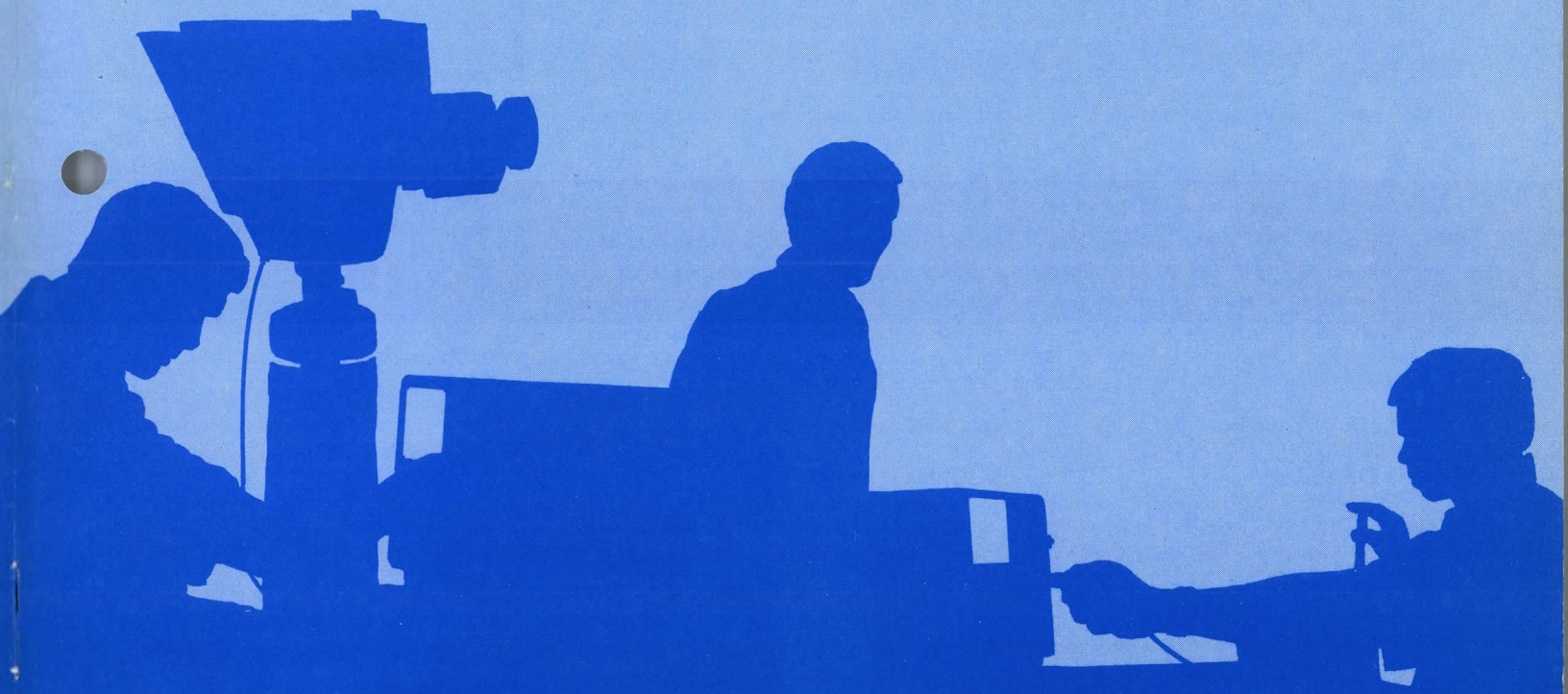
TELEQUIPMENT

. . . . a subsidiary of Tektronix, Inc.



atalog 5 **oscilloscopes** *July, 1971*

General and Ordering Information

ORDERING

Telequipment products are manufactured in the United States by Tektronix, Inc. and in England by Telequipment. They are sold and serviced in the United States by Tektronix, Inc. Orders should be placed with your Tektronix Field Engineering Office listed on the inside rear cover.

TERMS OF SALE

Tektronix, Inc. standard terms of sale are Net 30 days. Other credit terms are available for a customer's particular requirements. Credit accommodations and terms of sale are arranged through your Tektronix Field Engineer.

SHIPMENT

Normally all prices and quotations are FOB Beaverton, Oregon. Unless otherwise specified on your order, shipment will be made via most economical method. If a specific surface carrier is specified, shipment will be made at full valuation unless your order instructs differently. If air shipment is desired, air freight at full evaluation will be the method of shipment unless otherwise specified on the order.

MAINTENANCE

Sections of the manual provided with each Telequipment product describe circuit operation and adjustment. Your Tektronix Field Engineering Office will process all orders for Telequipment parts. Tektronix has established Field Engineering Offices and service centers in cities listed on the inside rear cover. Please include instrument Type number, serial number, and all descriptive information contained in the manual when ordering spare parts. Please do not return instruments or parts before receiving instructions.

WARRANTY

All Telequipment instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be discussed with your Tektronix Field Engineer. Field Offices are listed on the inside rear cover.

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CONTENTS

SELECTING AN OSCILLOSCOPE

There are many different types of oscilloscopes available. Depending on performance and characteristics, they vary in price from less than $100 to several thousands of dollars. The following discussion is intended to clarify the significance of many of the characteristics requiring appraisal before making a selection.

RISETIME AND HIGH FREQUENCY RESPONSE

The first qualification generally sought in an oscilloscope is adequate risetime or adequate high-frequency response. The two are closely related mathematically when fast step-signals produce little or no overshoot or ringing. The product of risetime and frequency response (bandwidth) produces a factor whose value lies between 0.33 and 0.35 when transient response is optimum. For example, the product of 35 ns risetime (35×10^{-9} second) and 10 MHz (10×10^{6} Hz) equals 0.35.

Ideally, scopes should have a vertical system capable of rising in about one-fifth the time that the fastest step-signal applied rises. In such a case, the risetime of the signal (as indicated on the scope) will only be in error by about 2 percent, assuming sweep timing and linearity are perfect. Vertical deflection systems which have a risetime no better than *equal* to the fastest rising signal applied are often considered adequate—a conclusion which may or may not be true depending upon the accuracy desired. Such reasoning is based upon the fact that the indicated risetime will be in error by a predictable amount when transient response is optimum. Under such conditions, signal risetime can be calculated to a close approximation by the formula $T_s = \sqrt{T_i^2 - T_a^2}$ where T_s = signal risetime, T_i = indicated risetime and T_a = vertical system (usually amplifier) risetime. The accuracy of such calculations falls off sharply for signals which rise faster than the scope amplifier.

DEFLECTION FACTOR (SENSITIVITY)

Sensitivity, like frequency response and risetime, is one of the prime factors determining the suitability of a scope for a particular application. When the utmost in sensitivity is required, some bandwidth must be sacrificed because of the greater background noise associated with wideband, high-gain amplifiers. If amplification is sufficiently great, background noise may be evident in a display. When it is, the amount of noise should be specified so that a signal-to-noise ratio may be predicted. Oscilloscope deflection factors should be stated in terms of peak-to-peak voltage rather than RMS voltage since only *sine-wave* amplitudes can be read directly from a scope calibrated in RMS volts. When noise figures are stated in terms of RMS voltage, the figure should be multiplied by 5 or 6 to determine the approximate amount of peak-to-peak deflection that the noise will produce on the screen.

When an accuracy specification is stated for deflection factor, it encompasses all tolerances involved and the linearity of the entire vertical deflection system, including the CRT. If the accuracy is stated as within 3%, this means the maximum error in the voltage determination will be $\pm$ 3% (excluding operator error).

SWITCHED INPUTS AND DUAL-BEAM SCOPES

A very useful type of dual-input amplifier is one which can pass either of two input signals one at a time to permit viewing either signal without disturbing connections. Comparison of the two signals is thereby permitted as electronic switching permits simultaneous viewing of two signals. Since the two signals trace out separate displays, scopes with built-in electronic switches are commonly called dual-trace scopes. They should not be confused with dual-beam scopes. Dual-trace scopes offer some advantages over dual-beam scopes and vice versa. Two simultaneous, non-recurrent signals of *short duration* may be displayed on a dual-beam scope, but cannot be displayed on a dual-trace scope. Also, some dual-beam scopes can display non-recurrent signals on different time-bases. The principal advantages of dual-trace scopes are lower cost and intrinsically better comparison capabilities.

Electronic switches should be capable of switching in two ways: rapidly during sweeps or synchronously during sweep retrace intervals. The first way is usually called "chopped",

the second way "alternate". The alternate mode is used more frequently and is preferred for displays employing faster sweeps. The chopped mode usually is reserved for comparing low-frequency recurrent signals or long-duration, non-recurrent signals.

