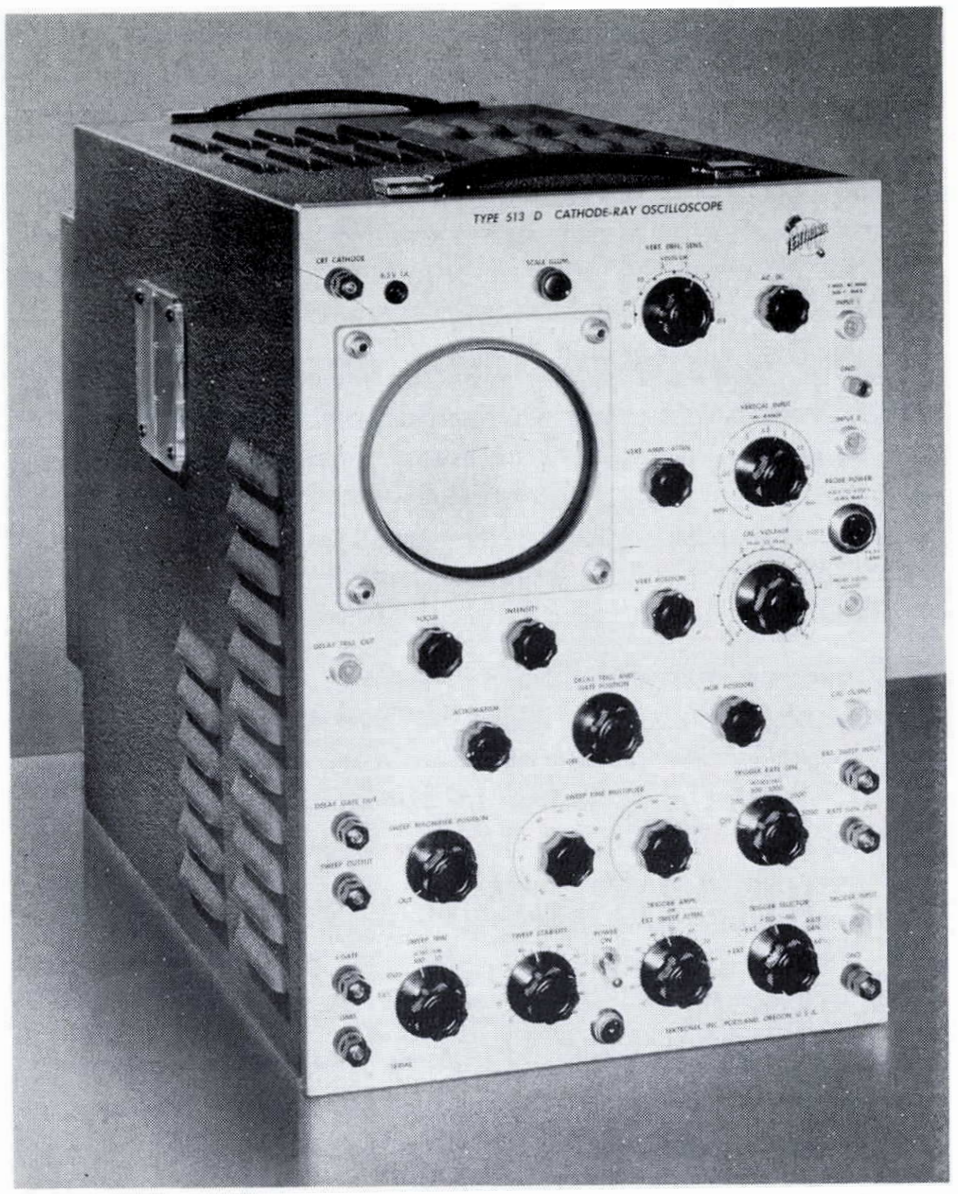
TYPE 513-D OSCILLOSCOPE



GENERAL DESCRIPTION

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

The direct coupled vertical amplifier, with its rise time of .025μsec, extends its usefulness beyond the limits of any previous cathode ray oscilloscope in general laboratory work.

