selection of 1x or 10x attenuation and another switch provides for positive or negative-trigger polarity.

OTHER CHARACTERISTICS

All other characteristics are identical to those of the Tektronix Type 531 Cathode-Ray Oscilloscope described in the preceding pages.

VACUUM TUBE COMPLEMENT

Vertical amplifiers	2	6CL6
Vertical amplifier CF	2	6BQ7A
Vertical amplifiers	2	12BY7



TYPE 530 SERIES OSCILLOSCOPES

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
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		6CL6
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		T51P2A

MECHANICAL SPECIFICATIONS

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

Construction—Aluminum-alloy cabinet and chassis.

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

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

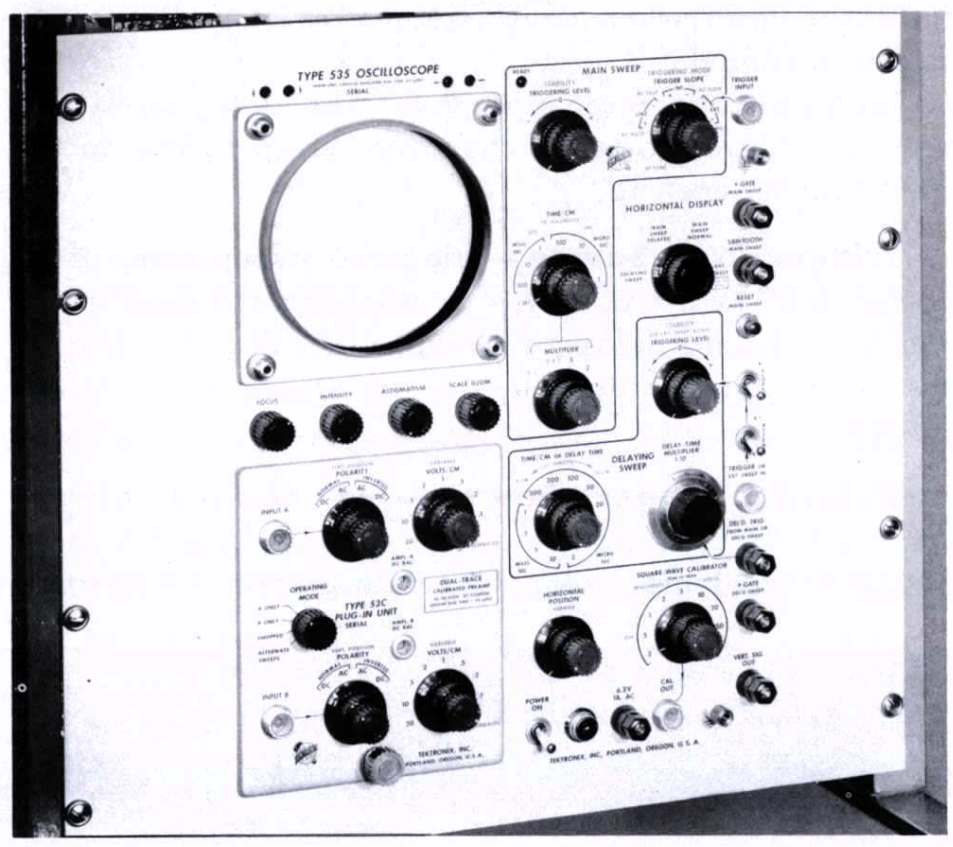
Weight—65 lbs.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 535 watts with Type 53/54C unit plugged in.

Type 535, without plug-in units.....**$1300**

Includes: 2—P510A probes
2—A510 binding-post adapters
1—W530B test lead (012013)
1—F510-5 green filter (378503) *1-power cord*
1—Instruction manual

Currently Available Extras



Rack Mounting.....Price on request
P2 crt phosphor normally furnished,
P1, P7, P11 optional.....No extra charge
Other phosphors can be furnished on special order.

Recommended Additional Accessories

P400-Series Low-Capacitance Probes — For complete specifications please see, Accessory Section.

For special test accessories for this instrument, please see the Test Accessory Section.

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

2 — $1325.00 - mod. list)
- #40 option = $1340.00
See SPR 37A

TYPE 530 SERIES OSCILLOSCOPES

TYPE 532 CATHODE-RAY OSCILLOSCOPE

Designed for Extra Dependability

Wide Sweep Range
0.2 μsec/cm to 12 sec/cm.

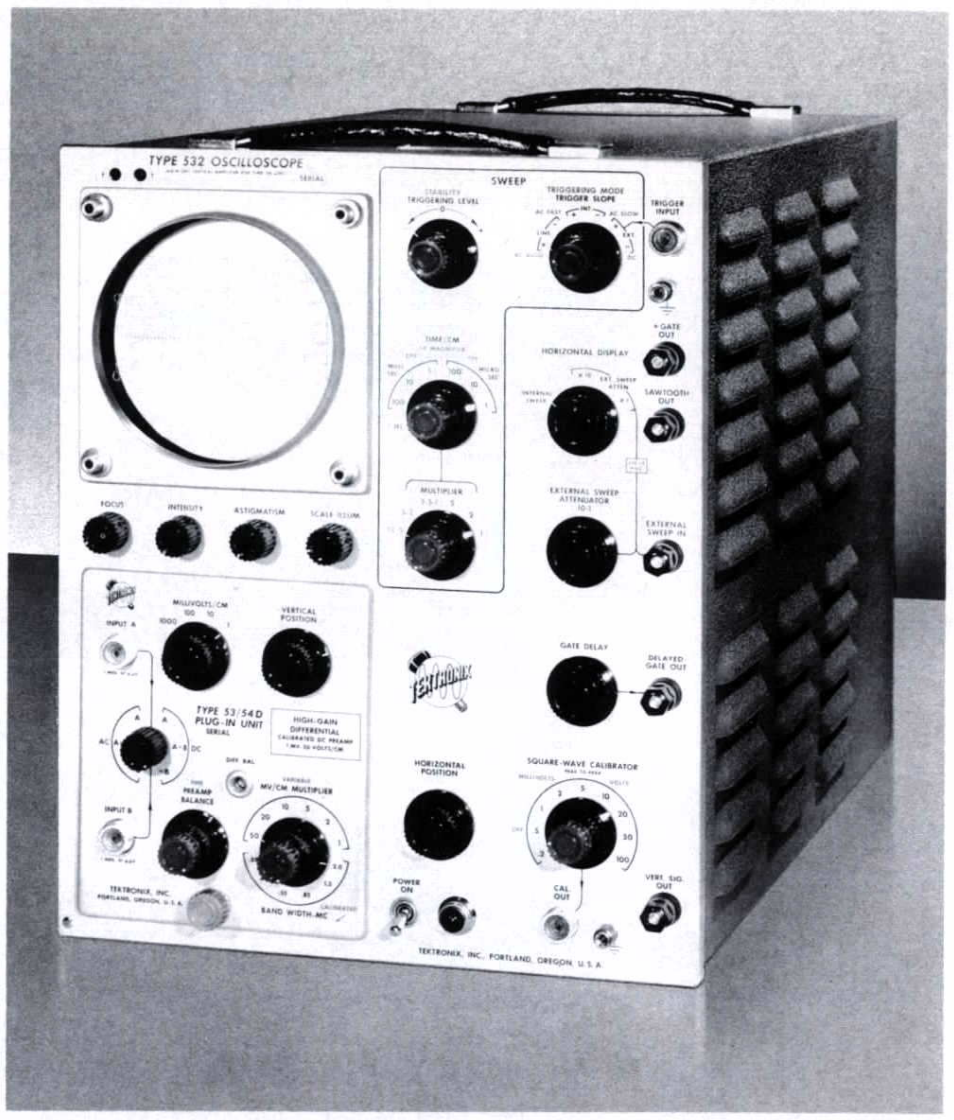
DC-Coupled Vertical Amplifier
Passband with wide-band plug-in units—dc to 5 mc.
Risetime with wide-band plug-in units—0.07 μsec.

Versatile Triggering Circuitry
Amplitude level selection or AUTOMATIC TRIGGERING.

Horizontal Input Amplifier
Sensitivity 0.2 v/cm to 20 v/cm, continuously variable.

DC-Coupled Unblanking

Vertical Beam-Position Indicators



GENERAL DESCRIPTION

The Tektronix Type 532 is designed for users who do not need the high-speed sweeps, high writing rate, and wide passband of the Type 531. Simplified circuitry eases vacuum-tube loading, lower accelerating potential reduces possibility of screen damage at very-slow sweep speeds and makes possible greater linear vertical deflection. The Type 532 has all the precision and stability you expect in Tektronix oscilloscopes. Signal-handling versatility of the Type 53 and Type 53/54 Plug-In Units is available in the Type 532, within the dc-to-5 mc passband of its main vertical amplifier. It is an instrument that will give lasting satisfaction in the many laboratory applications within its capabilities.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Output Amplifier—The vertical amplifier of the Type 532 is designed to be used with any one of the Type 53 or Type 53/54 Plug-In Preamplfiers. The passband of the Type 532 is less than 3 db down at 5 mc, adjusted for optimum transient response with the wide-band preamplifier units plugged in. Frequency response of the wide-band units is limited to that of the main-unit vertical amplifier, but the overall response is not materially affected when plug-in units with passbands of 2 mc and lower are used. The main-unit sensitivity is 0.1 v/cm with balanced input.

In order to operate the Type 532, one of the preamplifiers must be plugged in.

The 532 frequency response and risetime with the following plug-in units:

Type 53/54A—dc to 5 mc, 0.07 μsec.
Type 53/54B—dc to 5 mc, 0.07 μsec.
Type 53/54C—dc to 5 mc, 0.07 μsec.
Type 53/54D—dc to 350 kc at 1 mv/cm, increasing to 2 mc as sensitivity is decreased to 50 mv/cm.
Type 53/54E—0.06 cycles to 60 kc.
Type 53/54G—dc to 5 mc, 0.07 μsec.
Type 53/54K—dc to 5 mc, 0.07 μsec.

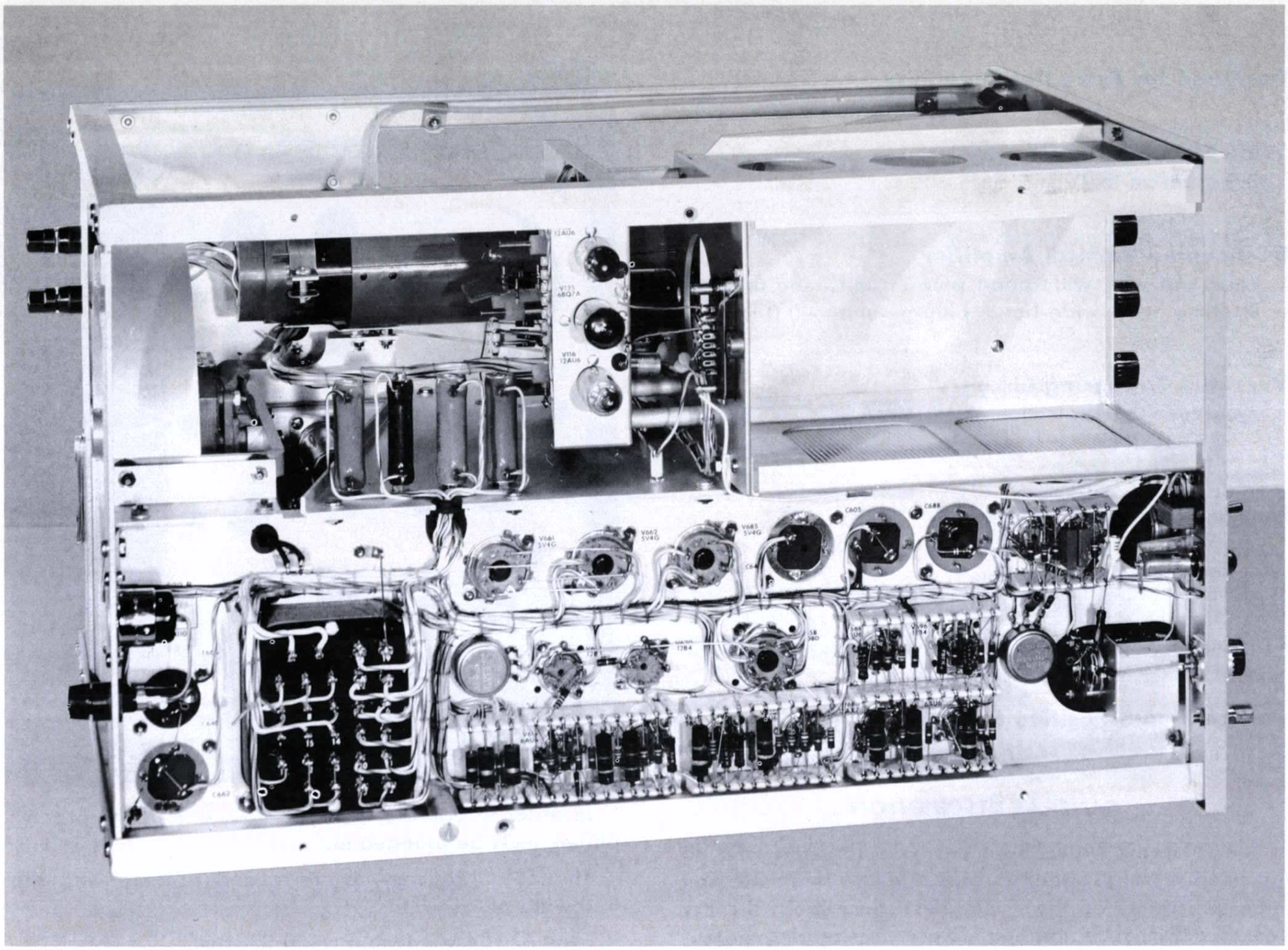
Direct Input to CRT—An aperture in the side of the cabinet permits direct connection to the crt deflection plates.

HORIZONTAL DEFLECTION SYSTEM

The sweep generator in the Type 532 is a Miller run-up type. Excellent sweep linearity results from use of inverse feedback in the timing circuits. Characteristics of the circuitry make possible the wide sweep range of 0.2 μsec/cm to 12 sec/cm.

Calibrated Sweeps—The Type 532 has twenty-one calibrated sweeps, accurate within 3%. The main sweep control has seven positions; 1, 10, 100 μsec/cm, . . . 1, 10, 100 millisec/cm, . . . 1 sec/cm. Three multi-

TYPE 530 SERIES OSCILLOSCOPES



plier switch positions of 1, 2, and 5 for each of the main sweep steps provide a total of 21 calibrated sweeps. The remaining three positions on the multiplier switch of 1 to 2.5, 2 to 5, and 5 to 12 provide continuously variable sweeps from 1 μsec/cm to 12 sec/cm. The 5x magnifier applied to the 1 μsec/cm sweep extends the calibrated sweep range to 0.2 μsec/cm.

Sweep Magnifier—Sweep magnification is obtained by effectively increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the trace is expanded to 10 cm. Any one-fifth of the magnified sweep can be displayed on the screen by means of the HORIZONTAL POSITION control. Accuracy is within 3% except on the 1 μsec/cm range, where accuracy is within 5%.

DC-Coupled Unblanking—The unblanking waveform is dc coupled to the grid of the crt to assure uniform unblanking bias for all sweep speeds and repetition rates.

Trigger Selection—A concentric control permits triggering from either the positive or negative slopes of an internal, external, or line signal; and selection of ac or dc coupling through the triggering circuits, or automatic triggering.

Automatic Triggering—With the control in the AUTO position, the sweep will be triggered by any recurrent incoming signal from approximately 60 cycles to approximately 2 mc. 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.

Triggering Level—The TRIGGERING LEVEL control selects the amplitude level where triggering occurs. It permits triggering the sweep at a selected level on simple or complex waveforms.

Trigger Requirements—Internal triggering—a signal large enough to cause 2 mm deflection. External triggering—a signal of 0.2 v to 100 v.

Horizontal Input Amplifier—DC-coupled external connection to the sweep amplifier is through a front-

panel terminal. Combination of a step attenuator and variable amplifier-gain control makes the horizontal input sensitivity continuously variable from 0.2 v/cm to 20 v/cm. Passband is dc to 300 kc.

Delayed Gate—A delayed gate voltage of approximately 20 v amplitude is available at the front panel. The amount of delay from the start of the sweep is continuously adjustable throughout the sweep duration.

OTHER CHARACTERISTICS

Cathode-Ray Tube—4-kv accelerating potential is applied to the Tektronix Type T52P cathode-ray tube. The T52P is a 5" flat-faced precision tube with a helical post-accelerating anode, providing 8 cm of linear vertical deflection. A P-2 phosphor, providing best results over the wide sweep range, is supplied unless another phosphor is requested.

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

Output Waveforms—Front-panel connectors provide a 20-volt positive-gate voltage of the same duration as the sweep, the positive-going sweep sawtooth waveform, and a positive delayed gate. The vertical signal is brought out to a front-panel terminal for external applications.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, and for current-demand differences among the Plug-In Preamplifiers.

Beam-Position Indicators—A pair of indicator lights shows the vertical direction of the electron beam when it is not on the screen.

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

VACUUM TUBE COMPLEMENT

Vertical amplifiers	2	12AU6
Cathode followers		6BQ7A
Vertical output amplifiers	2	6CL6
Beam position amplifier and internal trigger CF		6BQ7A
Vertical signal out		6AU6
Trigger amplifier		6U8
Trigger shaper		6U8
Positive multivibrator and hold-off CF		6BQ7A
Negative multivibrator		6AU6
Sweep generator		6AU6
Sweep generator CF and multi CF		6BQ7A
Disconnect diodes		6AL5
Sweep hold-off CF and stability CF		6BQ7A
Gate out CF and dual-trace trigger amplifier		6AN8
Sawtooth out CF and delayed gate out CF.		12AU7
Delayed gate pickoff	2	6AU6
External sweep amplifier		6BQ7A
Cathode follower and sweep output amplifier		6BQ7A
Sweep output amplifier and +130 v supply CF		6BQ7A
Calibrator multivibrator and CF		6BQ7A
Calibrator multivibrator		6AU6
Rectifiers	5	5V4
Voltage reference		5651
Comparators	2	12AX7
Regulator amplifiers	4	6AU6
Series regulators	3	12B4
Series regulators		6080
High-voltage oscillator		6AQ5
Shunt regulator and dc comparator		12AU7
High-voltge rectifiers	3	5642
Cathode-ray tube		T52P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures safe operating temperature.

Construction—Aluminum-alloy chassis and cabinet.

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

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

Weight—52 pounds.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 475 watts with Type 53/54D unit plugged in.

Type 532 R (Rack mounted) $850

Type 532, without plug-in units **$825**

Includes: 2—P510A probes
2—A510 binding-post adapters
1—W530-B test lead (012013)
1—F510-3 amber filter (378501)
1—Instruction manual

Currently Available Extras

Rack mounting . . . . . Price on request

P2 phosphor normally furnished.
P1, P7, P11 optional . . . . . No extra charge

Other phosphors can be furnished on special order.

Recommended Additional Accessories

For special test accessories for this instrument, please see the Test Accessory Section.

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

TYPE 540 SERIES OSCILLOSCOPES

TYPE 541 CATHODE-RAY OSCILLOSCOPE
for Fast-Rise Applications

Excellent Transient Response
Main-unit vertical-amplifier risetime—
10 millimicroseconds.

Wide Range of Vertical-Amplifier Characteristics
Instant convertibility through changing plug-in preamplifiers.