When displaying two very bright traces using the chopped mode, the display may show the chopping waveform transients as faint lines connecting the two traces. Some scopes blank (turn off) the CRT beam during these transition intervals to prevent them from appearing in the display.

The chopping rate (frequency) should be high as possible so long as the resulting traces are not broadened significantly by distortion of the chopping signal. When the chopped mode is used with relatively fast non-recurrent sweeps, the traces are not continuous but are made up of separate segments, the number of segments depending on the chopping rate and the sweep duration. For instance, if the chopping rate is 100,000 Hz and the sweep duration is 1 millisecond, there will be 100 segments in each trace. How well these separate segments depict all the detail in the two waveforms establishes the limits of usefulness of the chopped mode compared to an alternately switched display or a dual-beam scope.

VERTICAL SIGNAL DELAY

Whenever sweeps are triggered by the displayed signals and the entire leading edge of the signals is to appear, the arrival of the signals at the vertical deflection plates must be delayed with respect to the time each sweep is started. To provide such delay a delay-cable or delay-line is used somewhere in the signal path between the deflection plates and the point in the system where a sample of the vertical signal is taken to start the triggering process. The need for signal delay is greatest in the "faster" scopes where the time required for sweeps to start (and the beam to be turned on) is equal to a significant portion of the fastest sweep.

SWEEP TRIGGERING AND SYNCHRONIZING

The sweep generator in early oscilloscopes ran continuously and, to present a steady display, the generator was run at a frequency which was equal to (or some sub-multiple of) the displayed signal. The process was called synchronizing and was achieved by applying a suitable sample of the signal to the sweep generator. That system is limited to displaying recurrent signals which do not vary in amplitude or frequency and which have little or no "dead-time" between successive waveforms.

A more direct system was developed for displaying pulses of short duration and low repetition frequency: the pulses themselves "drive" or "trigger" the sweeps. We now commonly trigger sweeps by generating a triggering pulse *internally* from whatever triggering waveform is selected. Such practice accommodates almost any type of triggering signal except those having a very high frequency. For this reason, the early method of synchronizing is often included in modern scopes. It should be borne in mind that synchronizing in such a manner is very difficult or impossible if the synchronizing signal varies in amplitude or frequency.

There are two basic requirements in the triggering area . . . sensitivity and frequency range. Trigger sensitivity indicates how small a signal can be displayed on the CRT and remain stable. For internal triggering, this is usually stated in divisions (or portion of a division) of CRT display. For external triggering, it is usually expressed in volts(or millivolts). Trigger bandwidth is an indication of the range of signal frequency that can be displayed in a triggered mode.

TIME BASE

In early oscilloscopes, the sweep generator ran continuously and horizontal calibration was based on its repetition frequency. The sweeps in most modern oscilloscopes are calibrated in terms of a direct unit of time for a given distance of spot travel across the screen, hence the term 'time-base'. The higher the bandwidth of the vertical deflection system, the faster the time base required to display the signal. Conversely, a very slow time base is required to display a signal that changes very slowly with time. A versatile oscilloscope has time-base rates that vary from several seconds per division of horizontal deflection to a fraction of a microsecond per division. Time-base accuracy usually is specified in terms of the permissible full-scale sweep timing error for any calibrated sweep. That is, an accuracy of 3 percent would mean that the actual full-scale period of any sweep should not be more than 3 percent greater or less than indicated. Magnified sweeps may have poorer accuracy ratings than unmagnified sweeps, since magnification is usually achieved by reducing amplifier feedback.

SWEEP MAGNIFICATION AND SWEEP DELAY

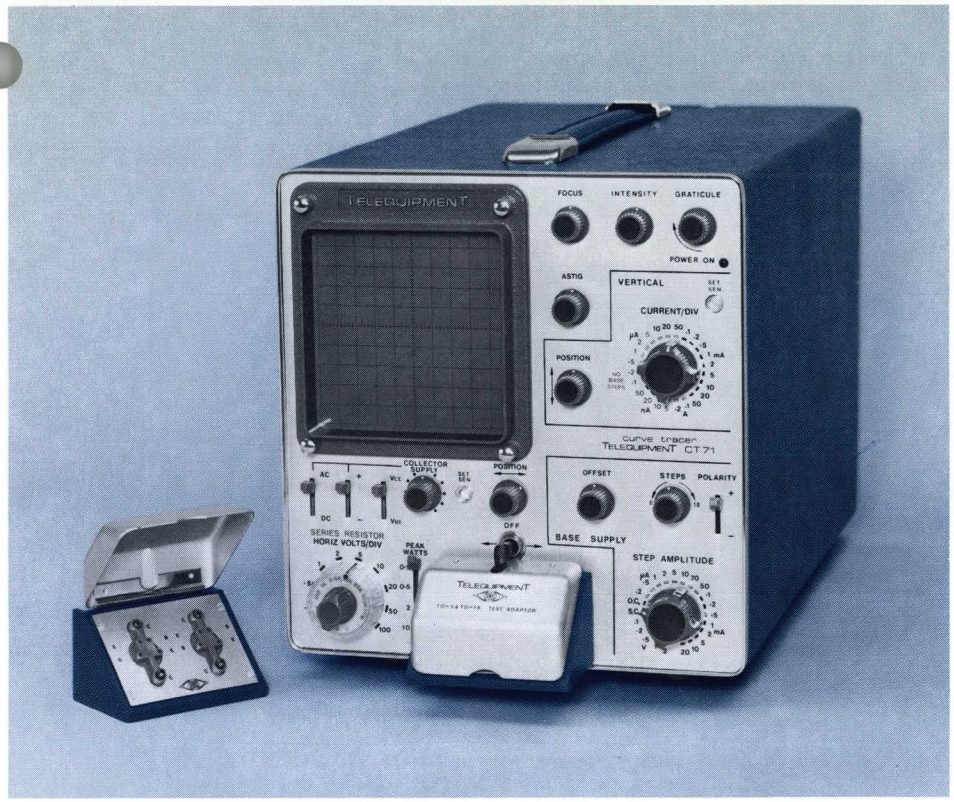
Sometimes it is desirable to display parts of waveforms which occur considerably later than suitable sweep triggering signals occur. Such waveforms can always be displayed on sweeps which last long enough, but if the duration of the waveform is short compared to the duration of a full sweep, an accurate examination may not be possible. The need to magnify (expand) the display for the time interval during which a particular event occurs is apparent. Portions of sweeps may be magnified by increasing the gain of the horizontal amplifier (allowing either or both ends of the sweeps to go off-screen) and positioning the display so that the desired portion is on-screen. This is a simple way to meet the need. Another way is to generate suitable delayed sweep triggering signals so that fast sweeps may be triggered just prior to the moment when the signal to be examined occurs. The first method delays the *presentation* of a sweep portion; the second method delays the actual *generation* of the displayed sweep. Calibrated sweep delay can provide some advantages over ordinary sweep magnification, cost and simplicity not being among them. These advantages are:

1. Greater ratios of effective magnification
2. Elimination of "time jitter" or "time drift" of displayed waveforms
3. Greater accuracy of time-interval measurements between waveforms
4. Better long-term accuracy of the displayed time base

WHY BUY TELEQUIPMENT?

When price is of prime importance, Telequipment warrants serious consideration. Telequipment oscilloscopes combine low price ($245 to $975) with a number of features not usually found in other oscilloscopes in this price range. Features such as calibrated sweep rate and vertical step attenuators, variable controls, triggered sweep, probe calibration outputs, illuminated graticule and TV field or line triggering, make the instruments easier to use and versatile.

Not to be forgotten is the quality of after-sales service. Telequipment products are marketed in the United States by 57 Tektronix, Inc. field offices and throughout the world by a network of Tektronix subsidiaries, distributors and representatives. Technical assistance and parts support is always nearby.



TELEQUIPMENT

CT71

Curve Tracer

- **Displays Dynamic Characteristic Curves**
- **Direct Comparison of Transistor, Diode and FET Characteristics**
- **DC Collector Supply to 1 kV**
- **Leakage Measurements to 5 nA**
- **Step Generator Range to 200 mA or 20 V**
- **10 x 10 cm Viewing Area**

The CT71 Curve Tracer is a dynamic semiconductor tester which displays characteristic curves of transistors, FET's and diodes. In addition the CT71 can be used to display dynamic characteristics over a wide range of semiconductor devices.

