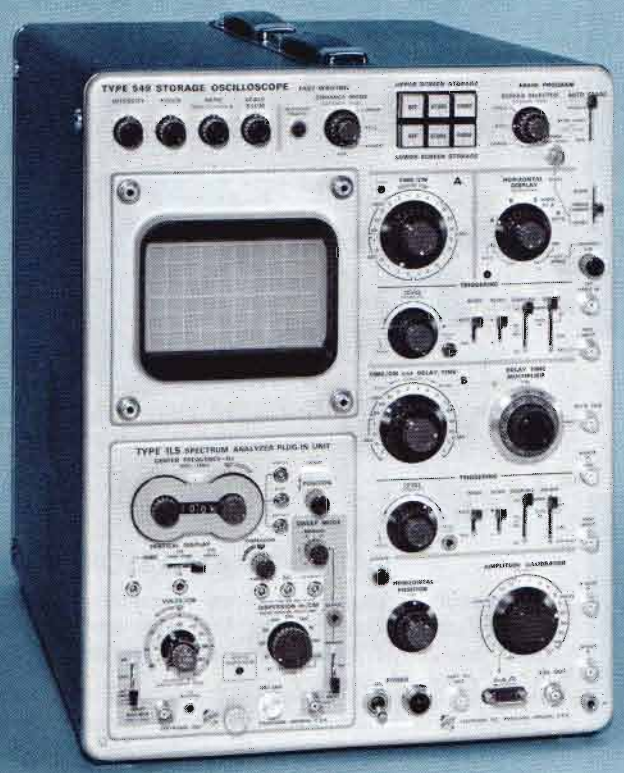
TYPE 549

SPLIT-SCREEN STORAGE OSCILLOSCOPE



- **BISTABLE SPLIT-SCREEN STORAGE AND CONVENTIONAL DISPLAYS**
- **VARIABLE VIEWING TIME**
- **5 cm/μs WRITING SPEED**
- **CALIBRATED SWEEP DELAY**
- **FULL-BANDWIDTH TRIGGERING**
- **ACCEPTS MULTI-TRACE, DIFFERENTIAL, SAMPLING, AND SPECTRUM ANALYZER PLUG-IN UNITS**

The Type 549 extends the exclusive Tektronix split-screen and bistable storage features into research and development applications. Offering a high degree of versatility, it accepts all letter-series and 1-series plug-in units covering many applications including sampling and spectrum analysis.

The split-screen, bistable CRT provides high contrast displays and unparalleled writing speeds. Each half of the 6 x 10-cm display area can be independently controlled, thus allowing stored or conventional displays on either the upper or lower half. A stored display can then be compared simultaneously with a conventional display.

A variable-viewing-time system offers a new convenience to storage oscilloscope users. Through front panel controls, this system can be directed to automatically erase either or both halves of the display area after a predetermined viewing time. Viewing time can be varied from $\leq$0.5 seconds to $\geq$5 seconds with AUTO ERASE selected for either PERIODIC or AFTER-SWEEP operation. Used in conjunction with the SINGLE SWEEP, the "After-Sweep" erase circuit automatically resets the Single-Sweep circuit at the end of the viewing-time interval.

CHARACTERISTIC SUMMARY

VERTICAL

Vertical deflection characteristics extremely flexible through use of all Letter-Series and 1-Series Plug-In Units.

HORIZONTAL

CALIBRATED TIME BASE—0.1 μs/cm to 5 s/cm.

X5 MAGNIFIER—Extends time base to 20 ns/cm.

CALIBRATED SWEEP DELAY—2 μs to 10 s.

EXTERNAL INPUT—0.2 V/cm, DC to 350 kHz.

STORAGE CRT

DISPLAY AREA—6 x 10 cm.

SPLIT SCREEN STORAGE—Store on either upper or lower half of screen with non-storage on other half; store on entire screen; or non-store on entire screen.

LOCATE ZONE—Locate button permits vertical position finding.

VIEWING TIME—Up to one hour.

ERASE TIME—150 ms maximum.

WRITING SPEED—0.5 cm/μs. 5 cm/μs with enhancement.

PHOSPHOR—P1

OTHER

AMPLITUDE CALIBRATOR—0.2 mV to 100 V; 5 mA current loop; 1 kHz.

POWER REQUIREMENTS—104, 115, 127, or 208, 230, and 254 volts, center value (regulation range ±10%), 650 W (approx) maximum.