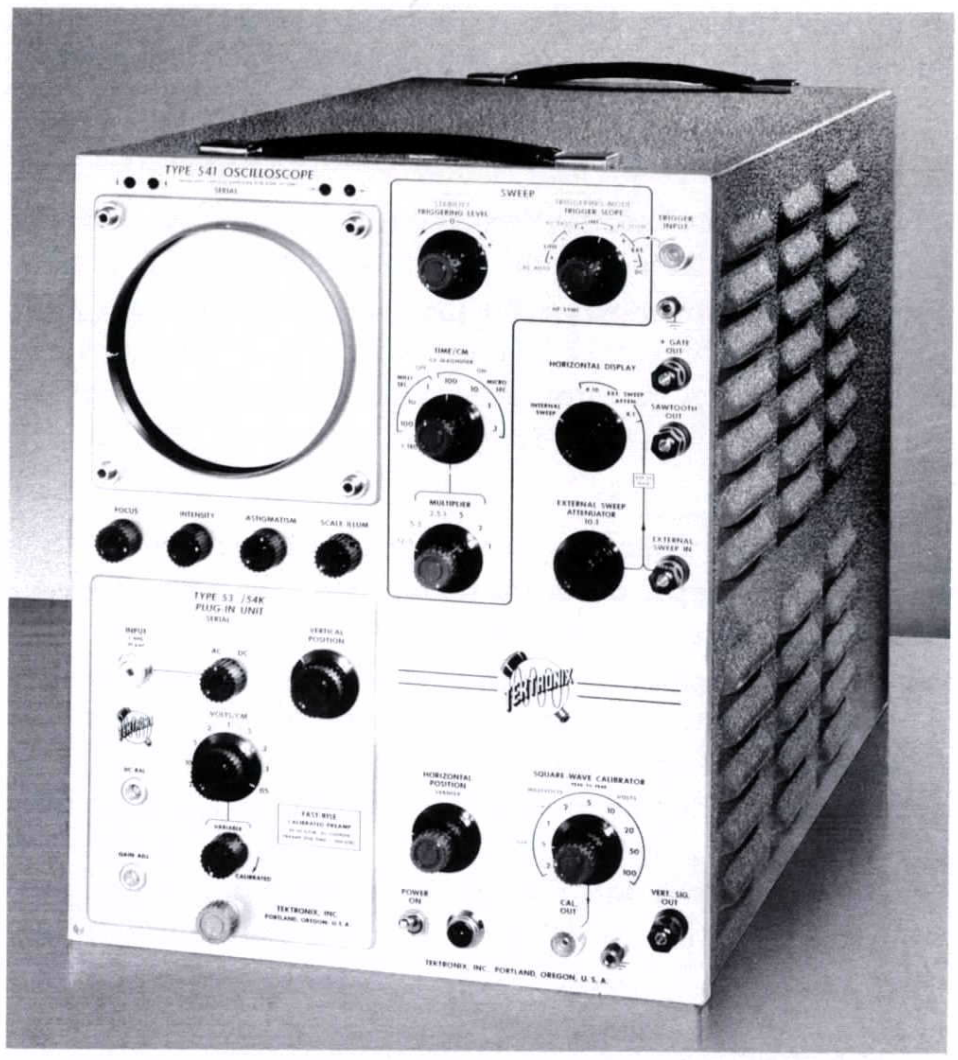
600,000,000 to 1 Sweep Range
0.02 μsec/cm to 12 sec/cm.

Versatile Triggering Circuitry
Positive and negative internal and external triggering, with 30 MC SYNC, amplitude level selection, and AUTOMATIC TRIGGERING.

10-kv Accelerating Potential

Full 4 cm x 10 cm Linear Deflection

Balanced 0.2 μsec Delay Network



GENERAL DESCRIPTION

The Tektronix Type 541 is a high-speed laboratory oscilloscope with performance capabilities far above any previous oscilloscope of its size and cost. In combination with the Type 53/54K Plug-In Unit, the Type 541 offers a vertical-amplifier passband of dc to 30 mc and a rise-time of 12 millimicroseconds, opening the way to faster, easier analyses of fast-rising waveforms. Wide sweep range, high accelerating potential, and full four centimeters of vertical deflection fully complement the extended vertical-amplifier range, and the convertibility provided by plug-in preamplifiers adds immensely to its value by making it adaptable to almost all laboratory-oscilloscope applications.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Output Amplifier—The wide-band fast-rise dc-coupled output amplifier has a risetime of 10 millimicroseconds, and is factory adjusted for optimum transient response.

The Type 53/54K Fast-Rise Plug-In Preamplifier, developed for Type 541 and Type 545 Oscilloscopes, provides a maximum sensitivity of 0.05 v/cm, with 12-millimicrosecond risetime, dc-to-30 mc passband, and 20-$\mu\mu$f input capacitance. (Frequency response is down 3 db $\pm$ ½ db at 30 mc, 6 db at approximately 41 mc, 12 db at approximately 55 mc.)

The Type 541 vertical deflection system is designed to be used with any of the Type 53/54 Plug-In Preamplifiers. In order to operate the Type 541, one of the preamplifiers must be plugged in.

Type 541 vertical response with the following plug-in units:

Type 53/54A — dc to 20 mc, 0.018-μsec risetime.

Type 53/54B — dc to 20 mc, 0.018-μsec risetime at 0.05 v/cm to 50 v/cm . . . 2 cycles to 12 mc, 0.03-μsec risetime at 5 mv/cm to 0.05 v/cm.

Type 53/54C — dc to 24 mc, 0.015-μsec risetime.

Type 53/54D — dc to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

Type 53/54E — 0.06 cycles to 60 kc.

Type 53/54G — dc to 20 mc, 0.018-μsec risetime.

Type 53/54K — dc to 30 mc, 0.012-μsec risetime.

Probes—Two P410 low-capacitance probes are supplied with the instrument. Input capacitance of the Type 541-Type 53/54K combination with the P410 probe is 8 $\mu\mu$f, maximum sensitivity is 0.5 v/cm. Excellent transient response is retained, as the P410 introduces no overshoot or ringing, but frequency response is down an additional 1 db at 30 mc. Accessory probes are available with input capacitances of 12 $\mu\mu$f at 5x, 5.5 $\mu\mu$f at 20x, and 2.5 $\mu\mu$f at 50x attenuation.

TYPE 540 SERIES OSCILLOSCOPES

Balanced Delay Netork — A signal delay of 0.2 μsec is introduced by the 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 deflection plates.

HORIZONTAL DEFLECTION SYSTEM

The horizontal deflection system of the Type 541 is essentially the same as that of the Tektronix Type 531. Sweep generator used in the Type 541 is the Miller runup type. Inverse feedback in the timing circuitry assures excellent linearity. Characteristics of this circuitry provide an extremely wide sweep range of 0.02 μsec/cm to 12 sec/cm.

Calibrated Sweeps—The Type 541 has twenty-four calibrated sweeps, accurate within 3%. The main sweep control has 8 positions—0.1, 1, 10, 100 μsec/cm . . . 1, 10, 100 msec/cm . . . 1 sec/cm. Multiplier positions of 1, 2, and 5 for each main-sweep step provide a total of 24 calibrated sweeps, permitting better use of the total screen area. The remaining three positions on the multiplier switch are 1 to 2.5, 2 to 5, and 5 to 12 variable positions, making the sweep time continuously variable from 0.1 μsec/cm to 12 sec/cm. The 5x magnifier applied to the 0.1 μsec/cm sweep extends the calibrated range to 0.02 μsec/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 the left and right of center to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accurate 5x magnification is obtained on all ranges, providing an additional 24 calibrated sweeps.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the grid of the cathode-ray tube, assuring uniform bias for all sweep speeds and repetition rates.

Trigger Selection—A concentric control permits triggering from either the positive or negative slopes of internal, external, or line voltage signals; and selection of ac or dc-coupling through the triggering circuits, automatic triggering, or high-frequency sync.

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

Automatic Triggering—With the control 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 approximately a 50-cycle rate, providing a reference trace on the screen.

High-Frequency Sync—When the TRIGGER MODE switch is in the HF SYNC position, the sweep will synchronize with sine-wave signals in the frequency range of about 5 mc to about 30 mc.

Trigger Requirements—Internal triggering—a signal large enough to cause a 2-mm deflection. External triggering—a signal of 0.2 v to 100 v.

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 240 kc.

OTHER CHARACTERISTICS

Cathode-Ray Tube—10-kv accelerating potential assures bright displays when using fast sweeps at low repetition rates, and in single-sweep applications. The Type 541 uses the new Tektronix Type T54P cathode-ray tube. The T54P is a 5" flat-faced metallized precision tube with helical post-accelerating anode. It provides a linear 4 cm x 10-cm viewing area. For best results over the wide sweep range of the Type 541, a P2 screen is normally furnished with the instrument.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v, and for current-demand differences among the plug-in preamplifiers.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel uhf connector. Eighteen fixed voltages—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. The vertical signal is brought out to a front-panel terminal for external applications.

Beam Position Indicators—Two pairs of indicator lights show the direction of the crt 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 measurements in time and amplitude. Illumination of the graticule is controlled by a front-panel knob.

VACUUM TUBE COMPLEMENT

Vertical beam-position indicators and input amplifiers	2	6AW8
Driver and internal trigger CF		6BQ7A
Driver and vertical signal out CF		6BQ7A

TYPE 540 SERIES OSCILLOSCOPES

Internal trigger amplifiers	2	6CB6
Distributed output amplifiers	12	6CB6
Calibrator multivibrator		6U8
Cal output and horizontal position CF		6BQ7A
Trigger amplifier		6BQ7A
Trigger shaper		6U8
Positive multivibrator and multi CF		6BQ7A
Negative multivibrator		12BY7
Unblanking and holdoff CF		6BQ7A
Stability and holdoff CF		6BQ7A
Sawtooth and gate CF		6BQ7A
Dual-trace sync amplifier		6AU6
Disconnect diodes		6AL5
Sweep generator		6CL6
Sweep generator CF		6BQ7A
External horizontal and dc level CF		12AU7
External horizontal amplifier		6BQ7A
Horizontal driver CF		6BQ7A
Horizontal amplifier and output CF	2	6BQ7A
Sweep start compensator		6CL6
Voltage reference		5651
Comparator amplifiers	2	12AX7
Regulator amplifiers	5	6AU6
Series regulators	4	12B4
Series regulators	2	6080
High-voltage oscillator		6AU5
Regulator		12AU7
High-voltage rectifiers	5	5642
Cathode-ray tube		T54P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperatures.

Construction—Aluminum-alloy chassis and cabinet.

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

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

Weight—61 ½ pounds.

Power Requirements—105-125 v or 210-250 v 50-60 cycles, 485 watts with Type 53/54K Unit plugged in.

Type 541, without plug-in units.....**$1145**

Includes: 2—P410 probes
2—A510 binding-post adapters
1—W530B test lead (012013)
1—F510-5 green filter (378503)
1—Instruction manual

Type 541R (Rack mounted) #1,170

Currently Available Extras

Rack mounting.....Price on request

P2 crt phosphor normally furnished,

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

Other phosphors can be furnished on special order.

Recommended Additional Accessories

Low Capacitance Accessory Probes—for use with wide-band Plug-In Units. These probes preserve the excellent transient response, introducing no overshoot or ringing, but cause an additional frequency-response loss of approximately 1 db at 30 mc.

Probe	Input Impedance	Maximum Sensitivity	Price
P405	12 $\mu\mu$f, 5 megohms	0.25 v/cm	$10.50
P410	8 $\mu\mu$f, 10 megohms	0.5 v/cm	10.50
P420	5.5 $\mu\mu$f, 10 megohms	1 v/cm	10.50
P450-L	2.5 $\mu\mu$f $\pm$10%, 10 megohms	2.5 v/cm	12.50
P4100	2.5 $\mu\mu$f $\pm$10%, 10 megohms	5 v/cm	12.50

P510A Probe—This probe should be used in place of the low-capacitance probes when the more-sensitive plug-in units—Type 53/54B and Type 53/54D—are used with the Type 541. Please see the Accessory Section for complete specifications.

For special test accessories for this instrument, please see the Test Accessory Section.

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

TYPE 540 SERIES OSCILLOSCOPES

TYPE 545 CATHODE-RAY OSCILLOSCOPE with Flexible Sweep Delay

Wide-Range Calibrated Sweep Delay
1 μsec to 0.1 sec, continuously variable.

Two Operating Modes
Conventional Operation—Inherent 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 Calibration
Range accuracy within 1%, incremental accuracy within 0.2% of full scale.

Trigger Rate Source
10 cycles to 40 kc, continuously variable.

All other major specifications same as Type 541.

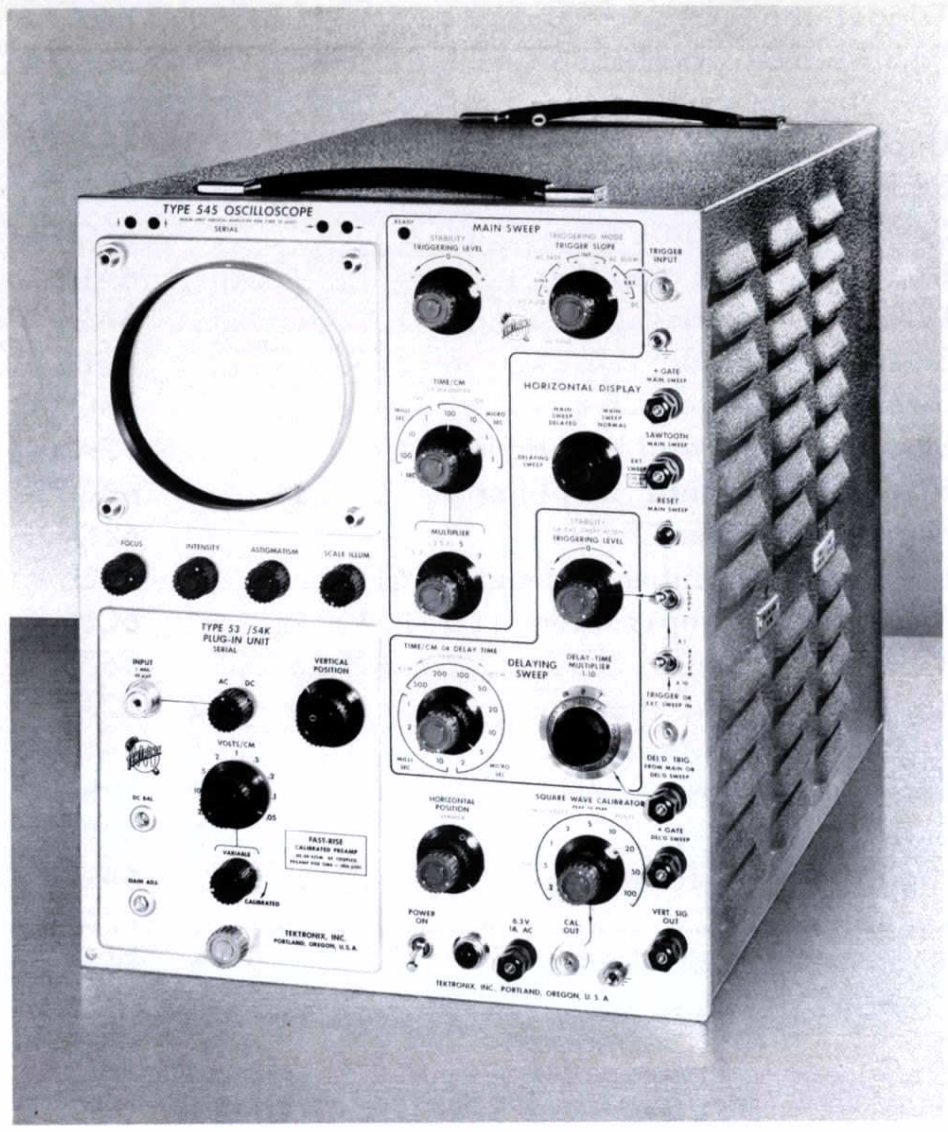
GENERAL DESCRIPTION

The Type 545 Cathode-Ray Oscilloscope is essentially the Type 541 plus the 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 541 section of this catalog for these specifications.

DELAYED SWEEP

The sweep-delaying system of the Type 545 is essentially the same as that of the Tektronix Type 535. 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 trigger 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. In triggered operation, the delayed sweep is started by the signal under observation, resulting in a steady display even in the presence of jitter in the incoming signal.

Sweep delay is accomplished in the Type 545 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 crt screen. When viewing the delaying sweep, the main sweep appears upon it as a section of increased brightness, and may be ranged in or out 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 after the period of delay. A turn of the HORIZONTAL DISPLAY switch returns the main sweep to the screen, delayed by the selected amount.

Calibration—A calibrated step control and a ten-turn precision control cover the sweep delay continuously from 1 microsecond to 0.1 second. Twelve steps—2, 5, 10, 20, 50, 100, 200, 500 μsec/cm, 1, 2, 5, and 10 msec/cm—are accurate within 1%. Incremental accuracy of the precision variable control is within 0.2%. Delay time can be read either from the screen in time per centimeter, or from the calibrated controls in total delay time. For extreme accuracy, any of the twelve steps can be adjusted to the accuracy of an external standard.

Manual Reset—Single sweeps can 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 the main sweep is reset and ready

to accept a trigger. For automatic reset operation, the delaying sweep can be adjusted to rearm the main sweep to fire on the next trigger received.

Trigger-Rate Source—Triggered sweep rates of 10 cycles to 40 kc are obtained by adjusting the duration of the free-running delaying sweep, and using it to trigger the main sweep internally, or to trigger an external device.

Delayed-Trigger Source—The delayed trigger, amplitude approximately 5 v, is derived from the main sweep or delaying sweep, depending upon the position of the HORIZONTAL DISPLAY switch. The delay is calibrated and is adjustable over the duration of the sweep sawtooth.

Other Available Waveforms—A positive gate from the delaying sweep at approximately 20-v amplitude is available at the front panel. The vertical signal is brought out from the main amplifier to a front-panel connector for use in triggering the delaying sweep or other external applications. Peak-to-peak level is about 1.5 v/cm of vertical deflection on the crt screen.

For extra convenience, 6.3 v ac at 1 amp is available at another front-panel connector.

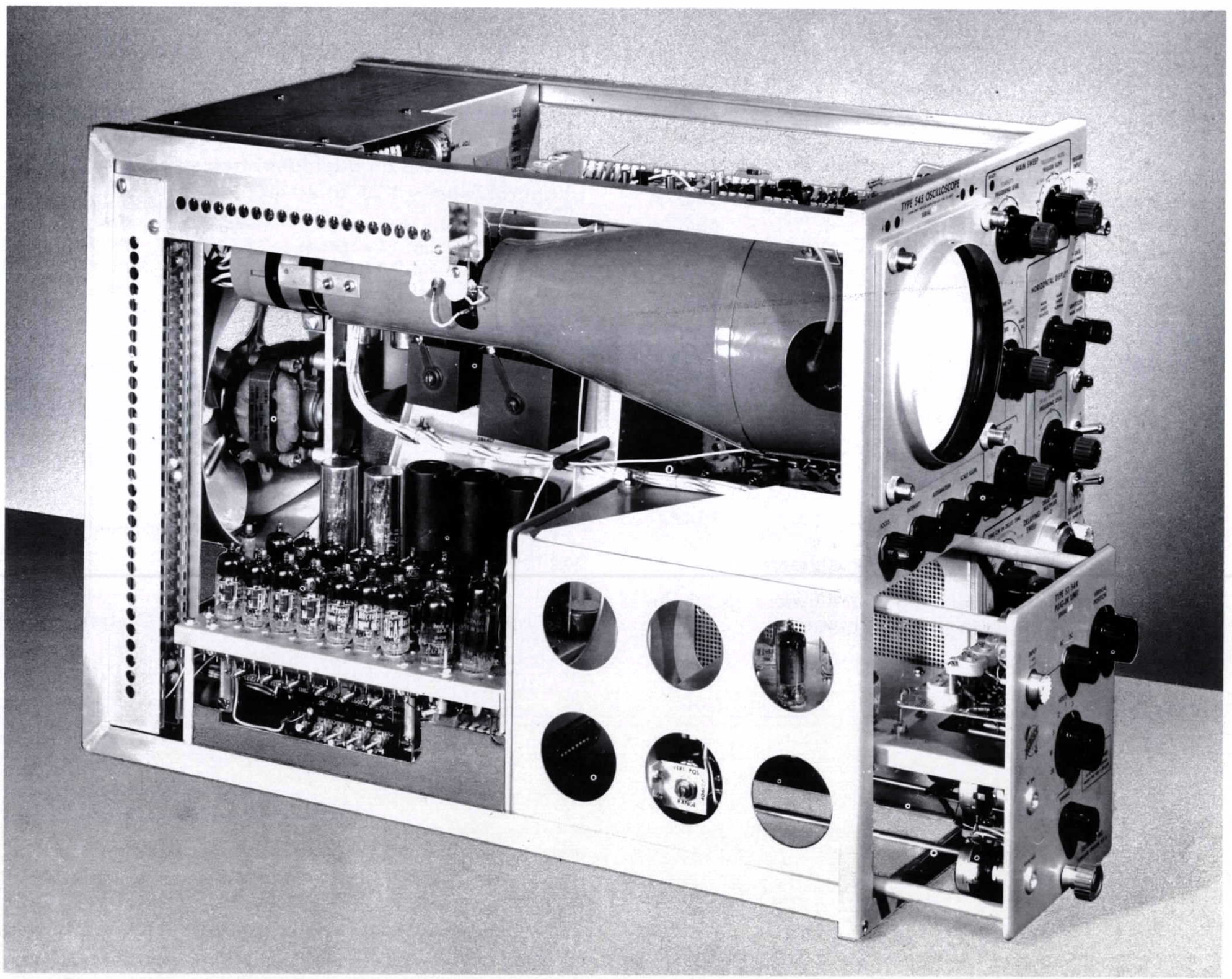
Trigger Requirements—The delaying sweep requires a trigger from 0.1 v to 100 v fed into its TRIGGER terminal. A switch permits selection of 1x or 10x attenuation and another switch provides for positive or negative trigger polarity.