General Description and Characteristics

COLLECTOR SUPPLY

Voltage Range

Peak voltage continuously variable from 0 to 1 kV, selected by horizontal volts/div switch, and polarity is selectable, either positive or negative. The collector voltage repetition rate is twice the line frequency or DC, selectable.

Peak Current

2 A, the peak power settings are 0.1, 0.5, 2 and 10 watts. Maximum power available is 15 watts.

Collector Series Resistances

Selectable: 0 Ω, 2.5 Ω, 10 Ω, 65 Ω, 250 Ω, 1 kΩ, 6.5 kΩ, 25 kΩ, 85 kΩ, 500 kΩ and 1.7 MΩ all within 5%.

BASE STEP GENERATOR

Current Range

0.2 μA/step to 20 mA/step in 16 steps (1-2-5 sequence).

Voltage Range

0.1 V/step to 2 V/step in 5 steps (1-2-5 sequence). Two positions are also available on the step amplitude switch to either open circuit (O.C.) the base allowing it to float, or short circuit (S.C.) the base to the emitter.

Steps/Offset

The steps are adjustable from 0 to 10 steps, selectable in either a positive or negative direction depending on polarity switch setting. A continuously variable offset with a ±1 step range is provided. Steps and offset are only available on collector current ranges greater than 10 μA/div.

VERTICAL AMPLIFIER

Collector Current Range

Displays collector current only, 5 nA/div to 0.2 A/div in 24 steps (1-2-5 sequence).

HORIZONTAL AMPLIFIER

Collector Voltage Range

Selectable display of collector or base voltage, 0.1 V/div to 100 V/div in 10 steps (1-2-5 sequence).

OTHER CHARACTERISTICS

Test Fixtures

Two test fixtures are provided, which plug into the front of the CT71, providing a means of connecting collector supply output, step generator output and display amplifiers to the device under test.

One fixture provides the following sockets: 1 pair of TO-18's in a source-drain-gate configuration, 1 pair of TO-18's in an emitter-base-collector configuration, 1 pair of TO-5's in an emitter-base-collector configuration. 2 sets of 3 terminals in the emitter-base-collector configuration are also provided.

The other fixture provides two pair of power transistor sockets (a pair of TO-66's and a pair of TO-3's) both pairs in a emitter-base-collector configuration.

Safety Interlock

The protective cover cannot be opened until the supplies to the test fixtures are de-energized.

Cathode-Ray Tube

5½-inch CRT with a 10 x 10 cm viewing area. 2.5-kV accelerating potential with P31 phosphor normally supplied. A front-panel control varies the graticule illumination intensity.

Power Requirements

Voltage settings are 100 V to 125 V in 5 V steps, 200 V to 250 V in 10 V steps. 48 Hz to 63 Hz line frequency, 37 VA.

Dimensions and Weight

Height	9⅝ in	24.5 cm
Width	9¼ in	23.5 cm
Depth	19 in	48.3 cm
Net Weight	25 lb	11.7 kg

Included Standard Accessories

Two test fixtures; instruction manual.

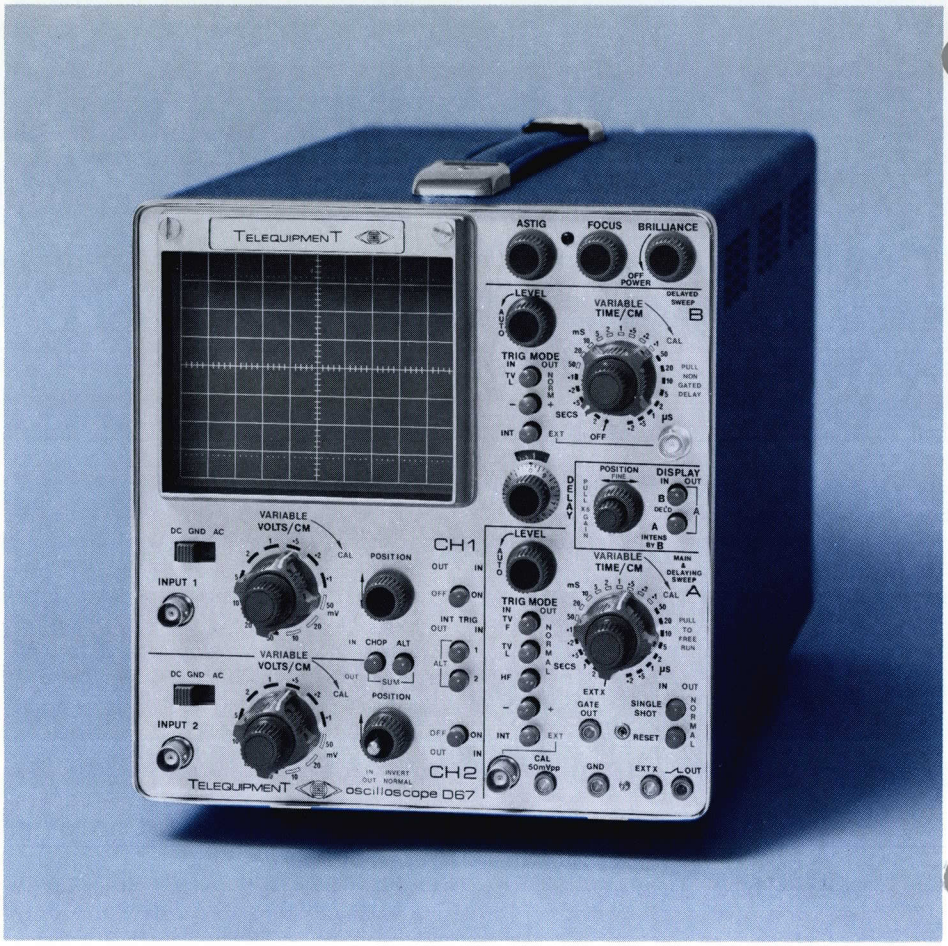
CT71, order TLCT71 . . . . . $795

U.S. Sales Price FOB Beaverton, Oregon

TELEQUIPMENT

D67

- **DC-to-25 MHz Bandwidth at 10 mV/cm**
- **3% Measuring Accuracy**
- **Signal and Sweep Delay**
- **Dual Trace, FET Inputs**
- **All Solid-State Design**
- **Large, Bright 8 x 10 cm Display**
- **Small Size — Lightweight**
- **Regulated Power Supplies**
- **Triggered Sweep**



The D67 is a 25 MHz, all solid-state dual-trace portable oscilloscope. An 8 x 10 cm mesh CRT provides a bright, clear display. The dual-trace vertical system displays either channel separately, adds channels algebraically, alternates between channels or chops between channels at 80 kHz rate. The delayed sweep feature permits close examination of any part of a complex waveform and also allows for accurate measurements of the time jitter in the input waveform. Solid-state design, using FET input circuitry, provides minimum drift and fast stabilization time.

Advanced design and use of solid-state circuitry throughout have produced an instrument of extra reliability ensuring long periods of operation without attention. Transistors are in sockets for easy servicing.

General Description and Characteristics

VERTICAL AMPLIFIER

Bandwidth and Risetime
DC to 25 MHz (approx 3-dB down), 14-ns risetime. Approx 2 Hz low frequency 3-dB point when AC coupled. Input can be AC or DC coupled.

Delay Line
200-ns signal delay permits viewing leading edge of displayed waveform.

Deflection Factor
10 mV/cm to 50 V/cm in 12 calibrated steps (1-2-5 sequence) accurate within ± 3%. Uncalibrated, continuously variable between steps to approx 125 V/cm.

Maximum Deflection
8 cm up to 25 MHz.

Input RC
1 megohm paralleled by approx 47 pF.

Maximum Input Voltage
400 V DC plus peak AC.

Operating Modes
Chopped switching between channels at approx 80 kHz, alternate switching during sweep retrace, Channel 1 only, Channel 2 only, Add. Channel 2 can be inverted.

TELEQUIPMENT

D67

HORIZONTAL DEFLECTION SYSTEM

Sweep Rates (A & B sweeps)
0.2 μs/cm to 2 s/cm in 22 calibrated steps (1-2-5 sequence) accurate within ± 3%. Uncalibrated, continuously variable between steps to approx 5 s/cm.

Display Modes
Three display modes, Normal (A sweep), A intensified by B, B delayed by A. The B sweep is triggerable after delay time or starts after delay time (non-gated delay). The delay time equals the A sweep TIME/cm setting X the DELAY setting. DELAY is uncalibrated.

Single Sweep (A sweep only)
Single shot facility with lockout is provided. A neon indicates when the time base is armed.