AVAILABLE DISPLAYS

With the wide range of vertical plug-in units, several types of stored and conventional displays are obtainable. The Type 549, by virtue of a **new** bistable split-screen storage CRT capable of unparalleled writing speeds, extends storage-measuring capability into previously unattainable areas.

SINGLE-TRACE AND MULTI-TRACE

Multi-trace displays are obtained by selecting a Type 1A1, 1A2, 1A4, CA, or M Amplifier Plug-In Unit. All other 1-Series and Letter-Series Plug-In Units will give single-trace displays. Selection of the Type 1A5, 1A6, 1A7, D, E, or G gives differential amplifier operation, while strain gage and other transducer operations are available with the Type Q Unit.

SAMPLING

Sampling displays with risetimes in the sub-nanosecond region are obtained using a Type 1S1 or 1S2 Sampling Unit. The Type 1S1 is a general-purpose sampler with 1 GHz bandwidth, delay line and internal triggering. The Type 1S2 is designed specifically for TDR (time-domain reflectometry) applications, but offers general-purpose sampling with 3.9 GHz bandwidth and built-in triggering.

SPECTRUM ANALYSIS

Spectral displays are obtained using a Type 1L5, 1L10, 1L20, or 1L30 Spectrum Analyzer Plug-In Unit to cover a frequency range from 10 Hz to 10.5 GHz.

There are decided advantages in using the storage oscilloscope for spectrum analysis. When slow sweep times are used, it is often difficult to view a complete display; however, by storing the display it can be completely and easily observed.

Signal drift is easily measured using the storage technique. The signal is stored and then as subsequent displays are stored, drift of the signal can be observed. Or, the spectral display can be stored on one half of the screen and simply compared with a similar non-stored display on the other.

STORAGE CRT AND DISPLAY FEATURES

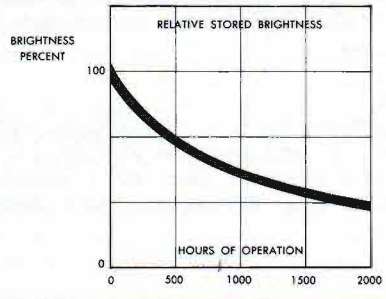
STORAGE CRT

Direct viewing, bistable, split-screen, mono-accelerating with 4-kV accelerating potential and separate non-store "locate zone". External edge-lighted graticule. Tektronix bistable storage offers: 1) Brightness of a stored trace independent of viewing time; 2) Contrast of a stored trace independent of viewing time; and 3) Brightness of a stored trace independent of writing speed.

DISPLAY AREA

6 x 10-cm split-screen storage area with independent or common control, plus locate zone.

LIFE CHARACTERISTICS



The aging rate of the storage target depends upon the mode of use. The above chart shows typical brightness aging characteristics when the target is used continuously in STORE mode.

SPLIT-SCREEN STORAGE

Store on either upper or lower half of screen with conventional display on other half; store on entire screen; or, non-store on entire screen. Independent operation of both halves.

VIEWING TIME

Up to one hour. If ENHANCE MODE is to be used, it is recommended that displays be stored for 20 minutes or less.

ENHANCE MODE

Controls the single sweep storage capabilities of the storage CRT. Through adjustment of ENHANCE LEVEL control, single-trace spot velocities up to 5 cm/μs or better can be stored with minimal loss of resolution and contrast.

LOCATE BUTTON (Serves two functions)

STORAGE—When depressed, the beam appears at the left of the CRT screen marking the vertical position of the next sweep. CONVENTIONAL DISPLAYS—Permits beam finding of off screen signals.

ERASE TIME

150 ms maximum.

AUTO ERASE SYSTEM

Viewing time before erase continuously variable from $\leq$0.5 s to $\geq$5 s.

In the PERIODIC Mode, there is a continuous sequence of storing, viewing time and erasure. This sequence occurs regardless of whether or not a signal is present and is independent of the sweep. In the AFTER SWEEP mode—which is used in conjunction with the SINGLE SWEEP—the sequence begins with the arrival of the signal. The signal initiates a sweep by triggering the Single Sweep circuitry. Viewing time begins as the sweep ends. At the end of the viewing time, erasure automatically resets the SINGLE SWEEP, readying it for the next signal. This cycle will automatically repeat itself as long as a signal is available.

Manual control available through Erase and Reset button or by Reset position of Single Sweep switch.