OTHER CHARACTERISTICS

All other characteristics are identical to those of the Tektronix Type 541 Cathode-Ray Oscilloscope described in the preceding pages.

VACUUM TUBE COMPLEMENT

Vertical beam-position indicators and input amplifiers	2	6AW8
Driver and vertical trigger CF		6BQ7A



TYPE 540 SERIES OSCILLOSCOPES

Driver and vertical signal out CF		6BQ7A
Internal trigger amplifiers	2	6CB6
Distributed output amplifiers	12	6CB6
Calibrator multivibrator		6U8
Cal output and horizontal position CF		6BQ7A
Trigger amplifier		6BQ7A
Trigger shaper		6U8
Positive multivibrator and multi CF		6BQ7A
Negative multivibrator		12BY7
Holdoff CF		6U8
Delayed trigger amplifier and CF		6U8
Stability CF and ready indicator		6U8
Sawtooth and gate CF		6BQ7A
Dual-trace sync amplifier		6AU6
Disconnect diodes		6AL5
Sweep generator		6CL6
Sweep generator CF		6BQ7A
Delaying sweep trigger CF		12AU7
Trigger amplifier		6BQ7A
Trigger shaper and ext sweep CF		6U8
Comparator		6BQ7A
Multivibrator		6U8
Multi and gate out CF		6BQ7A
Disconnect diodes		12AL5
Sweep generator		12AU6
Sweep generator and holdoff CF		6BQ7A
Delay pickoff		6U8
Trigger shaper		6U8
Trigger CF and constant current		6U8
Horizontal driver CF		6BQ7A
Horizontal amplifier and output CF	2	6BQ7A
Sweep start compensator		6CL6
Voltage reference		5651
Comparator amplifiers	2	12AX7
Regulator amplifiers	5	6AU6
Series regulators	4	12B4
Series regulators	2	6080
Unblanking mixer		6BQ7A
High-voltage oscillator		6AU5
Regulator		12AU7
High-voltage rectifiers	5	5642
Cathode-ray tube		T54P2

MECHANICAL SPECIFICATIONS

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

Construction—Aluminum-alloy chassis and cabinet.

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

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

Weight—65 pounds.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 545 watts with Type 53/54K Unit plugged in.

Type 545R (Rack mounted $1475.00

Type 545, without plug-in units.....**$1450**

Includes: 2—P410 probes
2—A510 binding-post adapters
1—W530B test lead (012013)
1—F510-5 green filter (378503)
1—Instruction manual

545-51 = $1475.00
545-52 = $1475.00

5456 = $1,490.00
or SRR 37A

Currently Available Extras

Rack mounting.....$25.00 extra.....Price on request
P2 crt phosphor normally furnished,
P1, P7, P11 optional.....No extra charge
Other phosphors can be furnished on special order.

Recommended Additional Accessories

Low Capacitance Accessory Probes—for use with wide-band Plug-In Units. These probes preserve the excellent transient response, introducing no overshoot or ringing, but cause an additional frequency-response loss of approximately 1 db at 30 mc.

Probe	Input Impedance	Maximum Sensitivity	Price
P405	12 $\mu\mu$f, 5 megohms	0.25 v/cm	$10.50
P410	8 $\mu\mu$f, 10 megohms	0.5 v/cm	10.50
P420	5.5 $\mu\mu$f, 10 megohms	1 v/cm	10.50
P450-L	2.5 $\mu\mu$f $\pm$10%, 10 megohms	2.5 v/cm	12.50
P4100	2.5 $\mu\mu$f $\pm$10%, 10 megohms	5 v/cm	12.50

P510A Probe—This probe should be used in place of the low-capacitance probes when the more-sensitive plug-in units—Type 53/54B and Type 53/54D—are used with Type 545. Please see the Accessory Section for complete specifications.

For special test accessories for this instrument, please see the Test Accessory Section.

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

PLUG-IN PREAMPLIFIERS

TYPE 53/54A PLUG-IN UNIT

Wide-Band DC Preamplifier

Transient Response

With Type 531 and Type 535—
Risetime—0.035 μsec.

With Type 532—
Risetime—0.07 μsec.

With Type 541 and Type 545—
Risetime—0.018 μsec.

Frequency Response

With Type 531 and Type 535—
Passband—DC to 10 mc.

With Type 532—
Passband—DC to 5 mc.

With Type 541 and Type 545—
Passband—DC to 20 mc.

Sensitivity

Calibrated—0.05 v/cm to 20 v/cm.

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

GENERAL DESCRIPTION

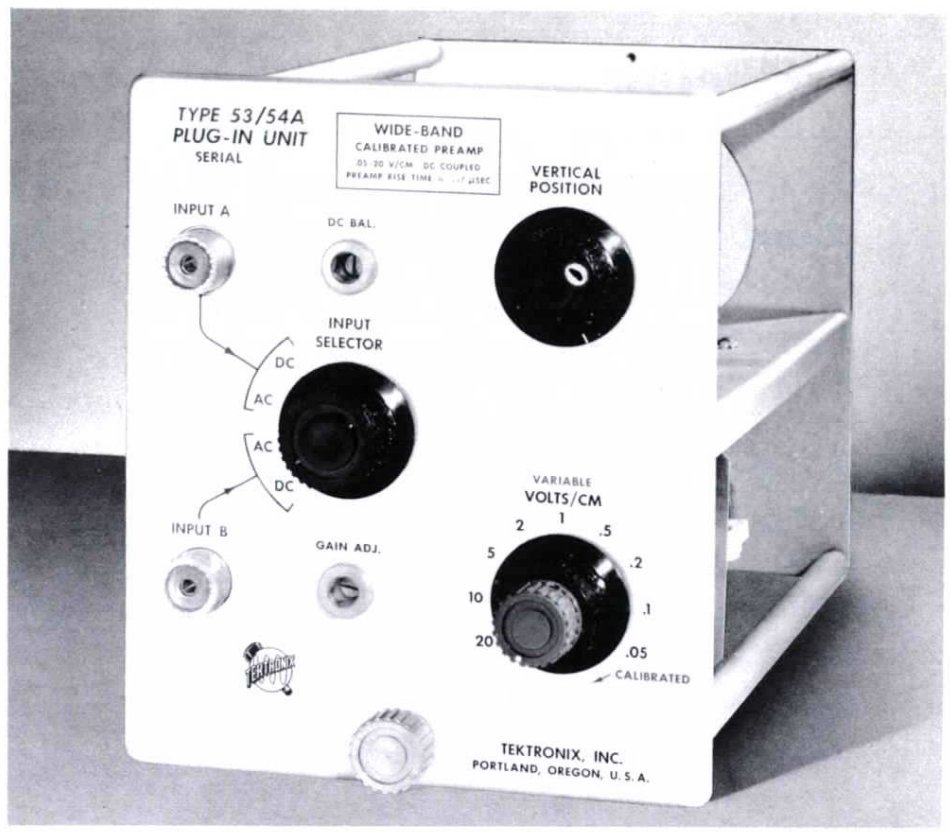
The Type 53/54A Plug-In Preamplifier meets the requirements of most wide-band applications. Wide passband, excellent transient response, dc-coupling, and calibrated sensitivity are qualities most users require in an oscilloscope vertical amplifier. The Type 53/54A gives all of these qualities to Type 530 and Type 540-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.

Calibration Accuracy—When accurately set on any one step, all other steps will be within 3% of the panel reading.

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—47 $\mu\mu$f paralleled by 1 megohm.

VACUUM TUBE COMPLEMENT

Input CF		12AU6
Amplifiers	2	12AU6
Output CF		12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight—3 ½ lbs.

Price $85

For low-capacitance accessory probes, please see the Accessory Section.

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

PLUG-IN PREAMPLIFIERS

TYPE 53/54B PLUG-IN UNIT

Wide-Band High-Gain Preamplifier

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

With Type 531 and Type 535—
0.05 v/cm to 50 v/cm, DC to 10 mc.
0.005 v/cm to 0.05 v/cm, 2 cycles to 9 mc.

With Type 532—
0.05 v/cm to 50 v/cm, DC to 5 mc.
0.005 v/cm to 0.05 v/cm, 2 cycles to 5 mc.

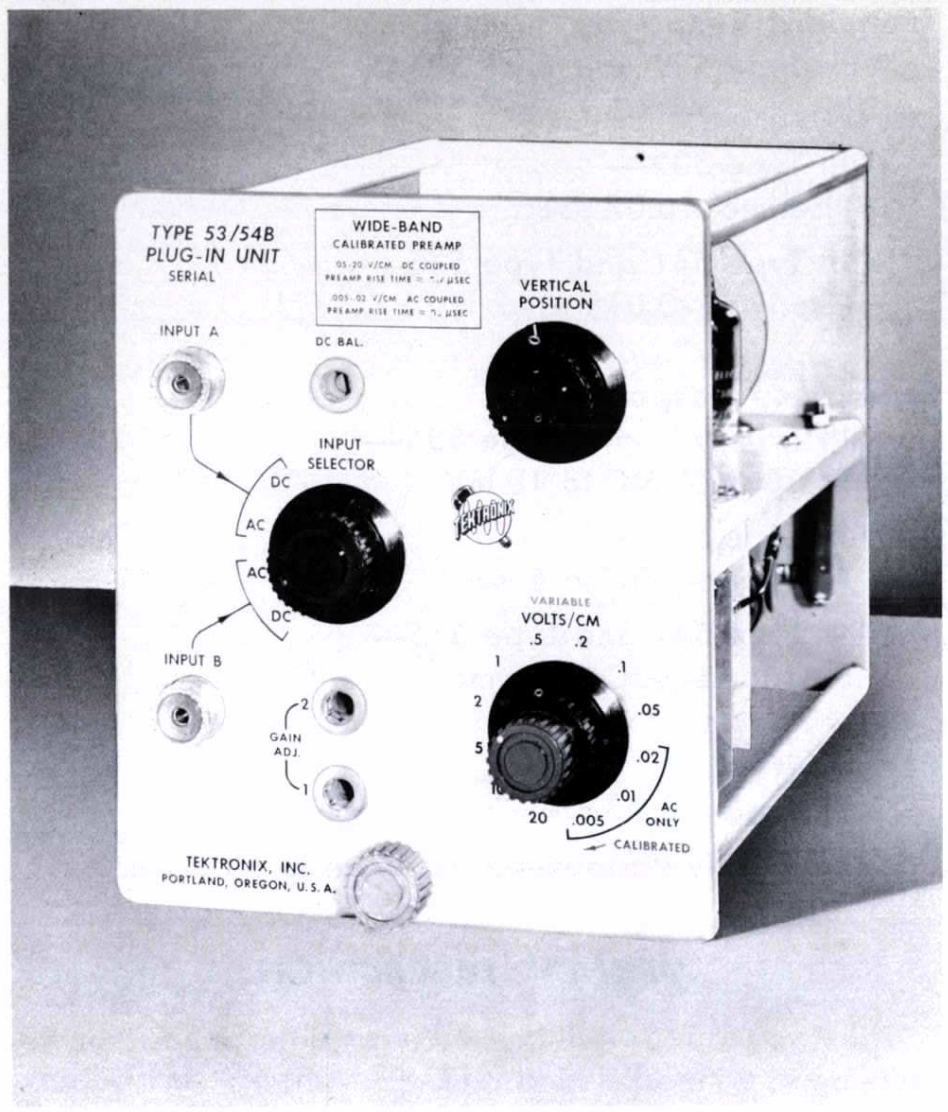
With Type 541 and 545—
0.05 v/cm to 50 v/cm, DC to 20 mc.
0.005 v/cm to 0.05 v/cm, 2 cycles to 12 mc.

Transient Response

With Type 531 and Type 535—
0.05 v/cm to 50 v/cm, 0.035-μsec risetime.
0.005 v/cm to 0.05 v/cm, 0.04-μsec risetime.

With Type 532—
0.07-μsec risetime for all sensitivities.

With Type 541 and Type 545—
0.05 v/cm to 50 v/cm, 0.018-μsec risetime.
0.005 v/cm to 0.05 v/cm, 0.03-μsec risetime.



GENERAL DESCRIPTION

The Type 53/54B Plug-In Unit is essentially the Type 53/54A with a preamplifier stage added. Three additional calibrated sensitivity steps, 0.005, 0.01, and 0.02 v/cm are available at slightly reduced frequency response and increased risetime when used with Type 531, 535, 541, 545 Oscilloscopes. In all other specifications the Type 53/54B is identical to the Type 53/54A.

OTHER CHARACTERISTICS

Calibrated Sensitivities—Twelve calibrated sensitivity steps—0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/cm are available. A variable attenuator fills in between steps, making the sensitivity continuously variable from 0.005 v/cm to 50 v/cm.

Calibration Accuracy—When accurately set on any one step, all other steps will be within 3% of the panel reading.

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—47 $\mu\mu$f paralleled by 1 megohm.

VACUUM TUBE COMPLEMENT

Preamplifier		5654
Input CF		12AU6
Cathode follower		6BQ7A
Amplifiers	2	12AU6
Output CF		12AT7

MECHANICAL SPECIFICATIONS

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

Price $125

For low-capacitance accessory probes, please see the Accessory Section.

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

PLUG-IN PREAMPLIFIERS

TYPE 53/54C PLUG-IN UNIT
Dual-Trace Preamplifier

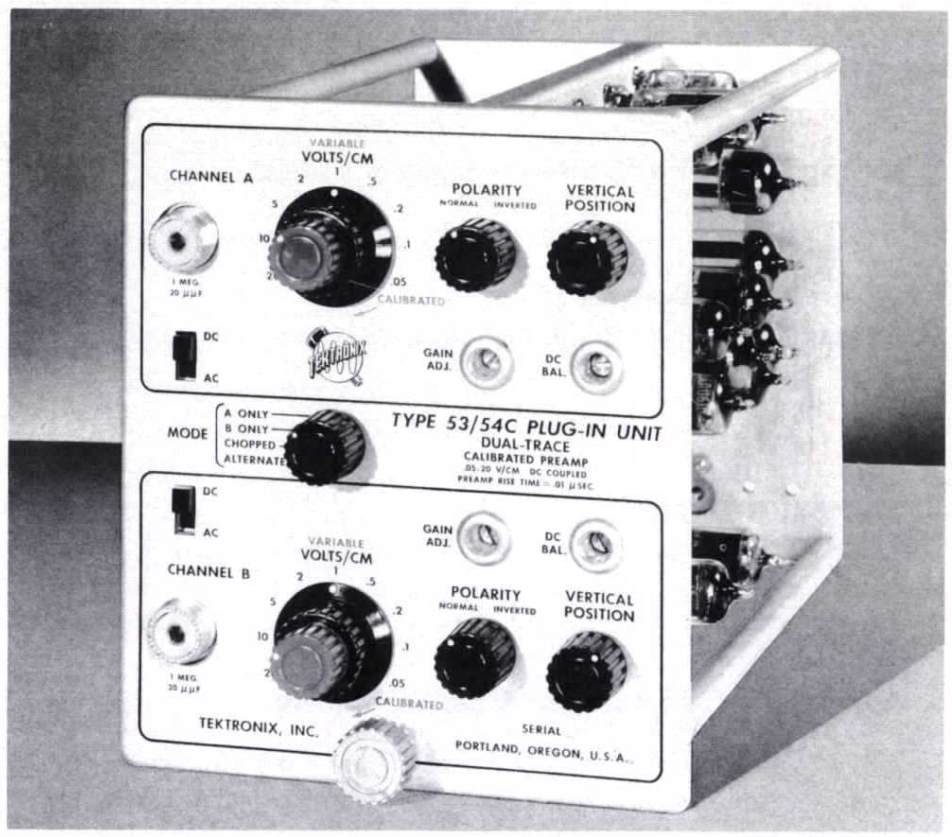
Two Identical Channels

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

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

Frequency Response
Passband—DC to 10 mc with Type 531 and Type 535.
Passband—DC to 5 mc with Type 532.
Passband—DC to 24 mc with Type 541 and Type 545.

Transient Response
Risetime—0.035 μsec with Type 531 and Type 535.
Risetime—0.07 μsec with Type 532.
Risetime—0.015 μsec with Type 541 and Type 545.



GENERAL DESCRIPTION

The Type 53/54C 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 within 2 mμsec, 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 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 53/54C 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.

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

Calibration Accuracy—When accurately set on any one step, all other steps will be within 3% of the panel reading.

Operating Mode Selection—A four-position switch 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 blocking capacitor is inserted in the AC positions, limiting the low-frequency response to 2 cycles.

Input Impedance—20 μμf paralleled by 1 megohm.

VACUUM TUBE COMPLEMENT

Input CF	2	6AK5
Amplifiers	4	12AU6
Switching amplifiers	4	6AU6
Output CF		12AT7
Coupling diode		6AL5
Multivibrator		12AU7
Multivibrator waveform shaper		12AU7
Switching CF		12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight—5½ lbs.

Price **$275**

For low-capacitance accessory probes, please see the Accessory Section.

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

PLUG-IN PREAMPLIFIERS

TYPE 53/54D 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 for in-phase signals.