Horizontal Expansion (A & B sweeps)
X5 magnifier (accurate within ± 5%), operates over full time base range, increases fastest sweep speed to 40 ns/cm.

Horizontal Amplifier
DC to 1 MHz (approx 3-dB down) 0.6 V/cm to 3 V/cm deflection factor. Input impedance 1 megohm paralleled by approx 30 pF. Max input voltage 400 V DC plus peak AC.

TRIGGERING

Automatic (A & B sweeps)
Triggers over a frequency range of approx 15 Hz to 5 MHz.

Trigger Level Selection (A & B sweeps)
Triggering occurs at any level on the input waveform over a frequency range of approx 15 Hz to 5 MHz.

High Frequency Sync (A sweep only)
Synchronizes the sweep over a frequency range of approx 1 MHz to >25 MHz.

TV
Triggers at TV field or line rate (A sweep), triggers at TV line rate (B sweep).

Slope (A & B sweeps)
Plus or minus.

Requirements
Internal, 2-mm deflection to 5 MHz, except HF is 1-cm deflection to 25 MHz. External, 250 mV peak-to-peak up to 15 V peak-to-peak, input impedance 100 kΩ paralleled by approx 30 pF.

OTHER CHARACTERISTICS

Power Requirements
100 to 125 VAC in 5-V steps or 200 to 250 VAC in 10-V steps, 48 to 400 Hz. The instrument specifications apply over a ± 10% mains variation for the step chosen. Rear-panel quick-change transformer tap connections should be set to most nearly correspond with the actual line voltage. Power consumption is approx 50 VA and cooling is provided by convection.

Cathode-Ray Tube
5-inch flat-faced rectangular CRT with 8 x 10 cm viewing area. Operates at 10 kV accelerating potential. P31 phosphor normally supplied, P7 and P11 optional. Z-axis modulation to grid of CRT requires approx 20 V peak-to-peak for perceptible modulation at average brilliance. Variable-intensity illuminated graticule.

Voltage Calibrator
Line-frequency squarewave, 50-mV peak-to-peak accurate within ±1%.

Front Panel Outputs
Sawtooth out— 1-36 V, DC coupled, 30 kΩ minimum load (A sweep only).

Gate out—negative-going rectangular pulses, 5 V peak, lasting for the duration of A or B sweep, depending on horizontal mode selected.

Dimensions and Weights

Height	9¾ in	24.7 cm
Width	8¼ in	21 cm
Depth	17½ in	44.5 cm
Net Weight	25½ lb	11.5 kg

Included Accessories
Instruction manual (070-1076-00); four coax BNC connectors (131-0649-00).

D67, Order TLD67 ..... $975

Optional Accessories
10X Passive Probe, BNC
Order 010-0233-00 ..... $9.50

U.S. Sales Prices FOB Beaverton, Oregon

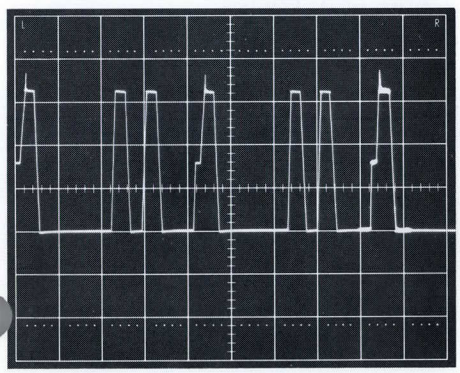


Fig 1 Delayed sweep is used to brighten a selected portion of the A sweep.

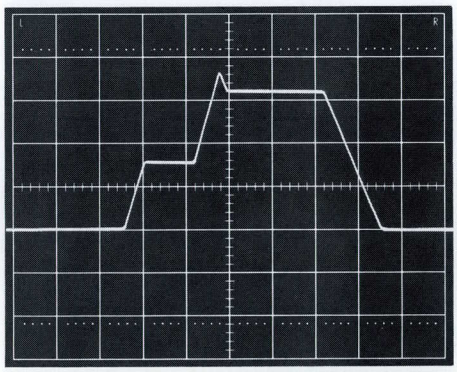


Fig 2 The selected portion of A sweep in Fig 1 is expanded to fill 10 cm. A greater resolution is thus obtained.

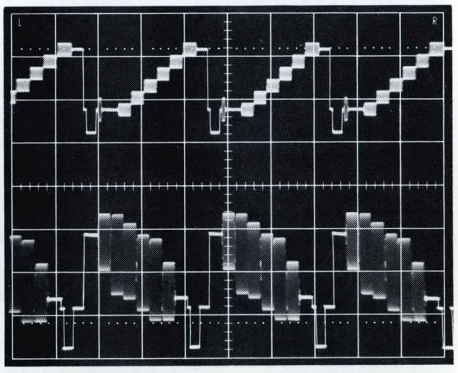
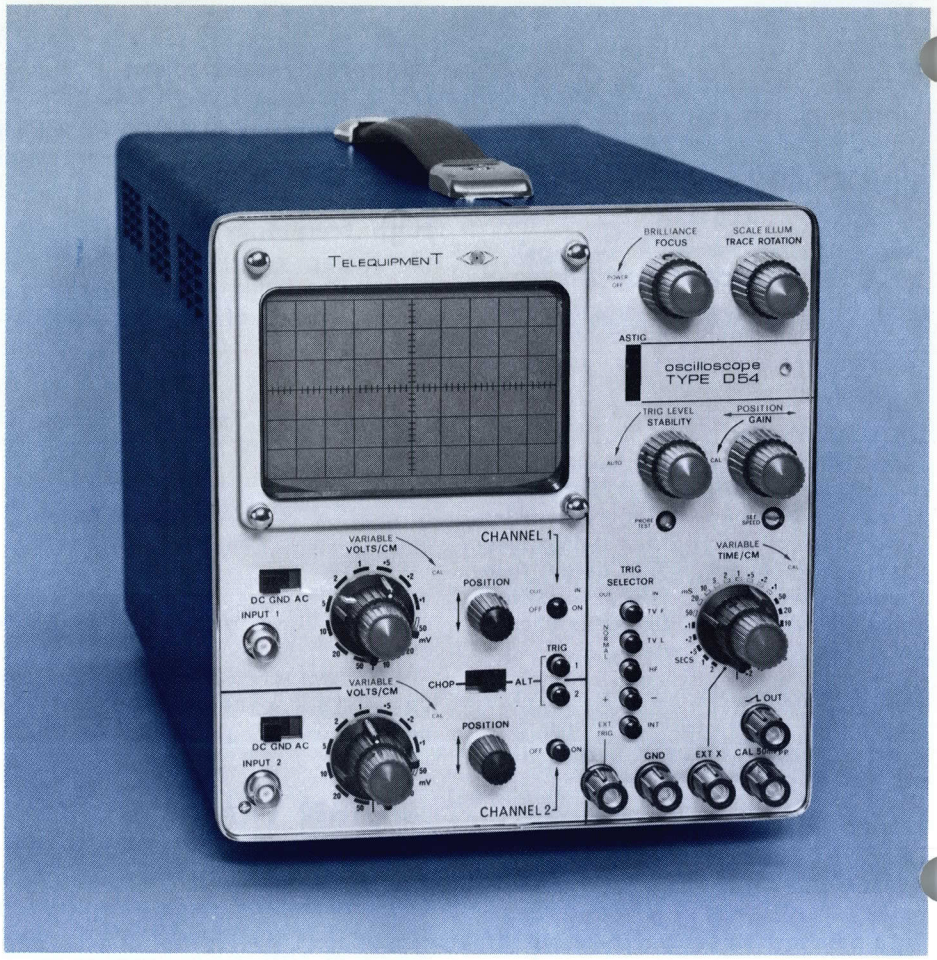


Fig 3 TV field or line triggering allows viewing of complex video waveforms.