REMOTE CONTROL OPERATION

The Type 549 has remote control-operation capabilities using contact closure. A 9-pin connector, located on the rear panel, supplies one ground and 7 inputs (plus one spare) that allows the following functions:

1. Remote erase of upper screen.
2. Remote erase of lower screen.
3. Remote resetting of sweep for single-sweep operation.
4. Remote erase of both halves of the screen and resetting of the sweep.
5. Remote switching from conventional operation to storage operation (independently or commonly) of upper or lower screen halves.
6. Remote interruption of the Auto Erase sequence in order to hold a stored waveform.

Operation of these circuits is achieved by grounding the appropriate pin in the connector.

REMOTE CONTROL UNIT

(Optional accessory, part number 012-0102-00). Performs Remote Erase and Reset functions numbers 1, 2, and 3 above.

Z-AXIS INPUT

A CRT grid selector switch on the rear panel allows the CRT grid to be driven from the internal unblanking signal, or from an external source. Bandpass is DC to $\geq$1 MHz at —3 dB. 20 V peak to peak required for beam modulation. Input RC is 100 kΩ and 80 pF. A CRT CATHODE-SELECTOR switch allows the cathode to be driven from the internal chopped-blanking signal, or from an external source, AC coupled. 20 V peak to peak required for beam modulation at normal intensity.

TYPE 549

VERTICAL PLUG-IN UNITS				
PLUG-IN UNIT	MINIMUM DEFLECTION FACTOR	BANDWIDTH (—3 dB)	T_R	
MULTIPLE TRACE				
1A1 Dual-Trace	50 mV/cm 5 mV/cm ≈500 μV/cm	DC to 30 MHz DC to 23 MHz 2 Hz to 14 MHz	12 ns 16 ns 25 ns	
1A2 Dual-Trace	50 mV/cm	DC to 30 MHz	12 ns	
CA Dual-Trace	50 mV/cm	DC to 23 MHz	16 ns	
1A4 Four-Trace	10 mV/cm	DC to 30 MHz	12 ns	
M Four-Trace	20 mV/cm	DC to 19 MHz	19 ns	
SINGLE TRACE				
B	50 mV/cm 5 mV/cm	DC to 18 MHz 2 Hz to 12 MHz	20 ns 30 ns	
H	5 mV/cm	DC to 14 MHz	25 ns	
K	50 mV/cm	DC to 27 MHz	13 ns	
L	50 mV/cm 5 mV/cm	DC to 27 MHz 3 Hz to 23 MHz	13 ns 16 ns	
SPECIAL PURPOSE				
O Operational	50 mV/cm	DC to 23 MHz	16 ns	
Q Strain Gage	10 μstrain/div	DC to 6 kHz	60 μs	
DIFFERENTIAL				
1A5 Comparator	5 mV/cm 2 mV/cm 1 mV/cm	DC to 30 MHz DC to 29 MHz DC to 28 MHz	12 ns 13 ns 13 ns	
1A6	1 mV/cm	DC to 2 MHz	0.18 μs	
1A7A High-Gain	10 μV/cm	DC to 1 MHz Selectable	350 ns	
D	1 mV/cm (to 50 mV/cm)	DC to 300 kHz (DC to 2 MHz)	0.18 μs	
E	50 μV/cm (to 10 mV/cm)	0.06 Hz to 20 kHz (to 60 kHz) Selectable	6 μs	
G	50 mV/cm	DC to 18 MHz	20 ns	
W Comparator	1 mV/cm 50 mV/cm	DC to 7 MHz DC to 22 MHz	50 ns 16 ns	
Z Comparator	50 mV/cm	DC to 13 MHz	27 ns	
SPECTRUM ANALYZERS				
1L5	10 μV/cm	10 Hz to 1 MHz		
1L10	—100 dBm	1 MHz to 36 MHz		
1L20	—110 to —90 dBm	10 MHz to 4.2 GHz		
1L30	—105 to —75 dBm	925 MHz to 10.5 GHz		
WIDE-BAND SAMPLING				
1S1	2 mV/cm	DC to 1 GHz	350 ps	
1S2 TDR	5 mρ/cm	140 ps system risetime		
	5 mV/cm	DC to 3.9 GHz	90 ps	

VERTICAL DEFLECTION

BANDWIDTH
DC to ≥30 MHz at 3-dB down, depending on plug-in unit. See chart.

RISETIME
≤12 ns, depending on plug-in unit. See chart.

DELAY LINE
Permits viewing leading edge of displayed waveform.

SIGNAL OUTPUT
DC to ≥5 MHz at 3-dB down, ≤70 ns risetime, 1.5 V ±20% for each centimeter of displayed signal.