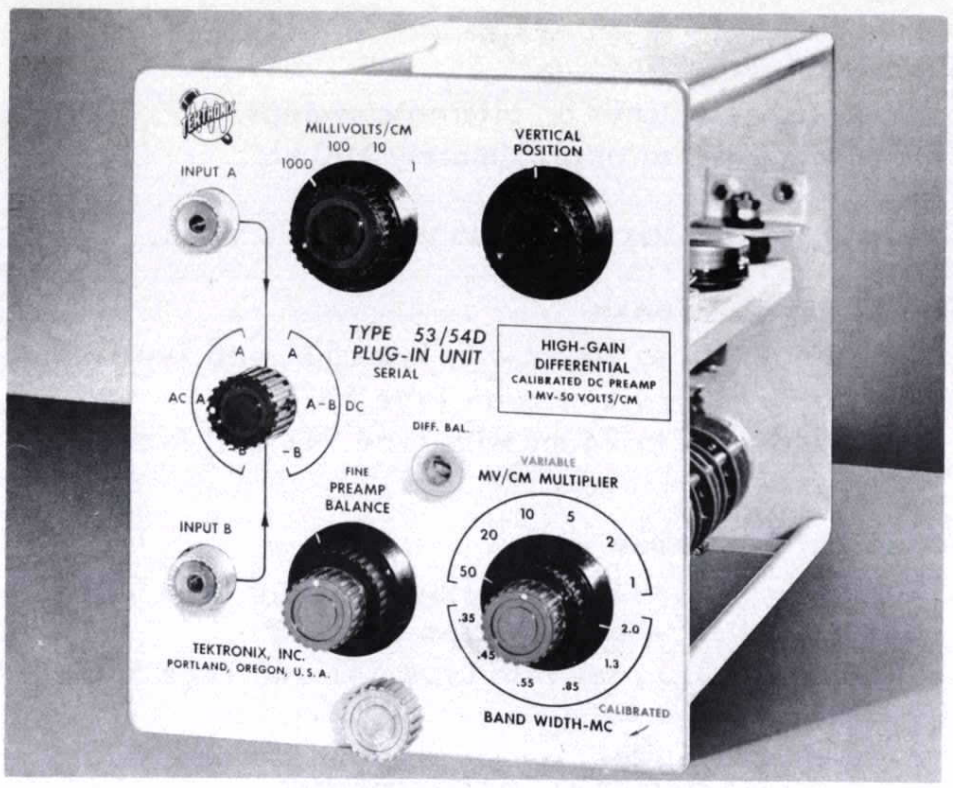
GENERAL DESCRIPTION

The Type 53/54D equips Type 530-Series and Type 540-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 MILLIVOLTS/CM switch has four calibrated positions: 1, 10, 100, and 1000 mv/cm. A six-position calibrated switch provides for multiplication by 1, 2, 5, 10, 20, and 50. Approximately 3-db point of amplifier high frequency response for each position is also indicated by this switch. 10,000-to-1 rejection ratio for in-phase signals up to 20 kc can be achieved at any position of the MV/CM MULTIPLIER switch, by careful adjustment of the differential balance control. The MV/CM MULTIPLIER, by attenuating within the amplifier, reduces drift and increases bandpass in applications that require less than maximum sensitivity. A variable attenuator control provides for continuously variable sensitivity from 1 mv/cm to 125 v/cm.



Calibration Accuracy—When accurately set on any one step, all other steps will be within 3% of the panel reading.

Input Impedance—47 $\mu\mu$f 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**

For low-capacitance accessory probes, please see the Accessory Section.

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

PLUG-IN PREAMPLIFIERS

TYPE 53/54E PLUG-IN UNIT

Low-Level Differential AC Preamplifier

Sensitivity

Calibrated—50 microvolts/cm to 10 millivolts/cm.

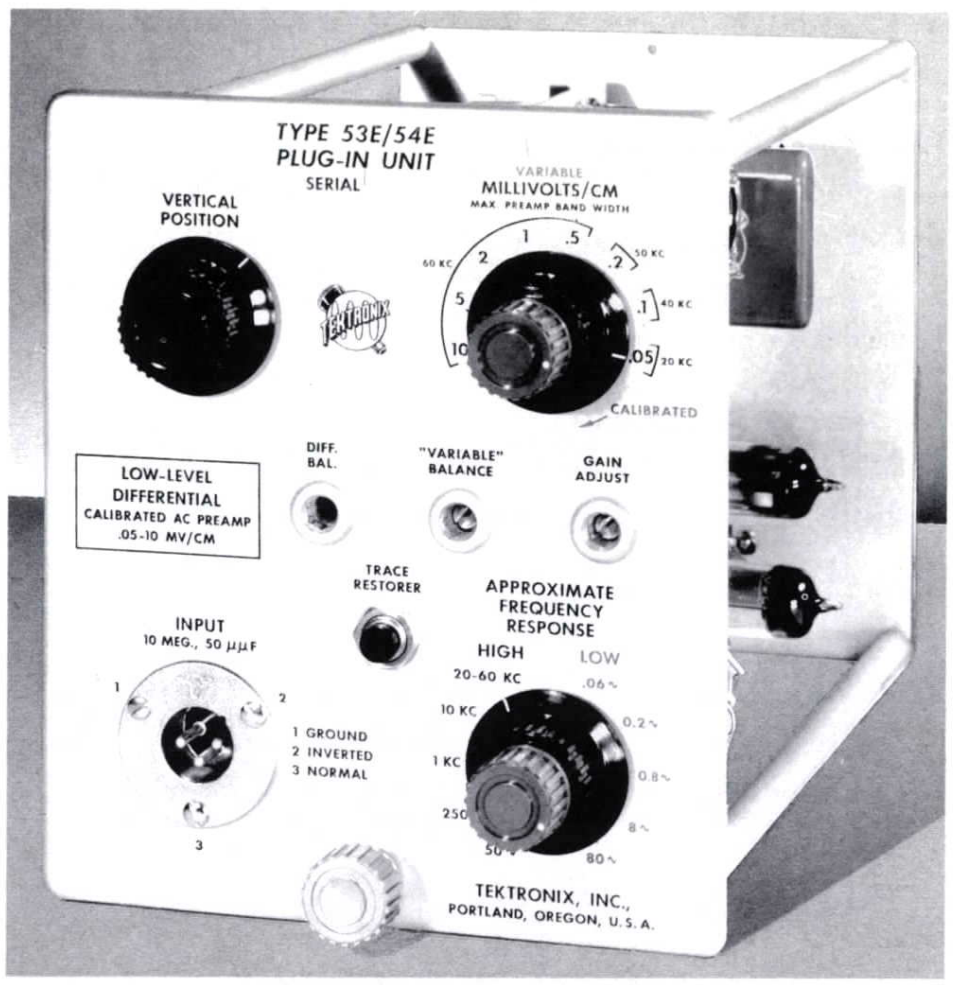
Continuously Variable—50 microvolts/cm to 25 millivolts/cm.

Frequency Response

0.06 cycles to 30 kc at full gain, increasing to 60 kc at 0.5 mv/cm.

Differential Input

50,000-to-1 rejection ratio for in-phase signals up to 1 kc of ±2 v or less.



GENERAL DESCRIPTION

The Type 53/54E Plug-In Unit provides Type 530-Series and Type 540-Series Oscilloscopes with calibrated vertical sensitivity to 50 microvolts/cm for low-level applications. Maximum combined noise and hum is 5 μv, rms, with input grids grounded at the input connector. Separate high-frequency and low-frequency response controls permit restricting the bandwidth to further increase the signal-to-noise ratio. A rejection ratio of 50,000 to 1 for in-phase signals up to 1 kc can be achieved by careful adjustment of the front-panel differential-balance control. Use of the internal attenuators has a negligible effect on the rejection figure.

OTHER CHARACTERISTICS

Calibrated Sensitivity—Eight calibrated sensitivity steps are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5 and 10 millivolts/cm. A variable attenuator fills in between steps making the sensitivity continuously variable from 50 microvolts/cm to 25 millivolts/cm.

Calibration Accuracy—When accurately set on any one step, all other steps will be within 3% of the panel reading.

Bandwidth Control—A five-position switch provides for approximate high-frequency 3-db points of 60, 10, 1, 0.25, and 0.05 kc. Another five-position switch selects the approximate low-frequency 3-db points of 0.06, 0.2, 0.8, 8 and 80 cycles. Restricting the bandwidth to the requirements of the particular application will provide an increase in the signal-to-noise ratio. Input to grids is dc-coupled to provide good rejection at low frequencies.

Trace Restorer—If the trace should be driven from the screen by a large transient, it can be returned to its normal position immediately by pressing the trace restorer button.

Input Impedance—50 μμf paralleled by 10 megohms.

VACUUM TUBE COMPLEMENT

Input amplifiers		5751
2nd stage and gain control	2	5879
3rd stage and positioning control		5814
Output CF		12AT7
Voltage regulators	2	OB2

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight—4½ lbs.

Price $165

Includes: 30" two-conductor shielded cable with input connector.

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

PLUG-IN PREAMPLIFIERS

TYPE 53/54G PLUG-IN UNIT

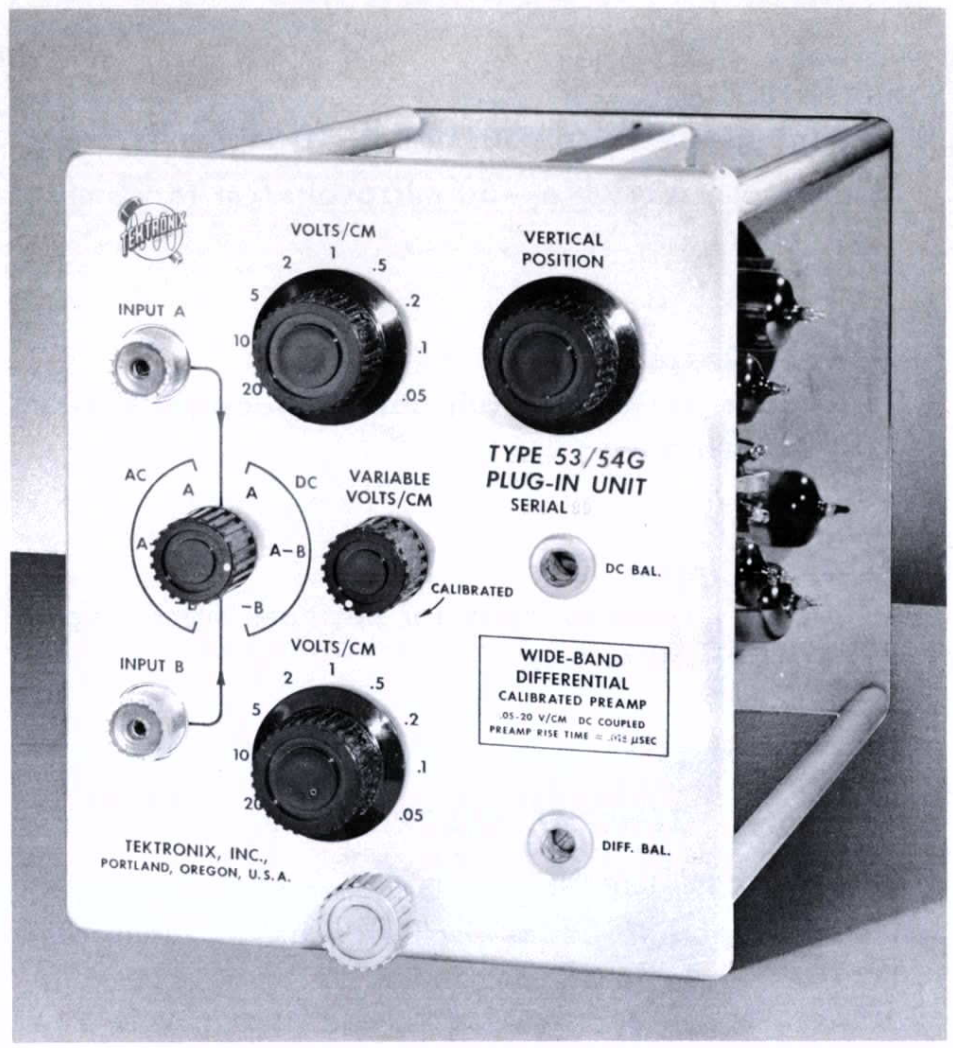
Differential-Wide-Band DC Preamplifier

Common-mode Rejection
100 to 1 at full gain.

Transient Response
Risetime—0.035 μsec with Type 531 and Type 535.
Risetime—0.07 μsec with Type 532.
Risetime—0.018 μsec with Type 541 and Type 545.

Frequency Response
Passband—DC to 10 mc with Type 531 and Type 535.
Passband—DC to 5 mc with Type 532.
Passband—DC to 20 mc with Type 541 and Type 545.

Sensitivity
Calibrated—0.05 v/cm to 20 v/cm.
Continuously Variable—0.05 v/cm to 50 v/cm.



GENERAL DESCRIPTION

The Type 53/54G Plug-In Unit equips Type 530 and Type 540-Series Oscilloscopes for wide-band differential-input applications. Common-mode rejection is better than 100 to 1 for the entire passband at full gain... better than 300 to 1 at 60 cycles. Independent step attenuators in each input with 80-db isolation permit mixing signals of wide amplitude difference. Either input can be used separately, INPUT B giving a polarity-inverted display.

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.

Calibrated Sensitivity—Each of the two attenuators has 9 calibrated positions: 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. The variable attenuator affects the gain of both inputs at the same time.

Calibration Accuracy—When accurately set on any one step, all other steps will be within 3% of the panel reading.

Input Impedance—47 $\mu\mu$f paralleled by 1 megohm.

VACUUM TUBE COMPLEMENT

Input amplifiers	2	12AU6
Cathode followers		12AT7
Output amplifiers		12AT7
Cathode followers		12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight—4 ½ lbs.

Price $175

For low-capacitance accessory probes, please see the Accessory Section.

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

PLUG-IN PREAMPLIFIERS

TYPE 53/54K PLUG-IN UNIT

Fast-Rise DC Preamplifier

Transient Response

With Type 541 and Type 545
Risetime—12 millimicroseconds.

With Type 531 and Type 535
Risetime—0.031 μsec.

With Type 532
Risetime—0.07 μsec.

Frequency Response

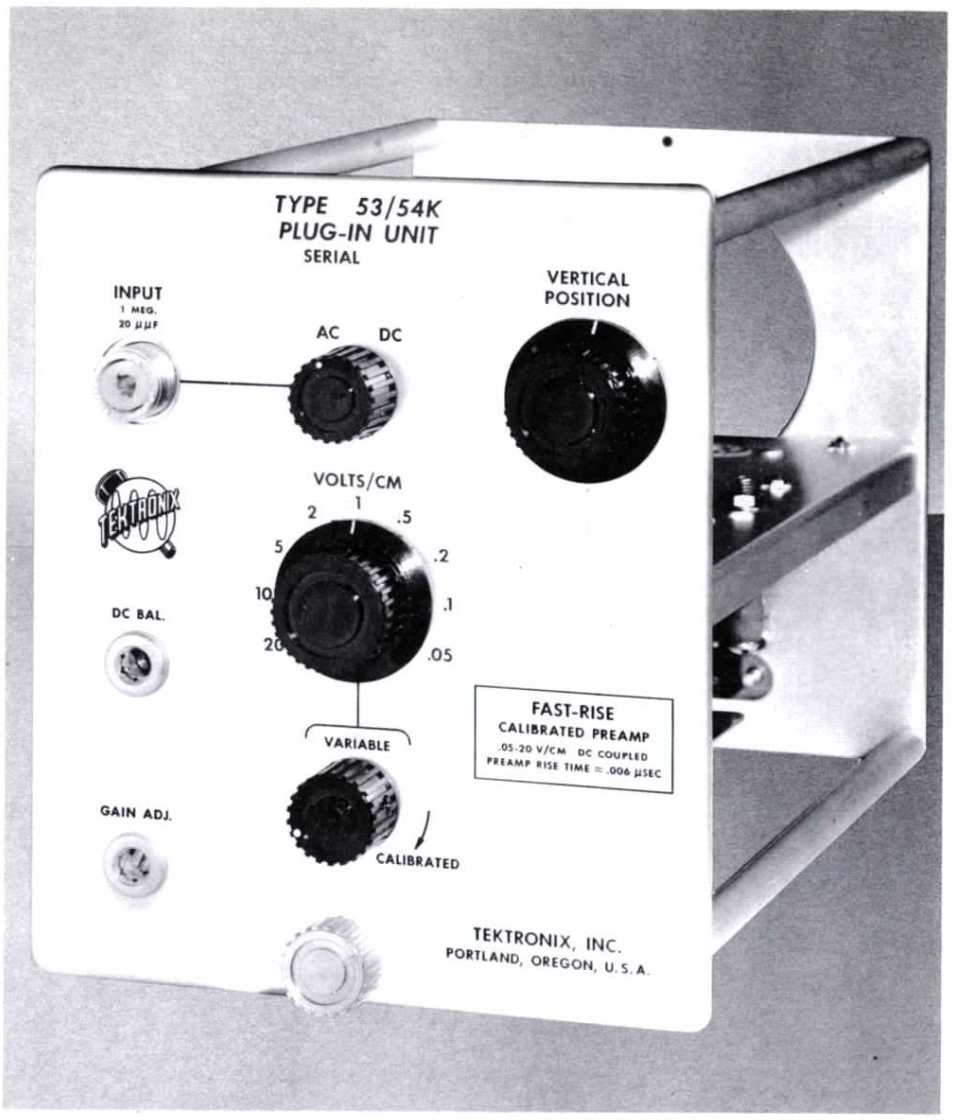
With Type 541 and Type 545
Passband—DC to 30 mc (down 3 db $\pm$ ½ db at 30 mc, 6 db at approximately 41 mc, 12 db at approximately 55 mc).

With Type 531 and Type 535
Passband—DC to 11 mc.

With Type 532
Passband—DC to 5 mc.

Sensitivity

Calibrated—0.05 v/cm to 20 v/cm.



GENERAL DESCRIPTION

The Type 53/54K Fast-Rise Unit provides Type 541 and Type 545 Oscilloscopes with calibrated sensitivity at low input capacitance, taking maximum advantage of the excellent transient response and wide frequency range of the oscilloscope vertical-deflection system. The Type 53/54K with either the Type 541 or Type 545 makes a 12-millimicrosecond risetime combination, ideal for applications involving fast-rising waveforms. Frequency response is down 3 db $\pm$ ½ db at 30 mc, 6 db at approximately 41 mc, 12 db at approximately 55 mc. The combined vertical-amplifier system is dc-coupled, and an AC-DC switch provides for insertion of a capacitor to block the dc component of the input signal, limiting the low-frequency response to 2 cycles.

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. Each step can be adjusted over approximately a 2-to-1 range by means of a variable control.

Calibration Accuracy—When accurately set on any one step, all other steps will be within 3% of the panel reading.

Input Impedance—Direct input impedance of the Type 53/54K is 1 megohm paralleled by 20 $\mu\mu$f. Input with the P410 Probe, furnished with Type 541 and Type 545 Oscilloscopes, is 10 megohms paralleled by 8 $\mu\mu$f. Other P400-Series Probes, described in the Accessory Section, provide input capacitances from 12 $\mu\mu$f to 2.5 $\mu\mu$f, at attenuation ratios from 5 to 1 up to 100 to 1.

VACUUM TUBE COMPLEMENT

Input cathode followers		12AT7
Cathode-coupled amplifiers	2	12AU6
Output cathode followers	2	12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight—3 ½ lbs.