TELEQUIPMENT

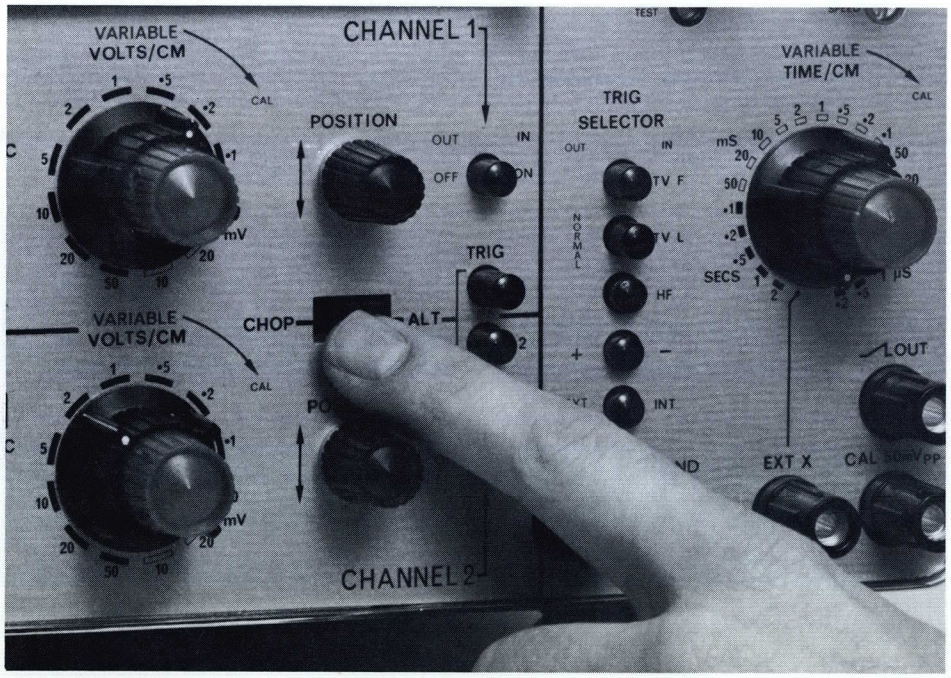
D54

- **DC-to-10 MHz Bandwidth at 10 mV/cm**
- **All Solid-State Design**
- **Dual Trace, Fet Inputs**
- **Triggered Sweep**
- **Flat-Face Rectangular CRT with 6 x 10-cm Illuminated Graticule**



FOUR DISPLAY MODES

Channel 1 only, Channel 2 only, chopped or alternate electronic switching between channels. Alternate: channels switched at the end of each trace during sweep retrace time. Chopped: successive 5-μs segments of each channel displayed at an approximate 100-kHz rate per channel. A switch permits selection of either channel 1 or channel 2 as the trigger source.



General Description and Characteristics

VERTICAL AMPLIFIER

Bandwidth and Risetime

DC to 10 MHz (approx 3-dB down), 35-ns risetime.

Input can be AC or DC coupled. ≈2-Hz low frequency 3-dB point when AC coupled.

Deflection Factor

10 mV/cm to 50 V/cm in 12 calibrated steps (1-2-5 sequence), accurate within ±5%. Uncalibrated, continuously variable between steps and to approx 125 V/cm.

Maximum Deflection

6 cm up to 5 MHz, decreasing to 3 cm at 10 MHz.

Input RC

1 megohm paralleled by approx 40 pF.

Maximum Input Voltage

400 V DC plus peak AC.

TIME BASE

Sweep Rates
200 ns/cm to 2 s/cm in 22 calibrated steps (1-2-5 sequence) accurate within ±5%. Uncalibrated, continuously variable between steps and to approx 5 s/cm.

Horizontal Expansion
Uncalibrated to approx X5, increasing max sweep to ≈40 ns/cm.

Horizontal Amplifier
DC to 1 MHz (approx 3-dB down) 0.6 V/cm-to-3 V/cm deflection factor. Input impedance 1 megohm paralleled by approx 30 pF. 400 V DC + peak AC.

TRIGGERING

Automatic
Triggers over a frequency range of approx 50 Hz to 1 MHz.

Trigger Level Selection
Triggering occurs at any level on the input waveform over a frequency range of approx 10 Hz to 4 MHz.

High Frequency Sync
Synchronizes the sweep over a frequency range of approx 1 MHz to at least 10 MHz.

TV
Triggers on TV field or line.

Slope
Plus or minus.

Requirements
Internal, 2-mm deflection to 1 MHz, increasing to 1-cm at 4 MHz. External, 1.5 V peak to peak up to 15 V peak to peak. Input impedance 100 kΩ paralleled by approx 10 pF.

OTHER CHARACTERISTICS

Cathode-Ray Tube
5-inch flat-faced rectangular CRT operating at 4-kV accelerating potential. Viewing area 6 cm vertical by 10 cm horizontal. P31 phosphor normally supplied, P7 and P11 optional. Z-axis modulation to grid of CRT requires approx 20 V. Variable-intensity illuminated graticule.

Voltage Calibrator
Line-frequency squarewave, 50 mV P-P accurate within 2%.

Front Panel Outputs
Sawtooth Out—1-35 V DC coupled, 30-kΩ minimum load.
Probe test—approx 0.5 V.

Power Requirements
For best performance rear-panel quick-change connections to the transformer taps should be set to the voltage settings most nearly corresponding to the actual line voltage. Voltage settings are 100, 105, 110, 115, 120, 125, 200, 210, 220 230 240 250 V. 48-to-440 Hz line frequency, 32 VA.

TELEQUIPMENT

D54R

The Type D54R is a rackmount version of the Type D54. It is electrically identical to the bench model, but mechanically designed to require only 5¼ inches of rack height in a standard 19-inch rack.

Convection Cooling

Dimensions and Weights

D54	Height	9¾ in	24.7 cm
	Width	8¼ in	21.0 cm
	Depth	17½ in	44.5 cm
	Net weight	20 lb	9.1 kg
	Shipping wt.	32 lb	14.5 kg
D54R	Height	5¼ in	13.3 cm
	Width	19 in	48.3 cm
	Depth	17½ in	44.5 cm
	Net weight	24 lb	11.3 kg

Included Accessories for D54
Instruction manual (070-0989-00); two coax BNC connectors (131-0649-00).

Type D54, order TLD54 . . . $595

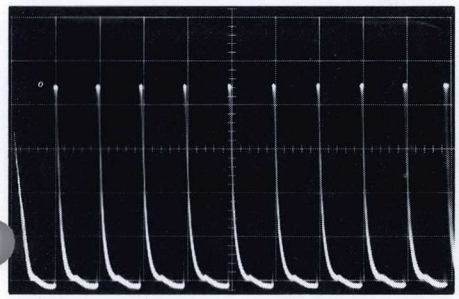
Included Accessories for D54R
Instruction manual (070-0989-01); two coax BNC connectors (131-0649-00).

Type D54R, order TLD54R $640

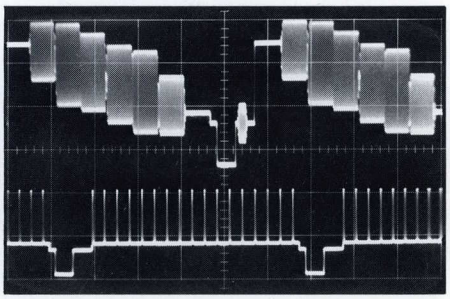
Optional Accessories
10X Passive Probe, BNC
Order 010-0233-00 . . . . . $9.50

BNC Female to Dual Banana
Order 103-0128-00 . . . . . $2.65

U.S. Sales Prices FOB Beaverton, Oregon



1 μs markers from a time mark generator clearly show the sweep to be linear, even at fast TIME/CM settings.



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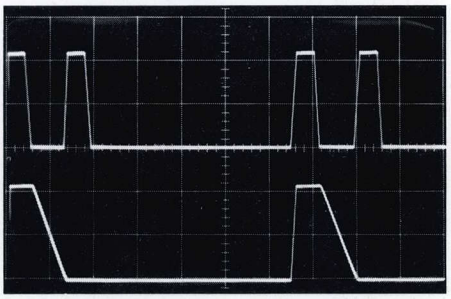
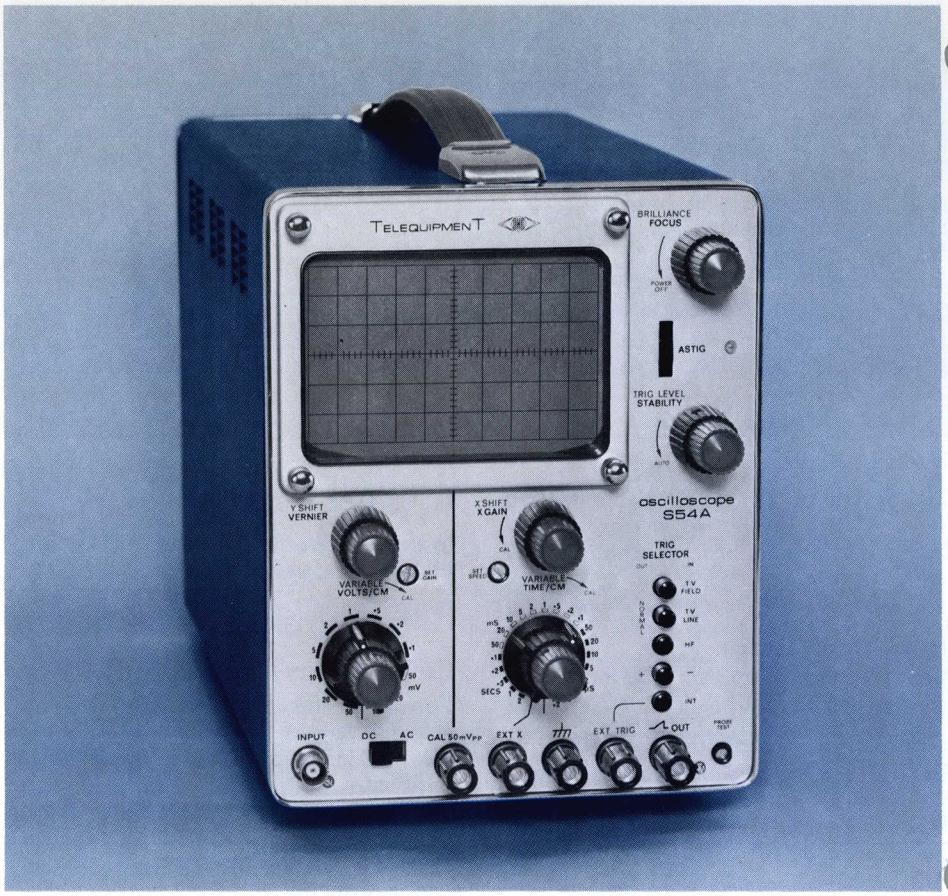