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

VERTICAL DEFLECTION SYSTEM

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

Sensitivity Control — Two controls are provided to enable the **Type 513-D** to display a wide range of signal amplitudes. The vertical deflection sensitivity control inserts RC compensated attenuators and also inserts the preamplifier stages in the two highest gain positions. It is variable in steps of approximately 3 to 1. The vertical amplifier attenuator is a low impedance potentiometer providing a continuously variable attenuation of 3 to 1 to fill in the steps of the vertical deflection sensitivity control. The overall sensitivity of the vertical amplifier is continuously variable from .03 volts/centimeter to 100 volts/centimeter, peak to peak.

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

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

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

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

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

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

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

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

HORIZONTAL DEFLECTION SYSTEM

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

TYPE 513-D OSCILLOSCOPE

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

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

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

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

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

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

OTHER FEATURES

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

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

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

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

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

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

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

CHARACTERISTICS

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

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

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

Sweep Lag — .1 microsecond, maximum.

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

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

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

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

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

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

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

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

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TYPE 513-D OSCILLOSCOPE

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

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

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

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

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

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

Dimensions — 18½" high, 13" wide, 24¾" deep.

Weight — 79 pounds,

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

VACUUM TUBE COMPLEMENT

Input Pre-Amplifier		12AW6
2nd Stage Pre-Amplifier		12AW6
Pre-Amplifier Cathode Follower		12AT7
Gain Control Cathode Follower		12AT7
Probe Power Cathode Follower		6J6
Internal Trigger Amplifier		12AW6
Delay Line Impedance Matching Cathode Follower		12AT7
Driver Cathode Follower		12AT7
Driver	4	6AH6
Driver Voltage Cathode Follower		6AS5
Cal. Multivibrator		12AU7
Cal. Limiter and Output Cathode Follower		12AU7
Output Distributed Amplifier	14	6CB6
Trigger Inverter		6AH6
Trigger Amplifier dc Restorer	½	6AL5
Coupling Diode	½	6AL5
Trigger Amplifier		6AG7
Sweep Multivibrator		6AH6
Sweep Multivibrator		6AG7
Sweep Generator Clamp Tube		6AG7
Sweep Charging Potential Cathode Follower		6C4
Sweep dc Restorer		6AL5
Sweep Amplifier, Phase Inverter		12AU7
Sweep Amplifier	2	6AQ5
Sweep dc Level Control	2	6CB6
+Gate Output Cathode Follower	½	12AU7
Astigmatism Potential Cathode Follower	½	12AU7
Unblanking Amplifier, Inverter		12AT7
Unblanking Cathode Follower		6C4
Sweep Length Multivibrator		12AT7
Sweep Output Cathode Follower		6C4
Sweep Magnifier dc Restorer		6AL5
Sweep Magnifier		6J6
Cathode Ray Tube		5XP
+800 v Rectifier, Doubler	2	6X4
+800 v Series Regulator		6AS5
+800 v Regulator Amplifier		6AU6
+275 v Series Regulator		6AU5
+275 v Regulator Amplifier		6AU6
+275 v Series Regulator		6AS7
+225 v Regulator Amplifier		6AU6
+225 v Regulator Comparator		12AX7
+225 v Voltage Reference		5651
—150 v Rectifier	2	6X4
—150 v Reference		OD3
High Voltage Oscillator Regulator		6AU5
High Voltage Oscillator		6AU5
High Voltage Regulator Comparator		12AU7
+10 kv Rectifier, Doubler	3	5642
—2000 v Rectifier		5642
Delayed Gate Multivibrator		12AT7
Delayed Gate Cathode Follower	½	12AT7
Blocking Oscillator Trigger Tube	½	12AT7
Delayed Trigger Blocking Oscillator		12AT7
Delayed Trigger Output Cathode Follower		12AT7
Trigger Rate Gen. Blocking Oscillator		6J6
Trigger Rate Gen. Cathode Follower		12AT7

Price — $1,650.00

TYPE 513 CATHODE RAY OSCILLOSCOPE

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

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

Currently Available Extras

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

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

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

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

Rack-mounting cabinet, purchased separately $50

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

Tektronix, Inc.