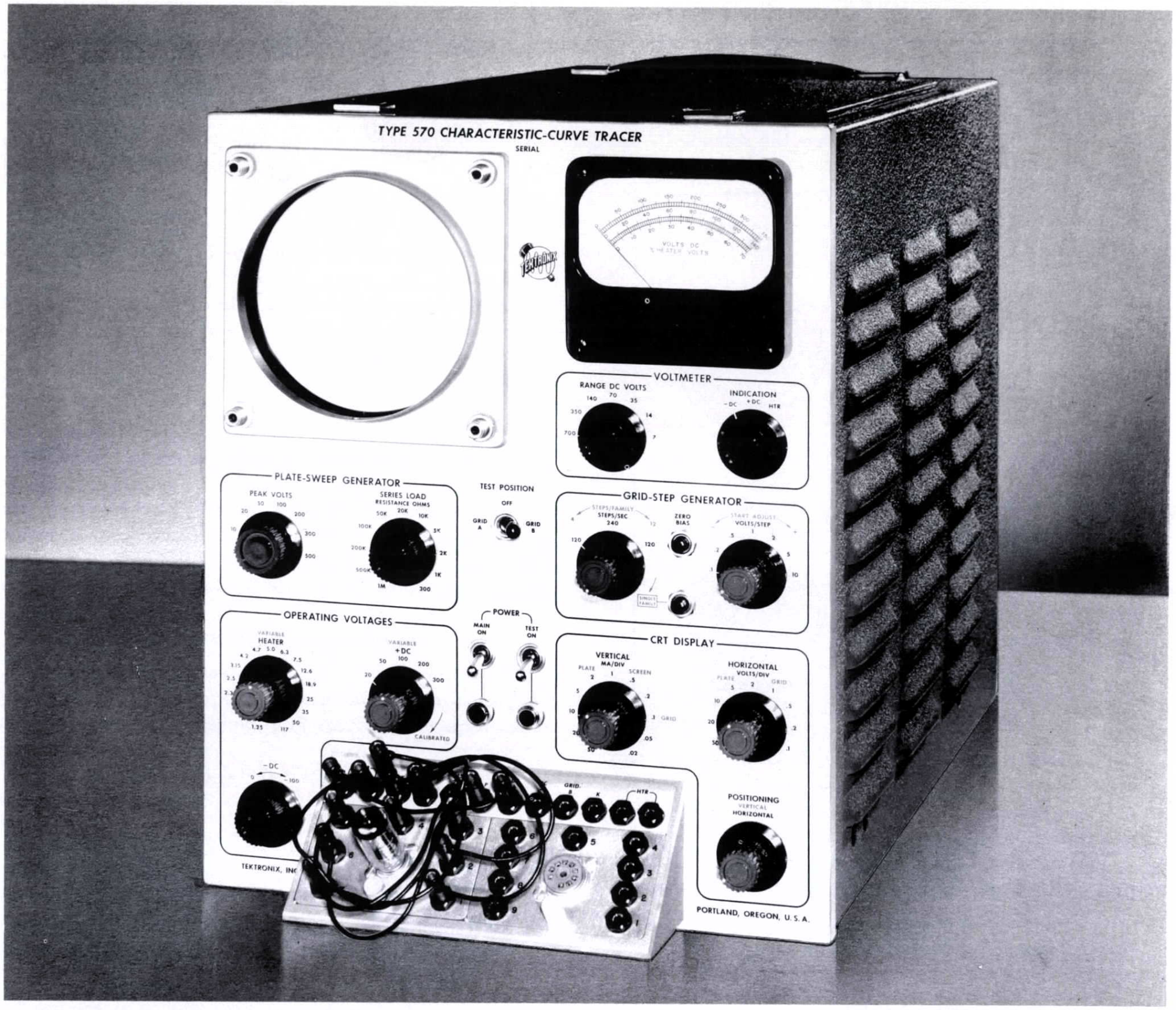
Price $125

For low-capacitance accessory probes, please see the Accessory Section.

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

TYPE 570 CHARACTERISTIC-CURVE TRACER

Pictures Dynamic Vacuum-Tube Characteristics



Displays Family of Curves on CRT Screen

Four to twelve characteristic curves per family.

Plots All Important Characteristics

Plate current against plate or grid voltage.
Screen current against plate or grid voltage.
Grid current against plate or grid voltage.

Positive-Bias Curves

Plots up to 8 positive-bias curves per family.

Calibrated Controls

Accurate current and voltage readings directly from the crt screen.

Wide Display Range

11 current ranges from 0.02 ma/div to 50 ma/div.
9 voltage ranges from 0.1 v/div to 50 v/div.
11 series-load resistors from 300 ohms to 1 megohm.
7 grid-step values from 0.1 v/step to 10 v/step.

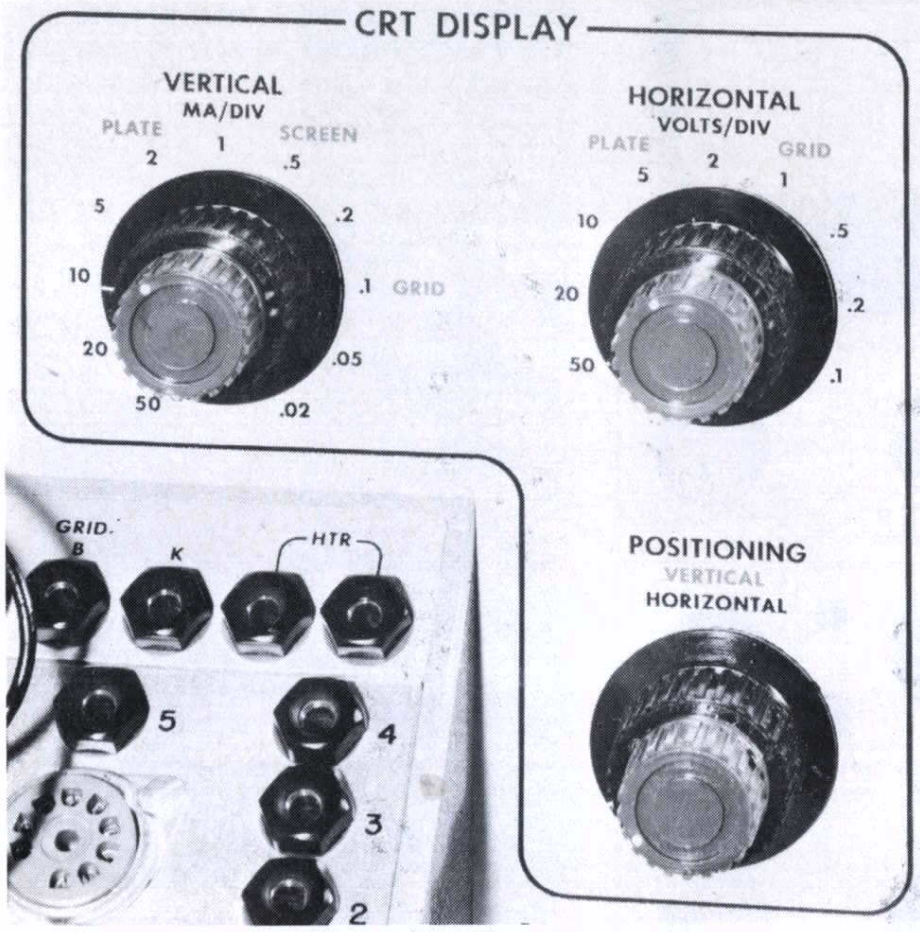
GENERAL DESCRIPTION

The Tektronix Type 570 Characteristic-Curve Tracer presents an accurate graphic analysis of vacuum-tube characteristics under almost any conceivable operating conditions. Circuit design can now be tailored to more closely fit the operating characteristics of available tubes. Tubes can be selected faster and more accurately for circuits requiring other than average vacuum-tube characteristics. Two-socket arrangement with front-panel switching permits rapid comparisons between two tubes, or two sections of the same tube. You can also make rapid comparisons with preselected curves outlined on a crt mask. Patch-cord connector system with socket-adapter plates gives you complete control of operating-condition setup. Various socket-adapter plates furnished and wide range of heater voltages available fit the requirements of practically all receiving-type vacuum tubes.

TYPE 570 CHARACTERISTIC-CURVE TRACER

CATHODE-RAY-TUBE DISPLAY

Vertical Axis—Concentric controls provide for selection of plate, screen, or grid current display; and selection of any one of eleven current-per-division values —0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 ma/div. A graticule divides the screen into ten vertical divisions. Calibration accuracy is within 3%, permitting accurate current readings directly from the screen.



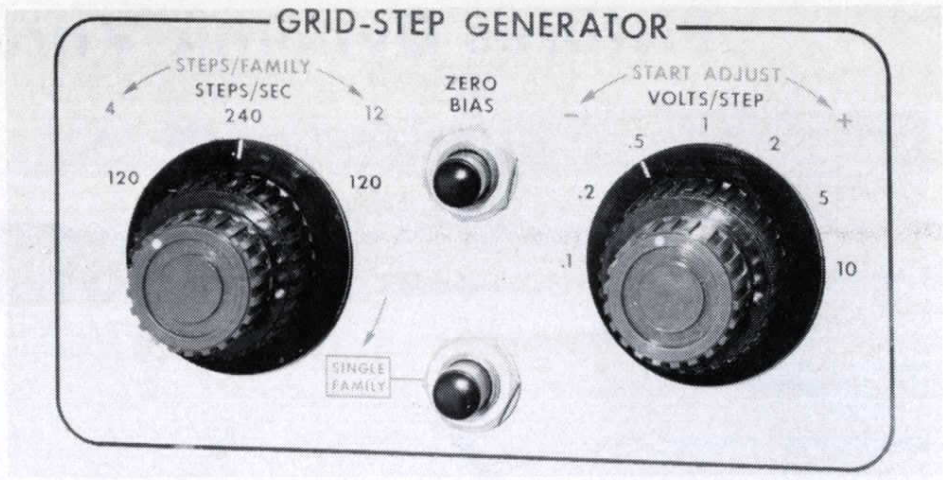
Horizontal Axis—Either plate or grid voltage can be displayed on the horizontal axis, and nine voltage-per-division values are available—0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 v/div. Ten horizontal divisions are scribed on the graticule. Calibration accuracy is within 3%, permitting accurate voltage readings directly from the screen.

Positioning—Concentric controls provide for both vertical and horizontal positioning of the display.

GRID-STEP GENERATOR

Family of Curves—A variable control is provided to adjust the number of curves in the display. As few as four and as many as twelve curves can be selected. A single family can be safely displayed with the tube under heavy overload conditions by means of a position on the STEPS/FAMILY control and a push button. With the STEPS/FAMILY control in the single-family position, pressing the button applies the selected conditions to the tube for only a fraction of second. Use of the SINGLE FAMILY push button permits observation or photography of tube characteristics under unusual conditions without danger of damage to the tube under test.

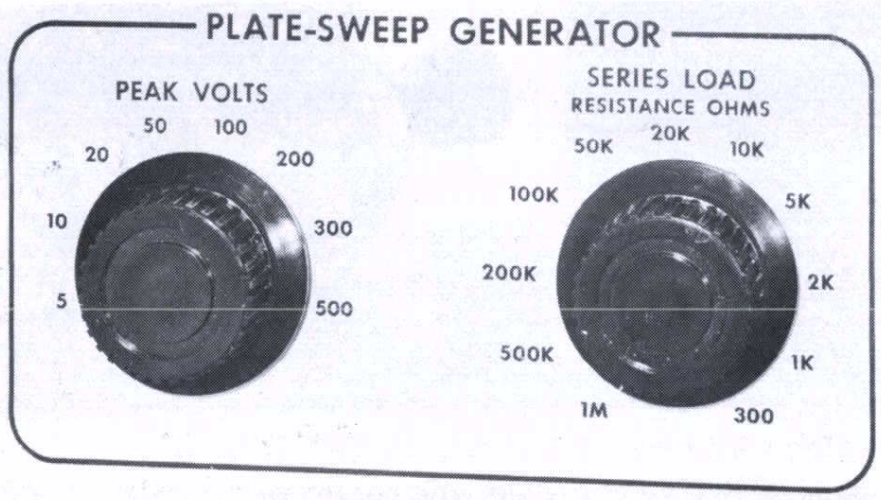
The STEPS/SEC switch controls the switching-rate of the step generator. A 120 or 240-steps/sec rate can be selected. The extra 120-steps/sec position causes switching to occur at the opposite end of the characteristic curve, for convenience when the area of interest is at either end of the curves displayed.



Bias voltage applied to the grid of the tube under test is impressed in a series of steps to produce the number of curves desired in the display. The voltage difference between steps is selected by a seven-position switch. Calibrated switch positions are: 0.1, 0.2, 0.5, 1, 2, 5, and 10 volts/step, accurate within 3%. Up to 150 ma peak grid current is available. A variable control is provided to adjust the starting point to a positive voltage, zero, or a negative voltage. Pressing the ZERO BIAS push button causes the display of the zero-bias curve only, to use as a reference in adjusting the starting point. As many as eight positive-bias curves can be included in the display.

PLATE-SWEEP GENERATOR

An eleven-position switch selects the desired series-load resistance for the plate circuit of the tube under test. Series-load values are: 300 ohms, 1 k, 2 k, 5 k, 10 k,



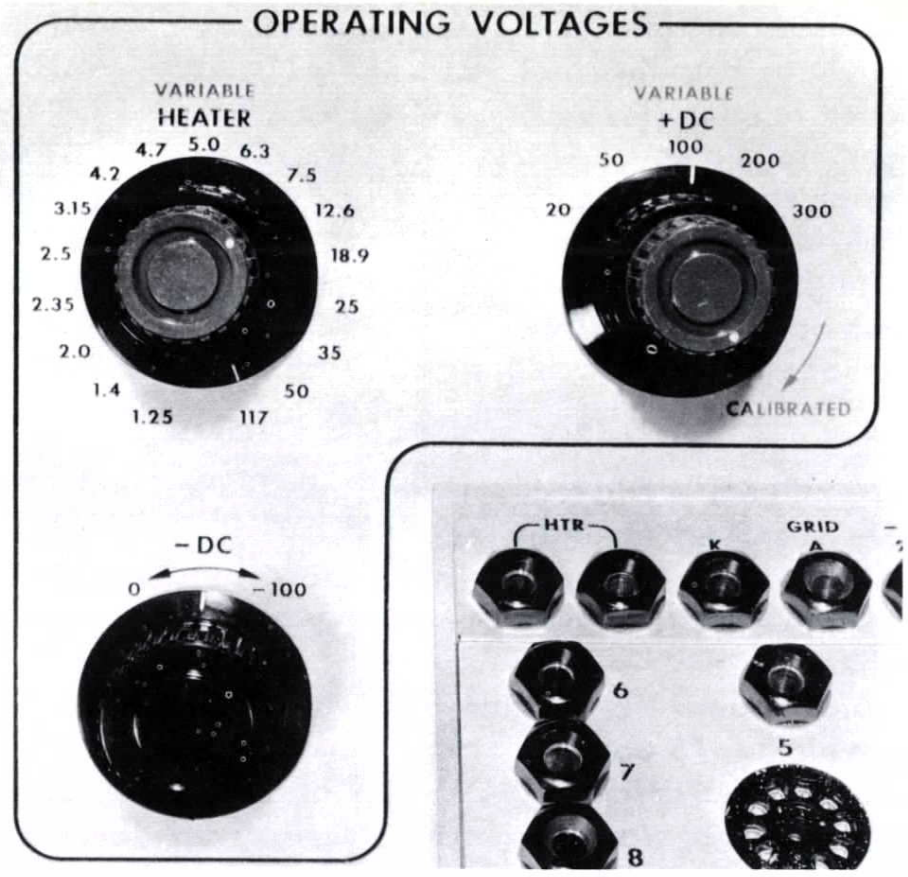
20 k, 50 k, 100 k, 200 k, 500 k, and 1 megohm. Power-handling capacity of all load resistors is sufficient to dissipate the maximum power available in the plate circuit.

The peak voltage applied to the plate through the series-load resistance is selected by an eight-position switch. Peak voltages are: 5, 10, 20, 50, 100, 200, 300, and 500 volts.

OPERATING VOLTAGES

Heater voltage is available in 17 fixed steps: 1.25, 1.4, 2.0, 2.35, 2.5, 3.15, 4.2, 4.7, 5.0, 6.3, 7.5, 12.6, 18.9, 25, 35, 50, and 117 volts ac. A control permits adjusting the selected heater voltage approximately ±20% for simulating the effects of low or high line voltage. The variable control provides sufficient spread

TYPE 570 CHARACTERISTIC-CURVE TRACER



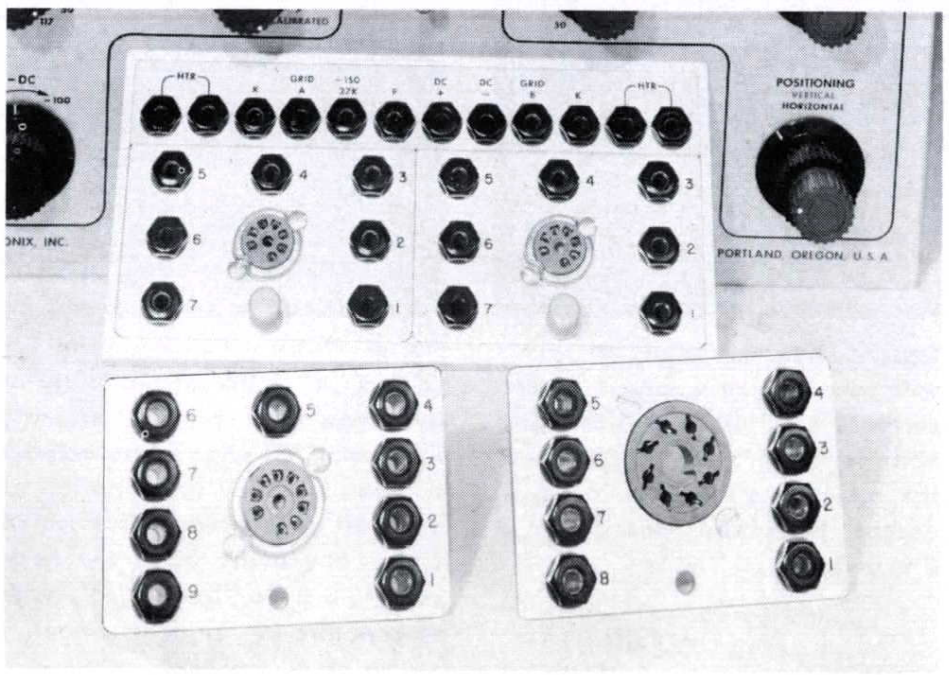
between steps to supply the proper heater voltage for practically all receiving-type vacuum tubes. Maximum power available from the heater transformer is 30 watts.

Positive dc voltage is available in five calibrated steps: 20, 50, 100, 200, and 300 volts, accurate within 3%. The positive voltage is also continuously variable from approximately 10 to 300 v. Up to 50 ma steady current is supplied. An adequate reserve is available for higher peak currents.

Negative dc voltage is available, continuously variable from 0 to —100 v. The negative dc supply is capable of delivering up to 1 watt.

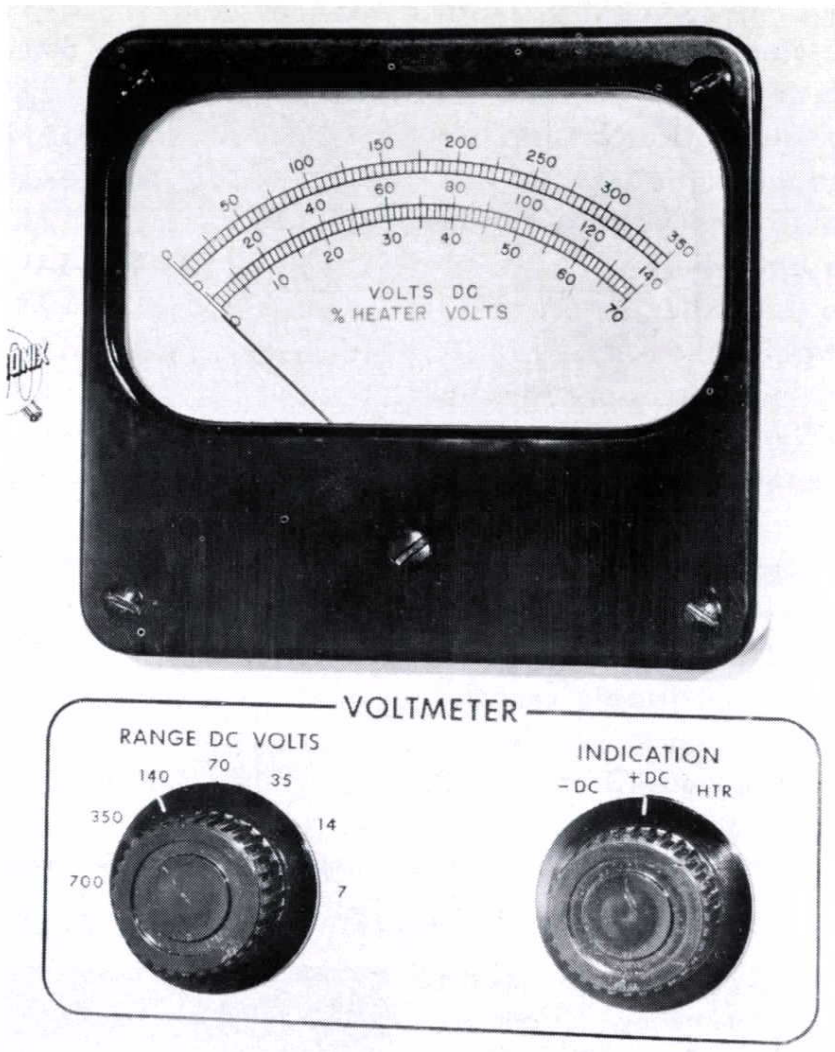
ADAPTER PLATES

Eight quick-changing adapter plates are furnished with the Type 570 — 2 with octal sockets, 2 with nine-pin miniature sockets, 2 with seven-pin miniature sockets, and 2 with pilot holes only. Plate receptacle holds any two adapter plates at the same time. Small banana jacks connect to each socket terminal. Three types of patch cords are also furnished, making it possible to connect any tube element to any voltage supplied by the instrument.