Dual-trace capability makes most measurements easier; pulse circuit analysis is just one application.

TELEQUIPMENT

S54A/S54U

- **DC-to-10 MHz Bandwidth at 10 mV/cm**
- **All Solid-State Design**
- **FET Input**
- **Triggered Sweep**
- **Flat-Face Rectangular CRT with 6 x 10-cm Illuminated Graticule**



TYPE S54A AC POWERED

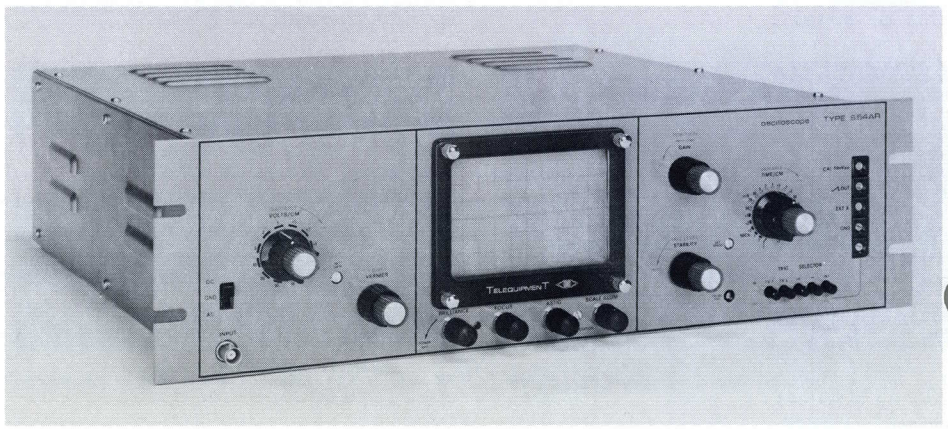
The S54 Series represents a new standard of performance for low-priced oscilloscopes. Features which serve to make the oscilloscopes a true measurement device, such as wide bandwidth, triggered sweep operation, calibrated sweep rate and vertical step attenuator, are incorporated through solid-state circuitry. Other features, such as variable controls, probe calibration outputs, illuminated graticule and TV field or line triggering, make the instrument easier to use and more versatile.

The Type S54A and S54AR operate from the AC line, the Type S54U operates from internal batteries, an external DC source, or from the AC line.

A dual-trace version of the Type S54A is also available, see the Type D54 on page 6.

TYPE S54U
AC, DC, BATTERY POWERED

The Type S54AR is a rackmount version of the Type S54A. It is electrically identical to the bench model, but mechanically designed to require only 5¼ inches of rack height in a standard 19-inch rack.



VERTICAL AMPLIFIER

Bandwidth and Risetime

DC to 10 MHz (approx 3-dB down), 35-ns risetime.
Input can be AC or DC coupled. ≈2-Hz low frequency 3-dB point when AC coupled.

Deflection Factor

10 mV/cm to 50 V/cm in 12 calibrated steps (1-2-5 sequence), accurate within ±5%. Uncalibrated, continuously variable between steps and to approx 125 V/cm.

Maximum Deflection

6 cm up to 5 MHz, decreasing to 3 cm at 10 MHz.

Input RC

1 megohm paralleled by approx 47 pF.

Maximum Input Voltage

400 V DC plus peak AC.

TIME BASE

Sweep Rates

200 ns/cm to 2 s/cm in 22 calibrated steps (1-2-5 sequence) accurate within ±5%. Uncalibrated, continuously variable between steps and to approx 5 s/cm.

Horizontal Expansion

Uncalibrated to approx X5, increasing max sweep to ≈ 40 ns/cm.

Horizontal Amplifier

DC to 1 MHz (approx 3-dB down) 0.6 V/cm-to-3 V/cm deflection factor. Input impedance 1 megohm paralleled by approx 30 pF. 400 V DC + peak AC.

TRIGGERING

Automatic

Triggers over a frequency range of approx 50 Hz to 1 MHz.

Trigger Level Selection

Triggering occurs at any level on the input waveform over a frequency range of approx 10 Hz to 4 MHz.

High Frequency Sync

Synchronizes the sweep over a frequency range of approx 1 MHz to at least 10 MHz.

TV

Triggers on TV field or line.

Slope

Plus or minus.

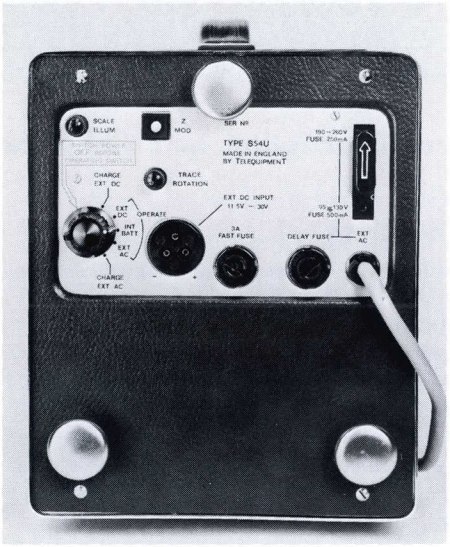
Requirements

Internal, 2-mm deflection to 1 MHz, increasing to 1-cm at 4 MHz. External, 1.5 V peak to peak up to 15 V peak to peak. Input impedance 100 kΩ paralleled by approx 10 pF.

POWER OPTIONS

Type S54A and S54AR

100 to 125 VAC in 5-V steps or 200 to 250 VAC in 10-V steps, 48 to 440 Hz, approx 24 VA. Rear-panel quick-change transformer tap connections should be set to most nearly correspond with the actual line voltage.



Type S54U

Internal NiCd batteries provide 3 hours operation (30 hours operation in standby mode). Batteries can be recharged in 14 hours from an external DC or AC source.

An external DC source of 11.5 to 30 V can be used. Power consumption is 2.5 to 3.75 W for standby, 18 W maximum for operation or maximum recharge.

An external AC source of 95 to 130 VAC or 190 to 260 VAC, 48 to 440 Hz can be used. Power consumption is 7 to 12 VA for standby, 34 VA maximum for operation or maximum recharge.

OTHER CHARACTERISTICS

Cathode-Ray Tube

5-inch flat-faced rectangular CRT operating at 4-kV accelerating potential. Viewing area 6 cm vertical by 10 cm horizontal. P31 phosphor normally supplied, P7 and P11 optional. Z-axis modulation to grid of CRT requires approx 20 V. Variable-intensity illuminated graticule (when operated from AC line).

Voltage Calibrator

Line-frequency squarewave, 50 mV P-P accurate within 2%.

Front Panel Outputs

Sawtooth Out—1-35 V DC coupled, 30-kΩ minimum load.

Probe test—approx 0.5 V.