VOLTMETER

The built-in voltmeter indicates the positive and negative operating voltages in seven ranges: 0 to 7, 14, 35, 70, 140, 350, 700 volts, accurate within 2% of full scale. The voltmeter can be switched to show the percent of heater voltage indicated by the heater-voltage selector switch.



OTHER FEATURES

Tube-Socket Switching—The TEST POSITION switch in the center of the front panel is used to switch in either of two vacuum tubes during comparison tests. It has an OFF position for changing tubes and for establishing a reference trace on the screen. Control-grid potential drops to —150 v in the off position.

Safety Switch—The extremely flexible operational-setup facility of the Type 570 requires that potentially dangerous voltages be present at the patch panel. All voltages to the patch panel can be removed by a front panel switch for safety and convenience while changing the operation setup. A jewel light indicates when power is present at the patch panel.

Regulated Power Supply—Electronic voltage regulation is used to compensate for line-voltage changes between 105 and 125 volts or 210 and 250 volts, and for variations in loading. All voltages affecting calibrations are fully regulated. Heater, negative-dc, and peak-plate supplies are unregulated.

Cathode-Ray Tube—A Tektronix T52P cathode-ray tube is used in the Type 570. Accelerating potential is approximately 3 kv. P1 phosphor is supplied unless another phosphor is specifically requested.

Illuminated Graticule—The 10 x 10-division graticule is edge-lighted. Illumination control, and focus, in-

TYPE 570 CHARACTERISTIC-CURVE TRACER

tensity, and astigmatism controls are accessible through a door in the top of the cabinet.

VACUUM TUBE COMPLEMENT

Split-load phase inverters and shaper amplifiers	2	6AN8
Rectifiers	2	6AL5
Cathode follower and step-control CF		12AT7
Clamp and coupling diode		6AL5
Grid-step generator		6AU6
Step-generator cathode followers		12AT7
Step multivibrator		6AN8
Disconnect diodes		6AL5
Step CF and voltage regulator CF		12AX7
Step amplifiers	2	6AU6
Step amplifier		12AT7
Cathode follower		6CL6
Plate power-supply rectifiers	2	6AX4
Rectifier diodes		6AL5
Horizontal-deflection amplifiers	2	6AU6
Horizontal-deflection amplifier CF	2	6AU6
Horizontal-deflection output amplifiers		6BQ7A
Vertical-deflection amplifiers	2	6AU6
Vertical-deflection output amplifiers		6BQ7A
Variable dc-supply rectifier		6AX5
Fixed dc-supply rectifier	4	6X4
Regulator amplifiers	2	6AU6
Voltage reference		5651
Regulator amplifier and series regulator		6AN8
Regulator amplifier		6AN8
Series regulators	2	12B4
Series regulator		6CD6GA
Variable dc-supply CF		12AT7
High-voltage oscillator		6AQ5
Regulator amplifier and CF		12AU7
High-voltage rectifiers	2	5642
Cathode-ray tube		T52P1

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperatures.

Construction—Aluminum-alloy chassis and cabinet.

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

Dimensions—16½" high, 13" wide, 24½" deep.

Weight—75 pounds.

Power Requirements—105-125 or 210-250 v, 50 or 60 cycles, 400 watts maximum, 300 watts standby.

Price **$925**

Includes: 8—Adapter plates
26—Patch cords
1—Instruction manual

Currently Available Extras

P1 crt phosphor normally furnished.

P2, P7, P11 optional . . . . . No extra charge

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

Type 570 Characteristic-Curve Displays

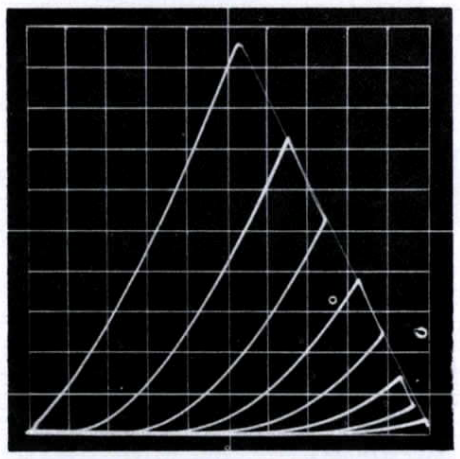


Fig. 1 — Plate current plotted against plate voltage for one triode section of a 12AU7. Plate load is 5 k, peak plate-supply voltage is 500 v. Grid voltage is changed 5 v between curves, from —35 v to zero. Vertical sensitivity is 5 ma/div, horizontal sensitivity 50 v/div. Calibrated controls permit accurate current and voltage readings directly from the screen.

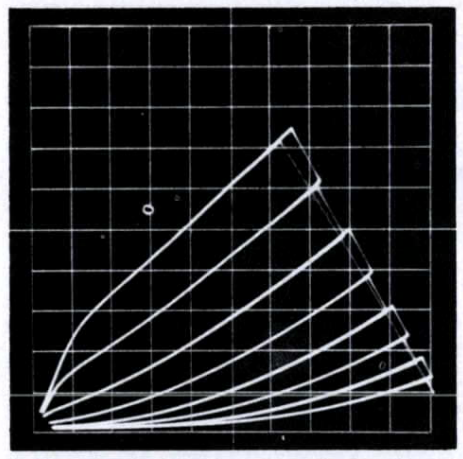


Fig. 2—Same triode section of 12AU7 with only 20-v peak plate supply and sensitivities increased to 0.2 ma/div vertical and 2 v/div horizontal. Grid voltage is changed 2 v between curves, from —14 v to zero. This is essentially a 25-times magnification of the lower left portion of Fig. 1, showing the operating characteristics at low plate-supply voltage.

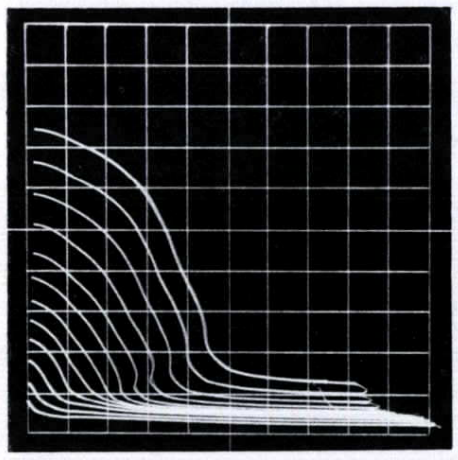


Fig. 3 — Screen current plotted against plate voltage with positive grid bias on a 6AQ5. Plate load is 300 ohms, peak plate voltage is 100 v, screen-grid voltage is 100 v, with grid voltage changing 2 v/step from +16 v to below zero. Vertical scale is 10 ma/div, horizontal scale 10 v/div.

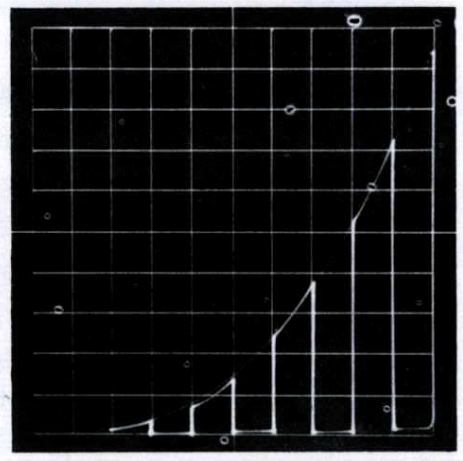


Fig. 4 — Typical 12AU7 Eg-Ip curves. Plate load 5 k, peak plate-supply voltage 500 v, grid voltage changing 5 v/step from —35 v to zero, vertical sensitivity 5 ma/div, horizontal sensitivity 5 v/div.

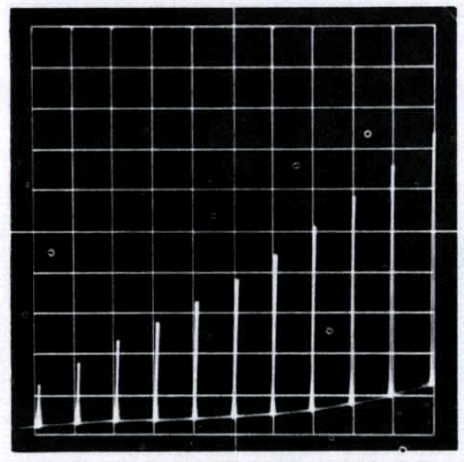


Fig. 5—Another family of curves with positive grid bias. Screen current is plotted against grid voltage. Operating conditions of the 6AQ5 are identical to Fig 3, except horizontal sensitivity is 2 v/div.

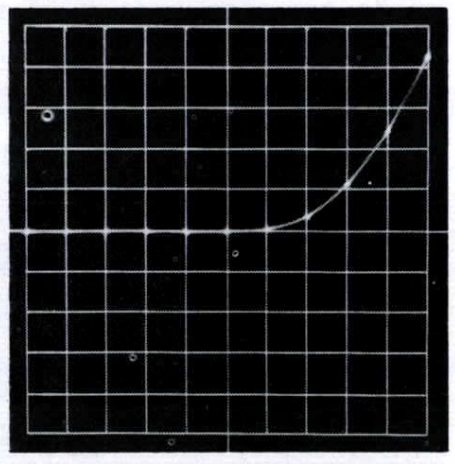


Fig. 6—Typical GERMANIUM DIODE curve. Inherent flexibility of the Type 570 permits accurate evaluation of diode characteristics and detailed examination of any part of the curve. Calibrated scales above are 0.2 v/div horizontal, 0.5 ma/div vertical, with zero points at center of screen.

ACCESSORIES

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

The Tektronix Type 500 Scope-Mobile is a sturdy, mobile support for Tektronix 5" Oscilloscopes. Convenient observation of the crt face is achieved by a 20-degree backward tilt of the top surface. Auxiliary equipment can be mounted in the enclosed vented space behind the blank front panel. A drawer, felt-lined and operating on roller bearings, provides handy storage for probes, cables, manuals, etc. An open shelf, topped with tough linoleum, is located at the bottom. Power input and three convenience outlets are mounted at the rear. Total weight is 42 pounds. Dimensions are 18½" wide, 39" high and 30" deep. $97.50

The Tektronix Type 500/53 Scope-Mobile is the Type 500 with a Type 53 Scope-Mobile front-panel installed. This front-panel has two supporting cradles to accommodate the Type 53 and 53/54 Plug-In Preamplifiers used in the Type 530 and Type 540-Series Oscilloscopes. In all other characteristics the Type 500/53 is identical to the Type 500. . . . . $108.00

Type 53 Scope-Mobile Panel — converts the Type 500 into a Type 500/53 Scope-Mobile by replacing the standard blank panel. 10.50

VIEWING HOODS

H510 Viewing Hood, for Tektronix 5" Oscilloscopes. Includes molded rubber eye-piece and aluminum light shield 4.50

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

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

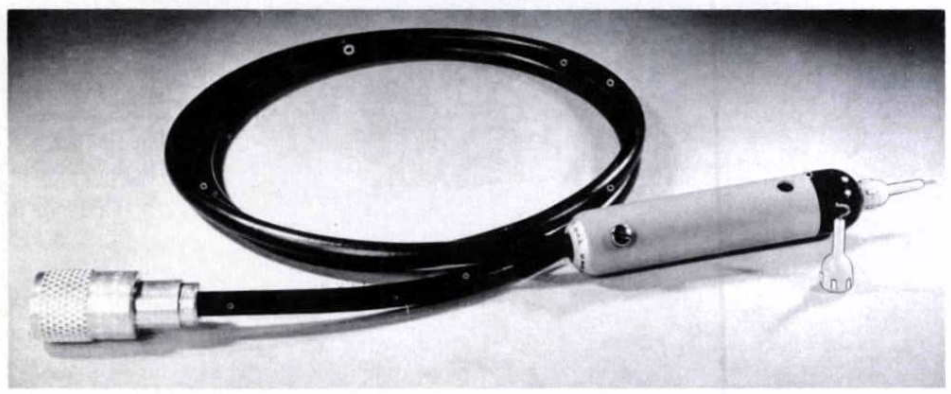
and are rated at 600 v peak-to-peak. Two interchangeable Tektips—a straight tip and a hooked tip—each adding less than 0.5 $\mu\mu$f to the input capacitance, are supplied with the probes.

P405, P410, P420 ..... 10.50
P450, P450-L, P4100 ..... 12.50
Replacement Tektips, each ..... .25

TABLE OF P400-SERIES PROBE SPECIFICATION

Probe	Attenuation Ratio	INPUT IMPEDANCE			DB Loss at 30 MC
		Resistance (Megohms)	Capacitance Minimum*	Maximum†	
P405	5:1	5	12 $\mu\mu$f	19 $\mu\mu$f	1-2
P410	10:1	10	8 $\mu\mu$f	11 $\mu\mu$f	1
P420	20:1	10	5.5 $\mu\mu$f	7 $\mu\mu$f	0.5-1
P450	50:1	10	3.5 $\mu\mu$f	3.5 $\mu\mu$f	0.5
P450-L	50:1	10	2.5 $\mu\mu$f		0.5
P4100	100:1	10	2.5 $\mu\mu$f	2.5 $\mu\mu$f	0.5

*When connected to Type 53/54C or 53/54K Plug-In Preamplifiers.
†When connected to instruments with input capacitances up to 50 $\mu\mu$f.



P510A Attenuator Probe provides an attenuation of ten times when used with Tektronix oscilloscopes and amplifiers. The P510A is small and streamlined, and pre-

use with the Type [illegible]
lower tube is a 5718 triode whose cathode load is the 170-ohm termination of the preamplifier grid line in the Type 517. Plate and heater voltages for this tube are provided at a four-terminal socket on the panel of the oscilloscope. The signal is attenuated by 2 times when using the P170CF. The input impedance of the probe will depend on the attenuator head being used, 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 $\mu\mu$f. Probe complete with 3 attenuator heads.....86.00

PAX-I Attenuator Head for P170CF, attenuation may be varied between 4 times and 40 times..... 11.00

PAX-II Attenuator Head for P170CF, attenuation may be varied between 20 times and 200 times..... 11.00

PAX-III Attenuator Head for P170CF, attenuation may be varied between 200 timees and 2000 times.. 11.00

P170CF may be used with the 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 terminations.) A rectifier kit, KP170CF, is recommended for installation in Type 513 to rectify the 6.3 volt heater supply.

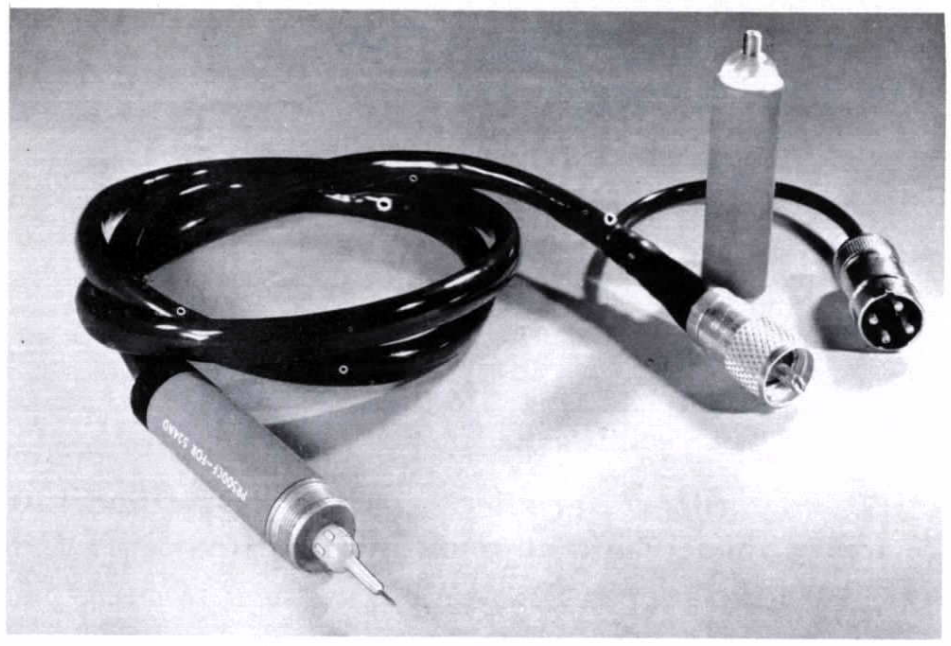
→ also used on old 517's

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

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

ACCESSORIES

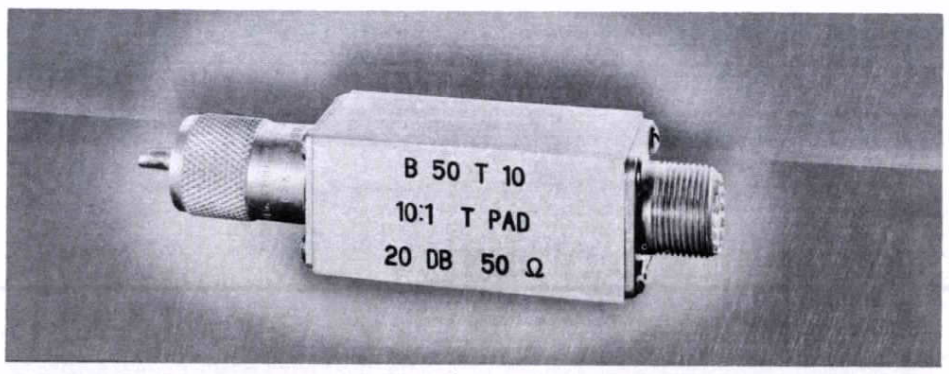
Operational Accessories



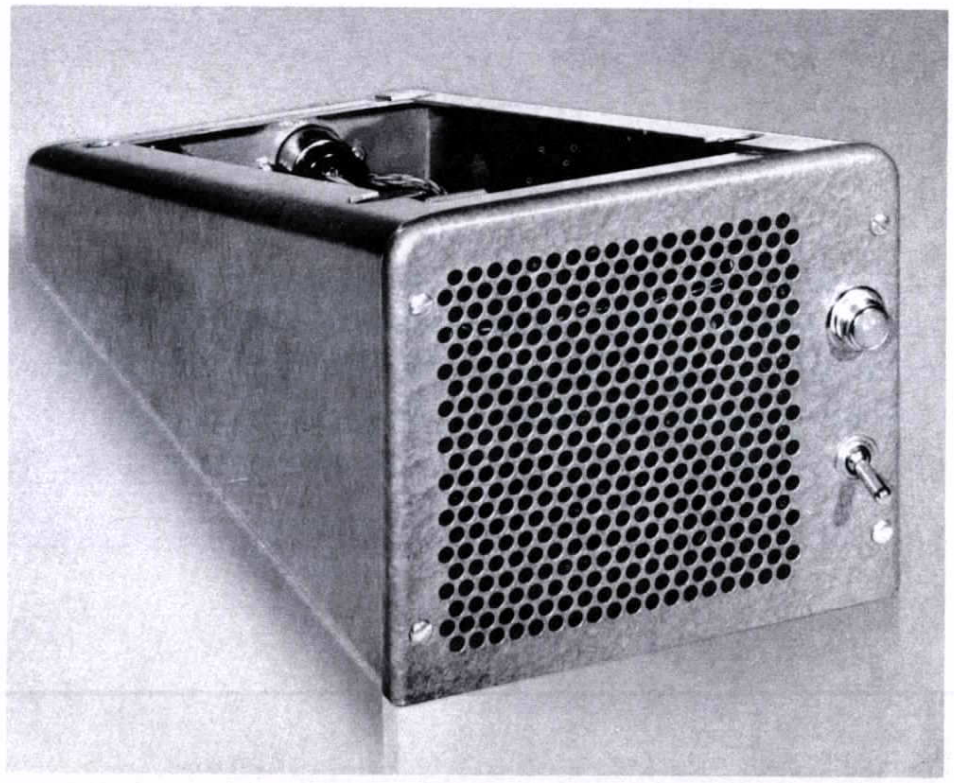
P500CF Cathode-Follower Probe—For use with Types 524D and 524AD Oscilloscopes. Presents low capacitance with minimum attenuation. Input impedance is 40 megohms paralleled by 4 $\mu\mu$f, gain 0.8 to 0.85. Input to probe is ac-coupled, limiting its low-frequency response to 5 cycles. Amplitude distortion is less than 3% on unidirectional signals up to 5 volts. 10x attenuator head is included with probe, and should be used on signals exceeding a few volts to minimize amplitude distortion. With the attenuator head attached, the probe input impedance is approximately 10 megohms paralled by 2$\mu\mu$f. Probe output level is 11 v positive, making it necessary to use the ac-coupled position of the oscilloscope AC-DC switch 64.00