Convection Cooling

Dimensions and Weights

S54A	Height	9¼ in	23.5 cm
	Width	6¾ in	17.2 cm
	Depth	16½ in	41.9 cm
	Net weight	17 lb	8.0 kg
S54AR	Height	5¼ in	13.3 cm
	Width	19 in	48.3 cm
	Depth	17½ in	44.5 cm
	Net weight	22 lb	10.0 kg
S54U	Height	9¼ in	23.5 cm
	Width	6¾ in	17.2 cm
	Depth	18 in	45.7 cm
	Net weight	25 lb	11.3 kg

Included Accessories for S54A

Instruction manual (070-0962-00); coax BNC connector (131-0649-00).

Type S54A, order TLS54A . $450

Included Accessories for S54U

Instruction manual (070-0951-00); coax BNC connector (131-0649-00); DC input plug (134-0113-00).

Type S54U including batteries, order TLS54U $715

Included Accessories for S54AR

Instruction manual (070-0962-00); two coax BNC connectors (131-0649-00).

Type S54AR, order TLS54AR $495

Optional Accessories

10X Passive Probe, BNC
Order 010-0233-00 . . . . . $9.50

BNC Female to Dual Banana
Order 103-0128-00 . . . . . $2.65

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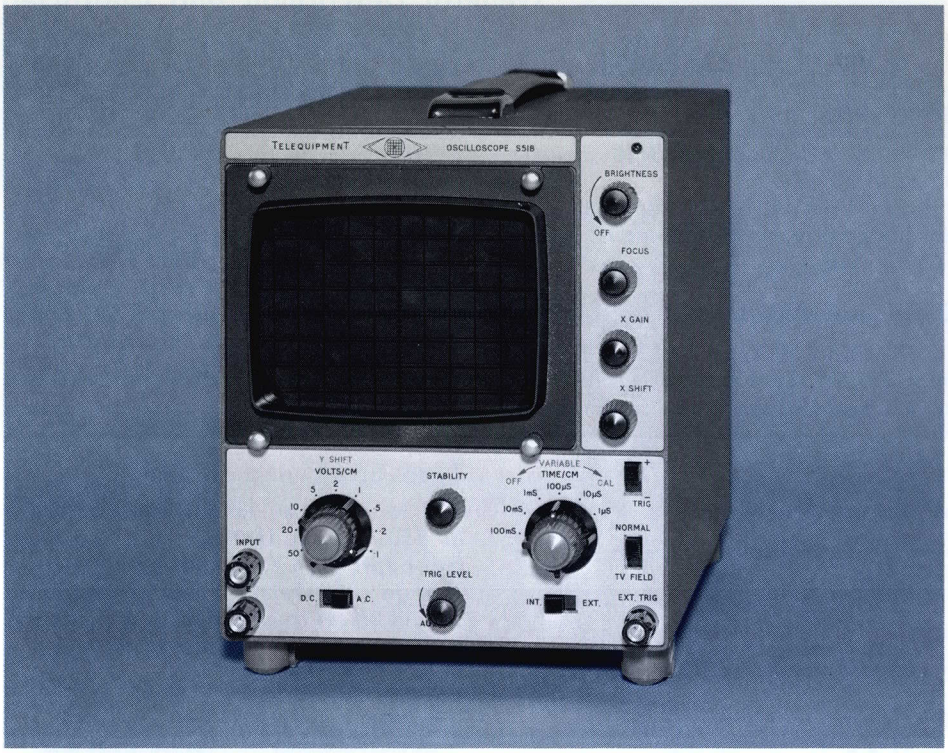
TELEQUIPMENT

S51B

- **DC-3 MHz Bandwidth**
- **Versatile Triggering Including TV Field**
- **8 cm x 10 cm Viewing Area**
- **Flat-Face CRT**
- **Small Size & Light Weight**
- **DC Coupled Horizontal Amplifier**



General Description and Characteristics

Vertical Amplifier

Bandwidth—DC to 3 MHz (approx 3-dB down) with DC coupling, 2 Hz to 3 MHz with AC coupling.
Deflection Factor—100 mV/cm to 50 V/cm in 9 calibrated steps (1-2-5 sequence), accurate within 5%.
Overshoot—Less than 2%.
Input RC—1 megohm paralleled by approx 47 pF.
Maximum Deflection—8 cm.

Horizontal Amplifier

Deflection Factor—Uncalibrated, continuously variable, approx 100 mV/cm at mid-position, range approx 2:1.
Bandwidth—DC to 500 kHz (approx 3-dB down).
Input RC—1 megohm paralleled by approx 100 pF.
Horizontal Positioning—Positions any portion of expanded trace on screen.

Time Base

Sweep Rates—1 μs/cm to 100 ms/cm in 6 calibrated steps (1-10 sequence). Uncalibrated, continuously variable between steps and to approx 1 s/cm.
Horizontal Expansion — Approx X2, continuously variable.
Time Measurement Accuracy—Within ±5% over center 8 cm (±10% over first and last 2 cm in 1 μs/cm range).
DC Coupled Unblanking.

Triggering

Automatic—Sweep free runs at a slow speed but triggers on any signal up to approx 1 MHz.
Trigger level selection—Triggering occurs at any level on the input waveform.

TV Field—Triggering occurs from the field pulses of a composite television signal.

Slope—Plus or minus.

Source—Internal or external.

Sensitivity—5 mm of signal internally, 3 V peak to peak externally.

External Trigger Input Impedance—1 megohm paralleled by approx 30 pF.

Cathode-Ray Tube

5-inch flat-faced CRT operating at 3-kV accelerating potential. Viewing area 8 cm vertical by 10 cm horizontal. P31 phosphor normally supplied, P7 optional. A detachable green filter improves contrast under high ambient light conditions.

Rear Connectors

Sweep Output—Approx 20 V peak to peak at a DC level of approx 30 V.
Horizontal Amplifier Input.
Z-axis Modulation to Cathode of CRT (0.01 μF and 1 megohm).

Power Requirements

Wired for 115 V or 240-V operation. For best performance, transformer taps should be soldered to the voltage terminals most nearly corresponding to line voltage. Voltage terminals are 90, 100, 105, 110, 115, 120, 130, 200, 210, 215, 220, 225, 230, 240 V. 50 to 400 Hz line frequency range, 58 VA.

Convection Cooling

Dimensions and Weights

Height	8 in	20.3 cm
Width	7 in	17.8 cm
Depth	15 in	38.1 cm
Net weight	16 lb	7.3 kg
Shipping weight	22 lb	10.0 kg

Included Accessories for S51B

Instruction manual (070-0792-00); test leads (012-0129-00).

Type S51B, order TLS51B . $245

Optional Accessories

10X Passive Probe, BNC
Order 010-0233-00 ..... $9.50

BNC Female to Dual Banana
Order 103-0128-00 ..... $2.65

Viewing Hood
Order 016-0251-00 ..... $12.75

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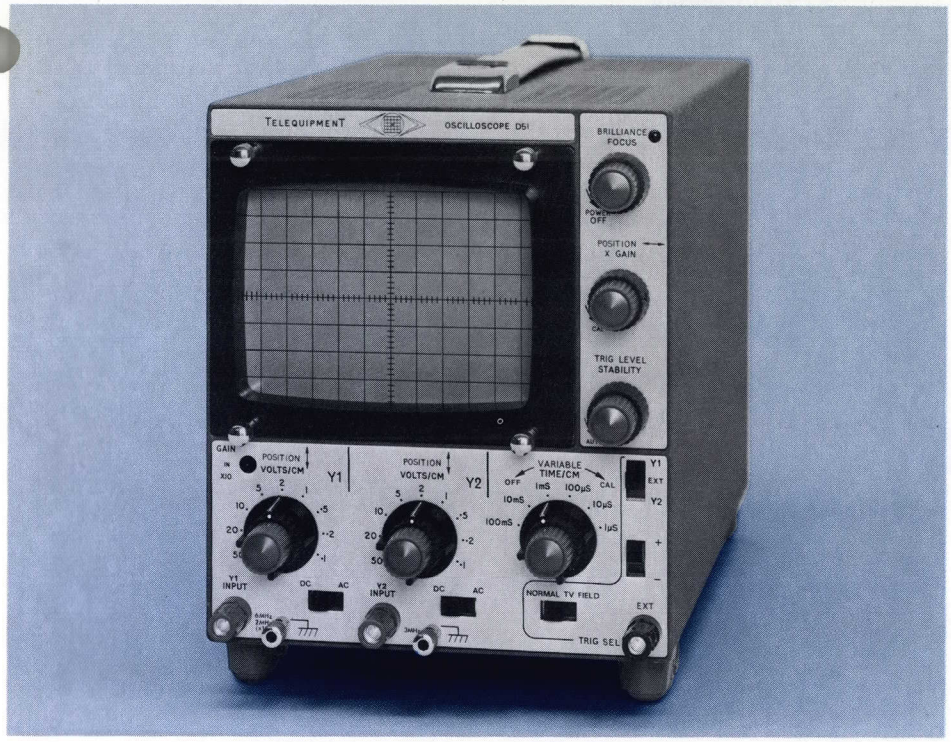

TELEQUIPMENT

D51

- **Dual Beam**
- **DC-6 MHz Bandwidth (Ch 1)**
- **DC-3 MHz Bandwidth (Ch 2)**
- **Versatile Triggering Including TV Field**
- **6 x 10 cm Viewing Area**
- **Flat-Face CRT**
- **DC Coupled Horizontal Amplifier**

General Description and Characteristics

Channel 1 Vertical Amplifier

Bandwidth—DC to 6 MHz (approx 3-dB down) with DC coupling, 2 Hz to 6 MHz with AC coupling.
Deflection Factor—100 mV/cm to 50 V/cm in 9 calibrated steps (1-2-5 sequence), accurate within 5%. Front-panel control selects X10 gain for deflection factors from 10 mV/cm to 5 V/cm at DC-to-2 MHz bandwidth (approx 3-dB down).
Input RC—1 megohm paralleled by approx 47 pF.
Maximum Input Voltage—400 V (DC + peak AC).
Maximum Deflection—6 cm for each trace.