A modification kit is available to equip the Type 524D Oscilloscope with a front-panel probe-power connector.
Modification Kit K524-1021A..... 5.00

TERMINATIONS, PADS, ATTENUATORS



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



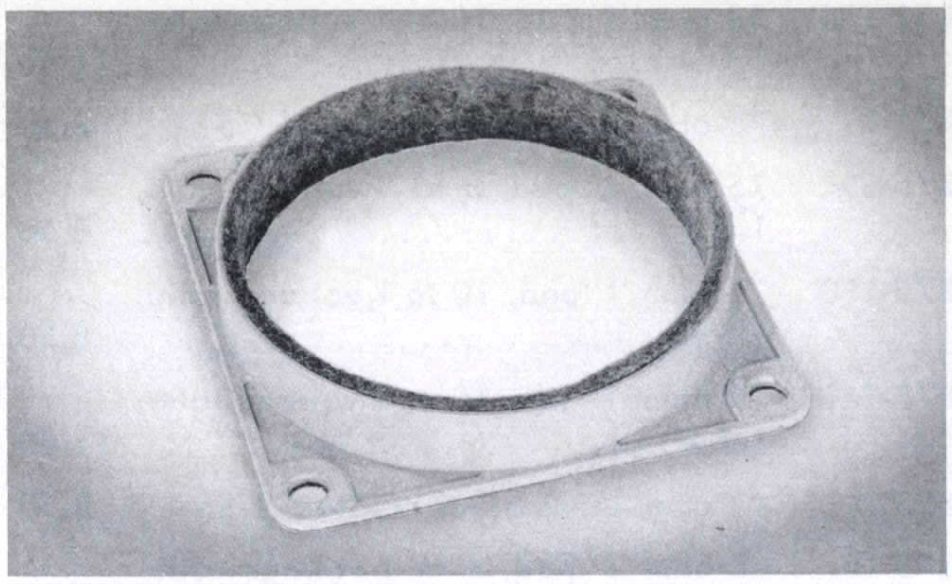
FB 310 Fan Base—for Type 310 Oscilloscope. Provides filtered, forced-air ventilation to assure safe operating temperature when the Type 310 Oscilloscope is being used continuously over long periods, or in hot or limited-ventilation areas. The fan base tilts the oscilloscope to a convenient viewing angle. For use on 105-125 v, 60 cycle only..... 25.00

FB 310-S1 Fan Base—for use on 210-250 v, 50 to 60 cycles only..... 25.00

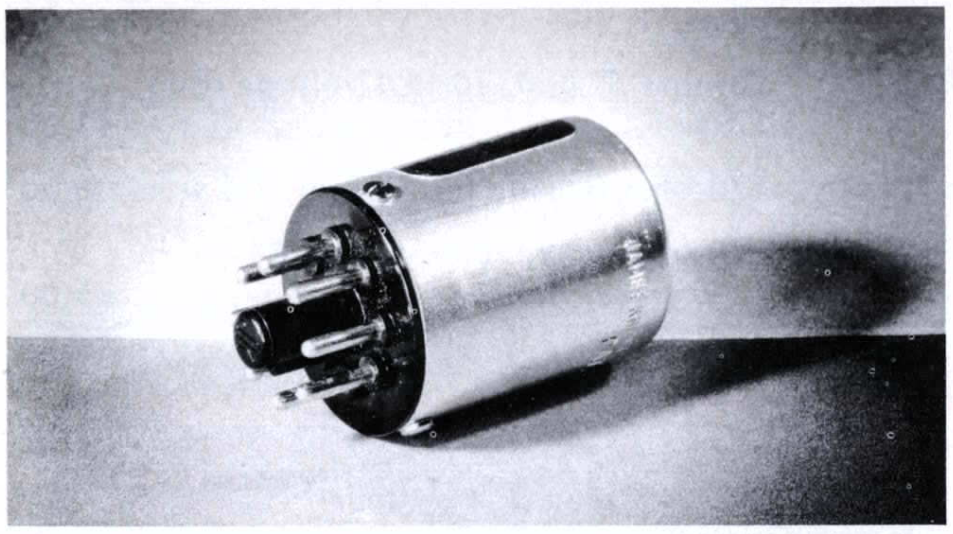
Prices f.o.b. Portland (Beaverton), Oregon

ACCESSORIES

Operational Accessories



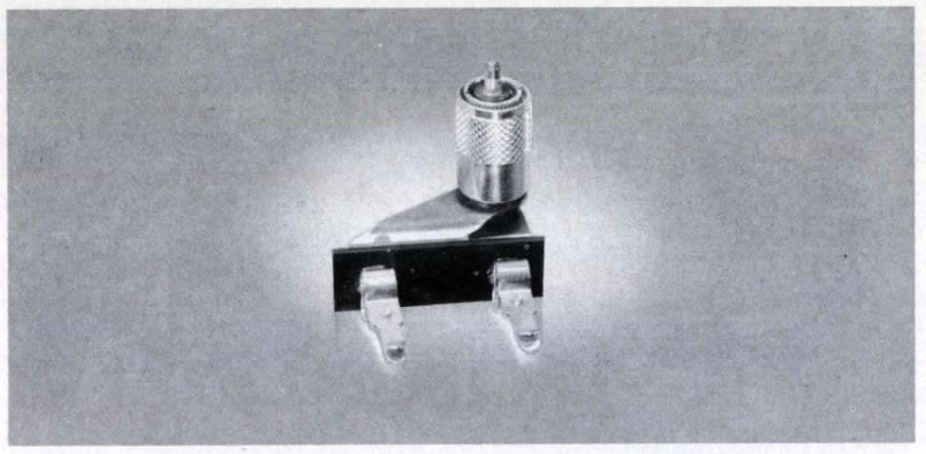
BE510 Bezel, for mounting camera on Tektronix 5" oscilloscopes. Dimensions—5 7/8" square; ring 7/8" deep, diameter 5 5/8" outside, 5 1/8" inside. Die-cast construction, gray wrinkle finish, felt lined. 4.50



CO181 Crystal-Oven Combination—A 1-mc crystal mounted in a temperature-stabilized oven. Directly interchangeable with standard crystal. Plugs into crystal socket of the Type 181—no wiring changes necessary. Provides a frequency stability of 2 ppm over a 24-hour period 27.00

MISCELLANEOUS

A100	Adapter, clip lead.	2.00
A510	Adapter, binding post.	2.00
FA160	Frame, mounting, for Type 122 and Type 160-Series units.	5.00



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

COAXIAL CABLES

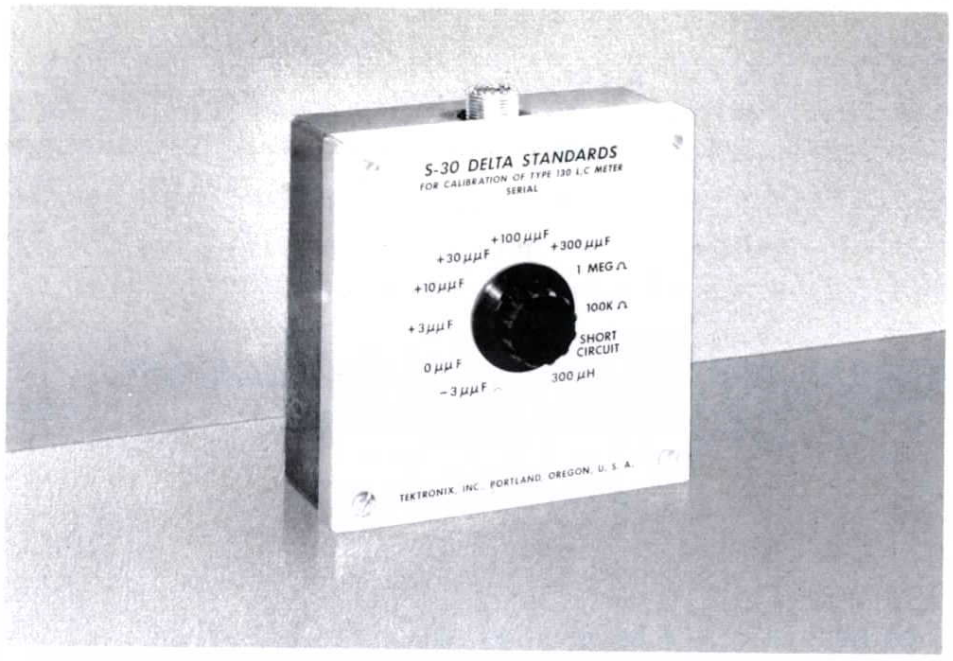
P52	Coaxial cable, 52 ohms nominal impedance, 42" long.	4.00
P75	Coaxial cable, 75 ohms nominal impedance, 42" long	4.00
P93	Coaxial cable, 93 ohms nominal impedance, 42" long	4.00
P93A	Coaxial output cable, 93 ohms, terminated with variable attenuator, 42" long. .	13.50
P93B	Coaxial output cable, 93 ohms, terminated with ½-watt 93-ohm resistor, 42" long	5.00
P170	Coaxial cable, 170 ohms nominal impedance, 42" long	9.50

DELAY NETWORKS

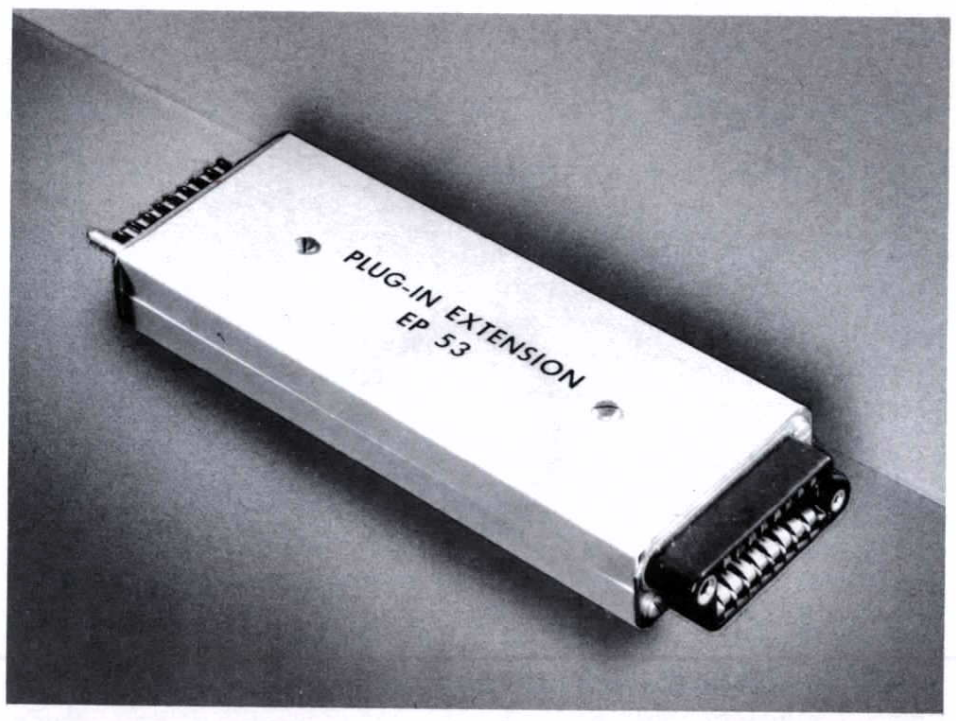
1-D-25	Delay network, 0.25 μsec delay, for Type 511.	50.00
1-AD-25	Delay network, 0.25 μsec delay, for Type 511A.	50.00
3-D-25	Delay network, 0.25 μsec delay, for Type 513.	65.00
4-D-25	Delay network, 0.25 μsec delay, for Type 514.	50.00

ACCESSORIES

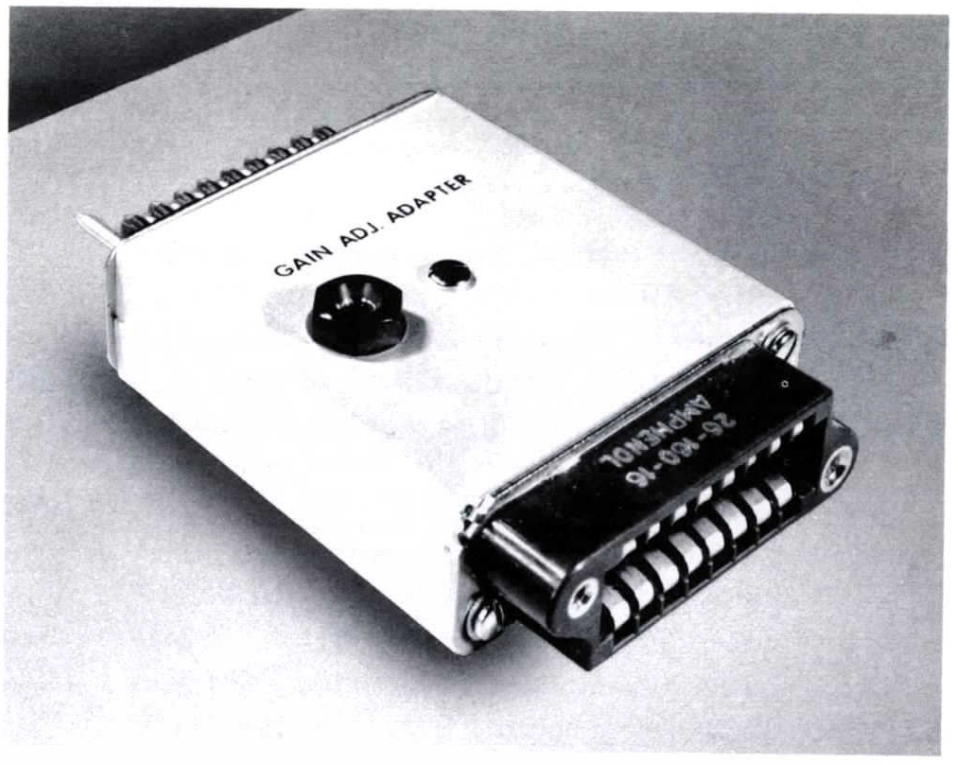
Test Accessories



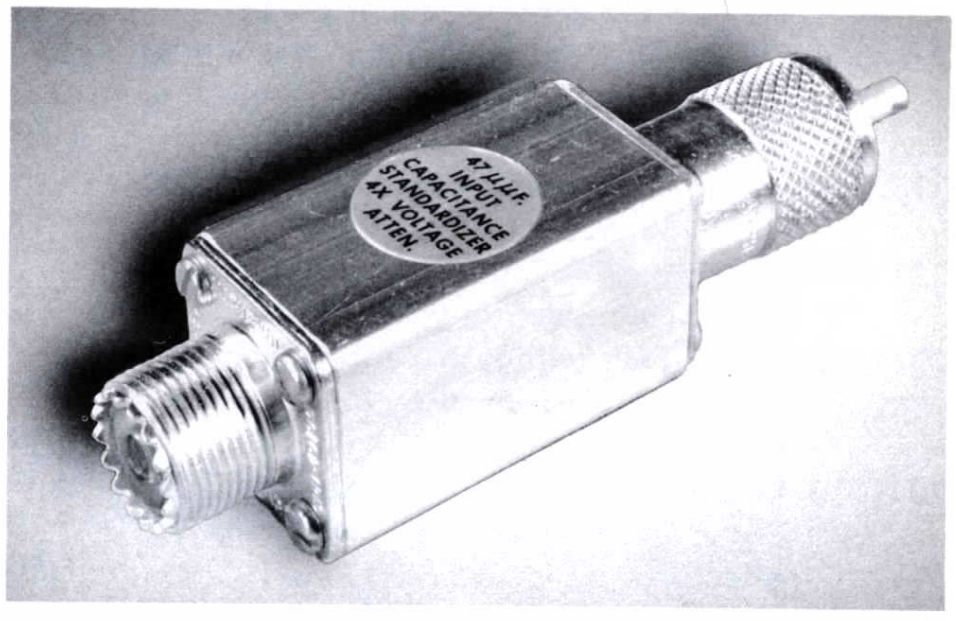
015-001 (S30) Delta Standards, for calibration of the Type 130 L,C Meter. The unit provides accurately adjusted steps of capacitance and inductance, selected by a rotary selector switch. Values of the capacitance steps correspond to the full-scale adjustments required on the five scales of the Type 130. 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-μh standard permits proper adjustments of the inductance ranges 22.00



013-002 (EP53) Plug-in Extension — Allows the plug-in preamplifier unit for the Type 530 and Type 540-Series Oscilloscopes to be operated partially out of its housing. A convenient accessory in making attenuator and transient response adjustments..... 5.00



013-005 (EP53A) Gain Set Adapter—Permits an external calibrating signal to bypass the plug-in preamplifier, for calibrating the sensitivity of the main amplifier of Type 530 and 540-Series Oscilloscopes..... 5.00



011-021 (CS 47) Input Capacitance Standardizer—For use with Type 53 and Type 53/54 Plug-In Preamplifiers having an input capacitance of 47 $\mu\mu$f. With this accessory the input capacitance of each preamplifier can be standardized to 47 $\mu\mu$f, eliminating the necessity for probe readjustment when used with different plug-in preamplifiers 11.50

011-022 (CS 20) Input Capacitance Standardizer—Similar to 011-021 (CS 47), for use with the Type 53/54C and Type 53/54K Plug-In Preamplifiers having 20 $\mu\mu$f input capacitance 11.50

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

ACCESSORIES

Replacement Parts

GRATICULES

386-395	Unruled, for Type 310	1.00
386-312	Unruled, for Type 315	1.00
331-027	Quarter-inch divisions, 8 divisions vertically, 10 horizontally, for Type 310 and 360	1.50
331-005	Quarter-inch divisions, 8 divisions vertically, 10 horizontally, for Type 315	1.50
386-326	Unruled, fits Types 511A, 512, 513, 514, 514A, 524D, 524AD	1.00
331-023	Centimeter ruling, 4 centimeters vertically, 10 horizontally, for Types 511A and 514 with 5CP CRT	1.50
331-006	Centimeter ruling, 6 centimeters vertically, 10 horizontally, for Type 512 with 5CP CRT, Types 514A, 524D, 524AD and Type 511A with 5ABP CRT	1.50
331-010	Centimeter ruling, 8 centimeters vertically, 10 horizontally, for Type 512 with 5ABP CRT	1.50
331-007	Centimeter ruling, 4 centimeters vertically, 8 horizontally, for Type 513	1.50
331-008	Centimeter ruling, 4 centimeters vertically, 8 horizontally, for Type 517	9.50
331-009	TV RMA style ruling for percentage measurements, for Types 524D and 524AD	1.50
331-029	Ruling in percentages, —40 to +100, for Type 525	1.50
331-026	Centimeter ruling, 8 centimeter vertically, 10 horizontally, for Type 532	1.50
331-016	Centimeter ruling, 6 centimeters vertically, 10 horizontally, for Types 531 and 535	1.50
331-025	Centimeter ruling, 4 centimeters vertically, 10 horizontally, for Types 541 and 545	1.50
331-028	Division ruling, 10 divisions vertically, 10 horizontally, for Type 570	1.50

CATHODE-RAY TUBE LIGHT FILTERS

378-506	3" Amber (for Type 315D)	.50
378-505	3" Green (for Type 315D)	.50
378-507	3" Blue (for Type 315D)	.50
378-501	(F510-3) 5" Amber	.90
378-503	(F510-5) 5" Green	.90
378-504	(F510-6) 5" Blue	.90

AC POWER CORDS

161-004	(COP 16-8) No. 16 wire, 8' long	2.40
161-003	(COP 18-1) No. 18 wire, 1' long	.85
161-001	(COP 18-8) No. 18 wire, 8' long	1.50

SPECIAL CORDS AND LEADS

012-007	(W112R) Red output lead for Type 112	1.00
012-008	(W112B) Black output lead for Type 112	1.00
012-009	(W122) Battery power lead for Type 122	7.50
012-014	(W130B) Black output lead for Type 130	1.00
012-015	(W130R) Red output lead for Type 130	1.00
012-016	(W160-20) 20" inter-unit power cable for Type 160-Series	2.00
012-017	(W160-10) 10" inter-unit power cable for Type 160-Series	2.00
012-012	(W517) Inter-unit power cable for Type 517	9.50
012-013	(W530B) Black test lead for Types 530 and 540-Series Oscilloscopes	1.00

MISCELLANEOUS

011-018	Attenuator unit, for Type 190	19.00
010-003	P93C Probe, for Type 130	2.00
014-003	FM 124 Mounting frame, for Type 124	5.00

INSTRUCTION MANUALS

104A	1.50
105	1.75
112	1.50
121	1.50
122	1.50
123	1.50
124	1.75
130	1.50
160 or 160A	1.50
161	1.50
162	1.50
163	1.50
180	2.00
181	1.75
190	1.50
310	3.50
315D	4.00
360	1.75
511A or 511AD	2.75
512	2.75
513 or 513D	2.75
514 or 514D	2.75
514A or 514AD	3.00
515	4.00
517 or 517A	4.50
524D or 524AD	5.00
525	4.50
531	4.50
532	4.50
535	5.00
541	4.50
545	5.00
53A or 53/54A	1.50
53B or 53/54B	1.50
53C or 53/54C	1.50
53/54D	1.50
53/54E	1.50
53G or 53/54G	1.50
53/54K	1.50
570	4.50

GENERAL INFORMATION

Terms and Shipment

Our terms are 1% ten days, net thirty days on domestic orders; on overseas orders terms are net letter of credit or advance payment. 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

To provide our overseas customers with instruments at published catalog prices, assistance in ordering, and most important, service after receipt of their instruments, Tektronix has established authorized distributors in many overseas countries. To take advantage of these services, available ONLY through your AUTHORIZED TEKTRONIX DISTRIBUTOR, and to eliminate the necessity of paying a premium for our instruments, please direct all inquiries and orders to the TEKTRONIX DISTRIBUTOR in your country. Customers in a country not presently served by an authorized Tektronix distributor are asked to send all inquiries and orders directly to Tektronix, Inc., Portland, Oregon.

Delivery

Acceptance of purchase orders is indicated by our acknowledgement, 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 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, notify us promptly, including sufficient details to identify the required parts. We will ship them prepaid (via air if requested) as soon as possible, usually within 24 hours.

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

APPROXIMATE SHIPPING WEIGHTS

INSTRUMENT TYPE	NET WEIGHT IN POUNDS	DOMESTIC PACKED IN POUNDS	EXPORT PACKED WEIGHT IN POUNDS	EXPORT PACKED WEIGHT IN KILOGRAMS	EXPORT PACKED VOLUME IN CU. FT.
104A	22	30	53	24	5
105	35½	47	64	29	5
112	32	49	75	51	7
121	18½	24	45	20	4
122	5½	9	16	7	1
124	21	32	55	25	5
130	9	17	40	18	4
160 Series	33	56	74	34	7
160A	21	28	45	20	4
161	3½	7	14	6	1
162	3½	7	14	6	1
163	3½	7	14	6	1
FA-160	1¼	3			
180	37	49	66	30	5
181	17½	34	49	22	7
190	24	35	55	25	5
310	23½	31	48	22	4
315D	36	47	60	27	4
360	9	17	32	15	4
517A					
Indicator Unit	76	101	127	58	9
Power Supply	72	83	105	48	5
Scopemobile	42	62	67	30	7
524AD	61	84	106	48	8
Viewing Hood	1¼	4	11	5	1
525	54	72	101	46	9
531	61½	82	107	49	8
532	52	73	97	44	8
535	65	87	111	50	8
541	61½	82	107	49	8
545	65	87	111	50	8
53/54A	3½	10	12	5	1
53/54B	3½	10	12	5	1
53/54C	5½	12	14	6	1
53/54D	4	11	14	6	1
53/54E	4½	12	14	6	1
53/54G	4½	12	14	6	1
53/54K	3½	10	12	5	1
570	75	96	116	53	8
500	42	53	62	28	7

Tektronix, Inc.

AN OREGON CORPORATION

Main Office and Factory—Sunset Highway and Barnes Road

Mailing Address—P. O. Box 831, Portland 7, Oregon

Phone—CYpress 2-2611 ● TWX—PD 265 ● Cable—TEKTRONIX

Tektronix Field Engineering Offices

ALBUQUERQUE	Tektronix, Inc., 127C Jefferson St., N. E., Albuquerque, New Mexico	Phone: 6-1279
BALTIMORE	Tektronix, Inc., 8118 Harford Road, Baltimore 14, Maryland	NOrthfield 5-2600
	Washington Area Phone	ENterprise 1-6023
BOSTON	Tektronix, Inc., 18 Austin St., Newtonville 60, Massachusetts	LAsell 7-2212
CHICAGO	Tektronix, Inc., 7514 W. North Ave., Elmwood Park 35, Illinois. . . . TWX—RIVER GROVE ILL 1395	GLadstone 6-7930
CLEVELAND	Tektronix, Inc., 3353 Edgecliff Terrace, Cleveland 11, Ohio	CLearwater 2-2121
	Detroit Area: ENterprise 7121	Pittsburgh Area: ZEnith 0212
DAYTON	Tektronix, Inc., 3898 Linden Ave., Room 212, Dayton 3, Ohio	LIncoln 1774
LOS ANGELES	Tektronix, Inc., 12434 Santa Monica Blvd., West Los Angeles 25, California	GRanite 3-1105
NEW YORK	Tektronix, Inc., 49 Pondfield Road, Bronxville 8, New York. . . . TWX—BRONXVILLE NY 1207	DEerfield 7-3771
PHILADELPHIA	Tektronix, Inc., 7709 Ogontz Ave., Philadelphia 38, Pennsylvania	WAverly 4-5678
PHOENIX	Tektronix, Inc., 2415 E. McDowell Road, Phoenix, Arizona	BRidge 5-9762
SAN FRANCISCO	Tektronix, Inc., 1436 El Camino Real, Menlo Park, California	DAvenport 2-5590
SYRACUSE	Tektronix, Inc., 313 Nottingham Road, Syracuse 10, New York	Phone: 72-3339

Tektronix Engineering Representatives

ATLANTA	Bivins & Caldwell, 3133 Maple Drive, N. E., Atlanta 5, Georgia	CHerokee 7522
DALLAS	M. F. Klicpera Company, P. O. Box 4117, Sta. A, Dallas 8, Texas	FEderal 0992
DENVER	Hytronic Measurement Associates, 446 Broadway, Denver 3, Colorado	SHerman 4-2241
FORT MYERS	Arthur Lynch & Associates, P. O. Box 466, Fort Myers, Florida	EDison 4-4431
HIGH POINT	Bivins & Caldwell, Security Bank Bldg., High Point, North Carolina	Phone: 3672
HOUSTON	~~M. F. Klicpera Company, P. O. Box 3113, Houston 1, Texas~~ P.V.T.	JAckson 2-8459
PORTLAND	Hawthorne Electronics, 700 S. E. Hawthorne Blvd., Portland 14, Oregon	BElmont 4-9375

Tektronix Overseas Distributors

BERLIN	Rohde & Schwarz Vertriebs, GmbH, Berlin W30, Augsburgerstrasse 33, West Germany	91 27 62
BOMBAY	Electronic Enterprises, 46, Karani Building, Opp. Cama Baug., New Charni Road, Bombay 4, India	75376
BRUXELLES	Regulation-Mesure, S.P.R.L. 22, rue Saint-Hubert, Bruxelles, Belgium	Phone: 34. 42. 96
HANNOVER	Rohde & Schwarz Vertriebs, GmbH, Hannover, Schillerstrasse 23, West Germany	2 33 80
HELSINKI	Into O/Y, 11 Meritullinkatu, Helsinki, Finland	21 425, 31 025
ISRAEL	Landseas Products Corp., 39 Broadway, New York 6, New York	WHitehall 3-6026
	Landseas Eastern Co., P. O. Box 2554, Tel Aviv, Israel	
JOHANNESBURG	Protea Holdings, Ltd., 7 Newton St., Wemmer, Johannesburg, Union of South Africa	33-2211
KARLSRUHE	Rohde & Schwarz Vertriebs, GmbH, Karlsruhe, Kriegstrasse 39, West Germany	250202
KOBENHAVN	Tage Olsen A/S, Centrumgaarden, Room 133, 6D, Vesterbrogade, Kobenhavn V, Denmark	Palae 1369, Palae 1343
KOLN	Rohde & Schwarz Vertriebs, GmbH, Koln, Habsburger-Ring 2-12, West Germany	215341
LONDON	Livingston Laboratories Ltd., Retcar Street, London N.19, England	Archway 6251
MUNCHEN	Rohde & Schwarz Vertriebs, GmbH, Munchen 9, Auerfeldstrasse 22, West Germany	4 46 38
OSLO	Eugen Nilsson, Mollergaten 8, Oslo, Norway	33 14 28, 33 27 62
PARIS	Maurice I. Parisier & Co., 1860 Broadway, New York 23, New York	CIrcle 5-5701
	Relations Techniques Intercontinentales, 145, Avenue Malakoff, Paris 16, France	Passy 08-36, Kleber 54-82
RIO DE JANEIRO	Empresa Comercial Importadora Limitada, Rua Araujo Porto Alegre, 70-8°, Rio De Janeiro, Brazil	42-9460
ROMA	CESA-Elettronica, viale Liegi N.62, Roma, Italy	846.592, 865.722
STOCKHOLM	Erik Ferner AB, Bjornsonsgatan 197, Bromma, Stockholm, Sweden	377700
THE HAGUE	C. N. Rood, Weteringkade 37, The Hague, Netherlands	771920
TOKYO	Midoriya Electric Co., Ltd., 3-4 Chome, Ginzanishi, Chuo-Ku, Tokyo, Japan	Kyobashi (56) 0486
ZURICH	Omni Ray AG, Dufourstrasse 56, Zurich 8, Switzerland	(051) 34-44-30

Other OVERSEAS areas please write or cable directly to the Export Department, Portland, Oregon, U.S.A.

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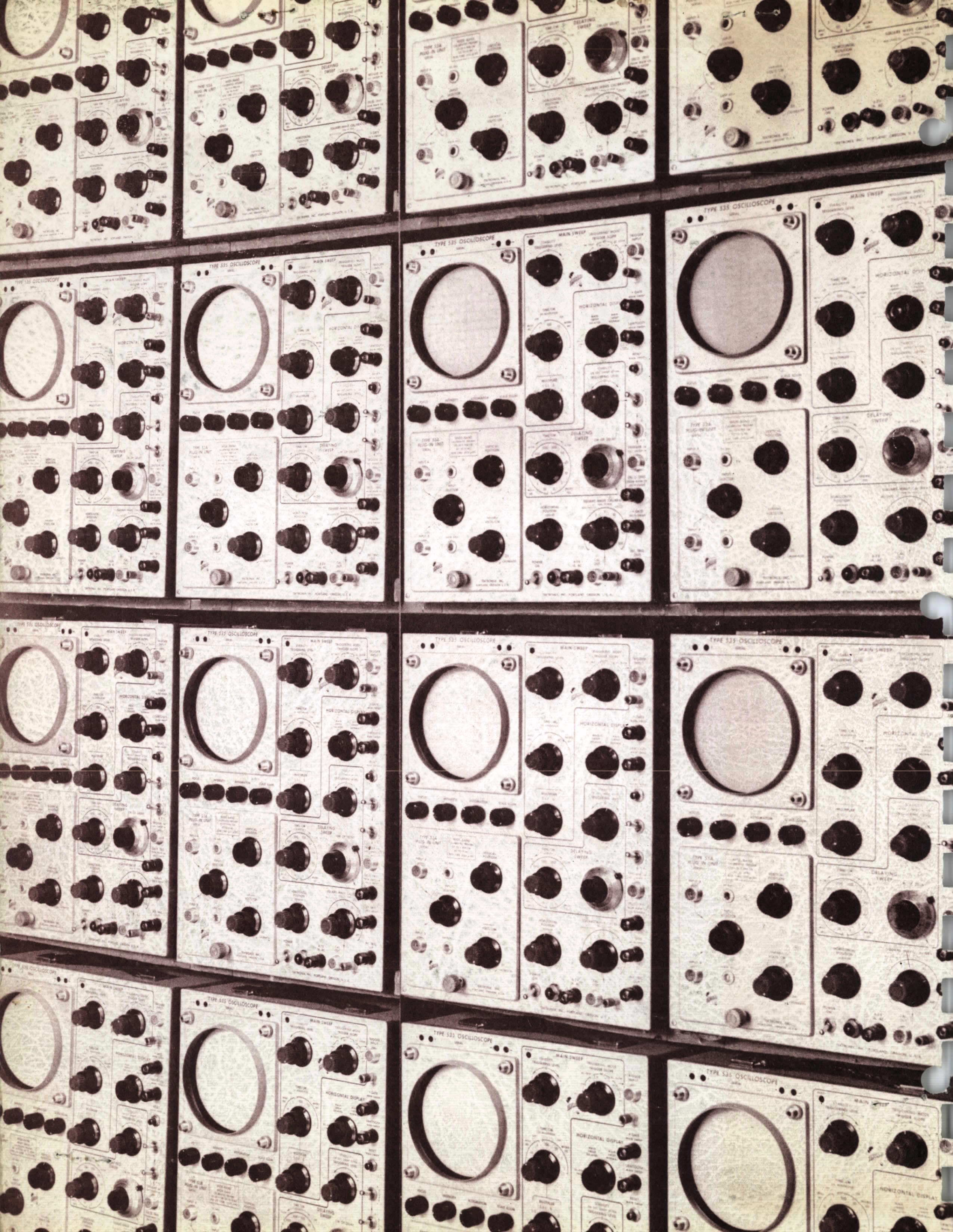
Type	Name	Price	Weight
105 (Rack Mounted)	Square Wave generator	#415.00	
104A	Square Wave Generator	$ 195.00	30
105	Square Wave Generator	$ 395.00	47
112	Amplifier	$ 495.00	49
121 Wide Band	Preamplifier	$ 265.00	24
122 Low Level	Preamplifier	$ 85.00	9
123 Miniature " "	Preamplifier	$ 30.00	1
124	Television Adaptor	$ 295.00	32
130	L, C Meter	$ 195.00	17
160	Series Waveform Generators		
160A	Power Supply	$ 140.00	28
161	Pulse Generator	$ 95.00	7
162	Waveform Generator	$ 95.00	7
163	Fast-Rise Pulse Generator	$ 95.00	7
180	Time-Mark Generator	$ 575.00 R #600.00	49 85
180-S1 (Has an oven)	Time-Mark Generator	$ 625.00	49
180-S2	Time-Mark Generator (400 cycle timing)	$ 585.00	49
181	Time-Mark Generator	$ 225.00	28
181-S1 (Has an oven)	Time-Mark Generator	$ 245.00	28
190	Signal Generator	$ 275.00	38
310	Oscilloscope	$ 595.00	34 1/2
310-S1	Oscilloscope	$ 595.00	34 1/2
315D	Oscilloscope	$ 770.00	47
315D-S1	Oscilloscope	$ 785.00	47
315D-S2	Oscilloscope	$ 790.00	47
315R	Oscilloscope	$ 795.00	77
315R-S1	Oscilloscope	$ 810.00	77
315R-S2	Oscilloscope	$ 815.00	77
360	Indicator	$ 195.00	14 1/2
515	Oscilloscope	$ 750.00	52
517A	Oscilloscope	$3500.00	243
524AD	Oscilloscope	$1180.00 AR $1,205.00	83 135
525	Television Waveform Monitor	$1050.00	72
531	Oscilloscope	$ 995.00 R-$1,020.00	82 141
532	Oscilloscope	$ 825.00 R-850.00	73 130
535	Oscilloscope	$1300.00 R-$1,325.00	87 144
535-S2	Oscilloscope - see mod. list	$1325.00	87
541	Oscilloscope	$1145.00 R-$1,070.00	82 141
545	Oscilloscope	$1450.00 R-1,475.00	87 144
53A	Wide-Band DC Preamplifier	$ 85.00	10
53B	Wide-Band High-Gain Preamplifier	$ 125.00	10
53C	Dual-Trace Preamplifier	$ 275.00	12
53/54D	Differential High-Gain DC Preamp.	$ 145.00	11
53/54E	Low-Level Differential AC Preamp.	$ 165.00	12
53G	Differential Wide-Band DC Preamp.	$ 175.00	12
53/54K	Fast-Rise DC Preamplifier	$ 125.00	10
570	Characteristic-Curve	$ 925.00	84
500 - Scopemobile	Operational Accessories	$ 97.50	53
500/53 " W. Panel	Operational Accessories	$ 108.00	53
BE 510 Bezel	Operational Accessories	$ 4.50	
H510 - Viewing Hood	Operational Accessories	$ 4.50	
H310 - Viewing Hood	Operational Accessories	$ 4.50	
016-010 " " collapsible		$ 3.50	Color T.V. great # 4.50
515	Oscilloscope	$750.00	
515R	Oscilloscope	$825.00	

	Additional	Field Kit
535-S1	$25.00	$40.00
545-S1	$25.00	$40.00
535-S2	$25.00	$40.00
545-S2	$25.00	Not yet
535-S6	$40.00	available
545-S4	$40.00	$47.50

*For further info on Rack Mount changes and "S" modifications see SPR's 37A and 38A.


TYPE 535 OSCILLOSCOPE
MAIN SWEEP
DELAYING SWEEP
HORIZONTAL DISPLAY