Channel 2 Vertical Amplifier

Bandwidth—DC to 3 MHz (approx 3-dB down) with DC coupling, 2 Hz to 3 MHz with AC coupling.
Deflection Factor—100 mV/cm to 50 V/cm in 9 calibrated steps (1-2-5 sequence), accurate within 5%.
Input RC—1 megohm paralleled by approx 47 pF.
Maximum Input Voltage—400 V (DC + peak AC).
Maximum Deflection—6 cm for each trace.

Horizontal Amplifier

Bandwidth—DC to 500 kHz (approx 3-dB down).
Deflection Factor—approx 100 mV/cm.
Input RC—1 megohm paralleled by approx 100 pF.

Time Base

Sweep Rates—1 µs/cm to 100 ms/cm in 6 calibrated steps (1-10 sequence). Uncalibrated, continuously variable between steps and to approx 1 s/cm.
Horizontal Expansion — Approx X2, continuously variable, extends fastest sweep to 0.75 µs/cm.
Time Measurement Accuracy—Within ±5% over center 8 cm.

Triggering

Automatic—Repetitive signals up to 1 MHz.
Trigger Level Selection—Triggering occurs at any level on the input waveform.
TV Field.
Slope—Plus or minus.
Sources—Internal from either amplifier, or external.

Cathode-Ray Tube

5-inch flat-faced CRT operating at 3.5 kV accelerating potential, single gun with beam splitter forms 2 electron beams, common horizontal deflection plates. Viewing area 6 cm vertical by 10 cm horizontal. P31 phosphor normally supplied, P7 optional. Detachable filters improve contrast under high ambient light conditions.

Rear Connectors

Sweep Output—Z-axis modulation to CRT, horizontal amplifier input, ground.

Power Requirements

For best performance, connections to the transformer taps should correspond as closely as possible to the actual line voltage. Voltage terminals are 90, 95, 100, 105, 110, 115, 120, 125, 130, 200, 205, 210, 215, 220, 225, 230, 235, 240 V. 50 to 400-Hz line frequency range, 70 VA.

Convection Cooling

Dimensions and Weights

Height	8 in	20.3 cm
Width	7 in	18 cm
Depth	18 in	45 cm
Net Weight	20 lb	9.1 kg

Included Accessories for D51

Instruction manual (070-0993-00); test leads (012-0168-00).

Type D51, order TLD51 . . $375

Optional Accessories

10X Passive Probe, BNC
Order 010-0233-00 . . . . . $9.50

BNC Female to Dual Banana
Order 103-0128-00 . . . . . $2.65

Viewing Hood
Order 016-0251-00 . . . . . $12.75

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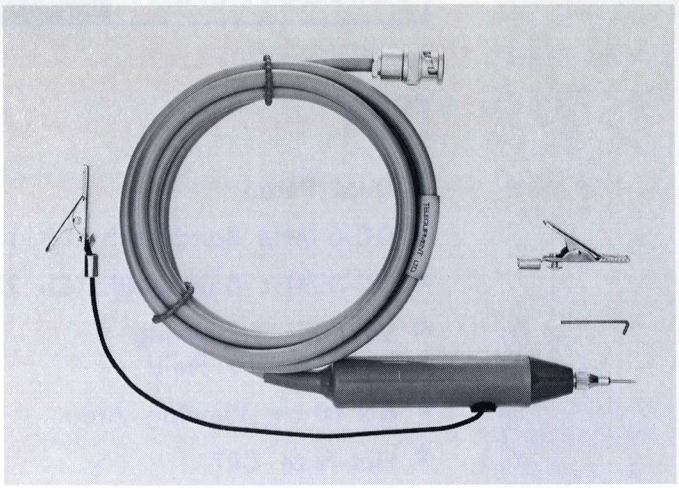
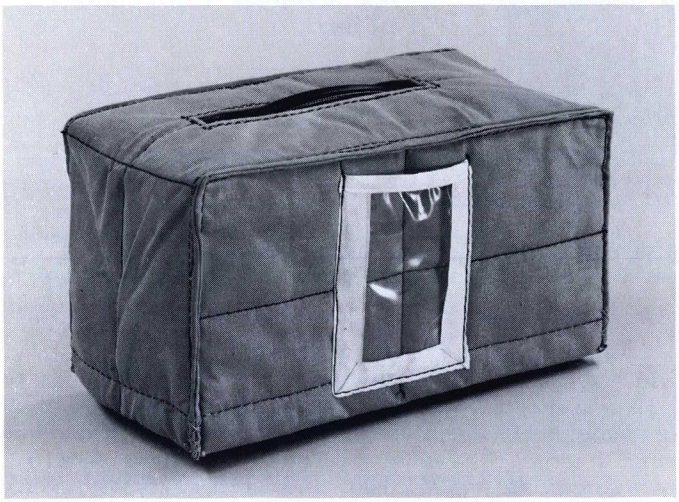
ACCESSORIES



PROBES

10X Passive Probe, BNC
Order 010-0233-00 ..... $9.50

10X Passive Probe, UHF
Order 010-0234-00 ..... $9.50



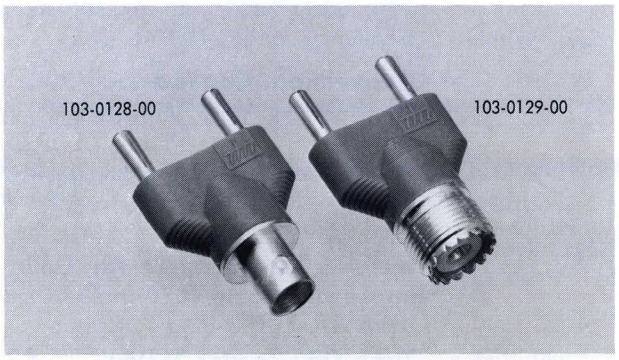
PROTECTIVE COVERS

The protective canvas cover is heavily padded and provides protection during transport or storage. The cover slips easily over the top of the instrument and has a slot which allows access to the instrument handle.

For S54A, S51B and S51E
Order 016-0138-00 ..... $16.50

For D51, D52, D54, D67, S52 and S54U
Order 016-0143-00 ..... $12.50

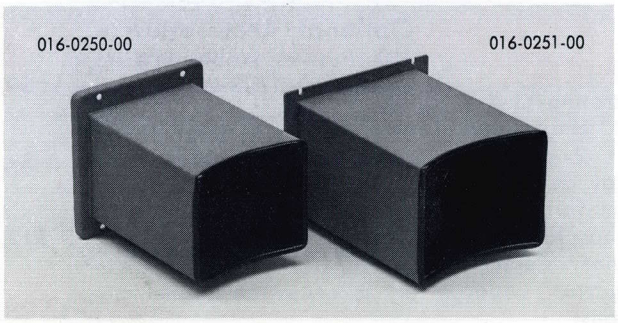
For D53A
Order 016-0144-00 ..... $22.75



COAXIAL ADAPTERS

BNC Female to Dual Banana
Order 103-0128-00 ..... $2.65

UHF Female to Dual Banana
Order 103-0129-00 ..... $2.65



VIEWING HOODS

Viewing Hood for D43 and S43
Order 016-0250-00 ..... $12.75

Viewing Hood for S51B, S52, D51, D52 and D53A
Order 016-0251-00 ..... $12.75

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