HORIZONTAL DEFLECTION

TIME BASE A
0.1 μs/cm to 5 s/cm in 24 calibrated steps (1-2-5 sequence), accurate within 3%. Uncalibrated, continuously variable between steps and to approx 12.5 s/cm. Warning light indicates uncalibrated setting.

TIME BASE B
2 μs/cm to 1 s/cm in 18 calibrated steps (1-2-5 sequence), accurate within 3%. Sweep length variable from 4 to 10 cm, allowing use of Time Base B as a repetition-rate generator from 0.1 Hz to 40 kHz.

X5 MAGNIFIER
Operates over full time base, increases fastest Time Base A rate to 20 ns/cm, and the fastest Time Base B rate to 0.4 μs/cm. Magnified time base accurate within 5%.

DELAY TIME
2 μs to 10 s, continuously variable and calibrated, accurate within 1% of indicated delay ±2 minor divisions. Add processing time of 200 ns at fast sweep rates. Incremental delay-time accurate within 1% ±4 minor divisions. Short-term jitter ≤1 part in 20,000 of the available delay time.

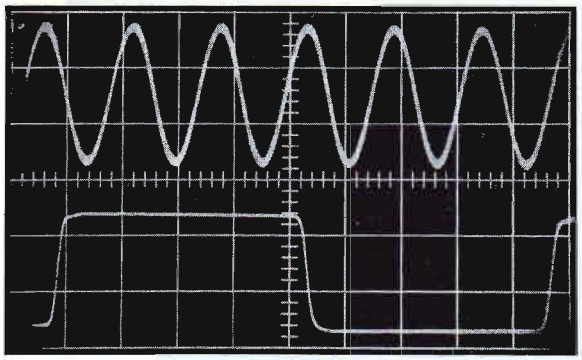
DELAY MODES
Depending on the setting of the Delayed Sweep stability control, the Delayed Sweep can start immediately at end of delay time, or be triggerable at end of delay time (for jitter-free displays).

OPERATING MODES
Time Base A, Time Base B, B intensified by A, and A delayed by B. Single sweep in any mode; reset accomplished with ERASE and RESET button on front panel, NORMAL-SINGLE SWEEP-RESET switch on front panel, automatically with AUTO ERASE switch in AFTER SWEEP and NORMAL-SINGLE SWEEP-RESET switch in SINGLE SWEEP, or by remote control through rear-panel connector.

EXTERNAL INPUT
Fixed steps of approx 0.2 V/cm and 2 V/cm, continuously variable between steps and to approx 20 V/cm, DC to ≥350 kHz at —3 dB with maximum gain. 600 V maximum input (DC + peak AC). Input RC approx 1 MΩ paralleled by <60 pF.

SIGNAL OUTPUTS
Gates from both time bases (0 to at least +20 V), sawtooth from Time Base A (0 to at least +130 V), and a delayed trigger pulse (at least +5 V).

STORED DISPLAYS

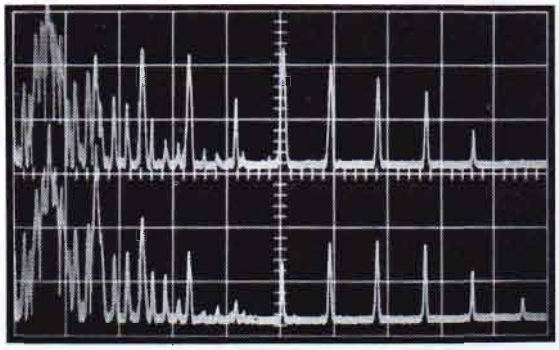


5 cm/μs SINGLE-SWEEP WRITING SPEED

Upper display shows a single shot 625-kHz sinewave stored in enhanced mode of operation. Sweep time is 1 μs/cm.

FAST REPETITIVE DISPLAY

Lower display is a recurrent, 1-MHz squarewave with a risetime of 20 ns stored without enhancement. Sweep time is 0.1 μs/cm.



FREQUENCY-BASED DISPLAY

Harmonic analysis of simulated 440-Hz oboe tone (upper) and violin (lower screen). Dispersion is 500 Hz/cm; minimum resolution bandwidth. Zero-frequency feedthrough is displayed in the first centimeter.

TRIGGER

MODES
Automatic or manual level selection. Automatic operation is useful between approx 50 Hz and 1 MHz, minimizes trigger adjustments for signals of different amplitudes, shapes, and repetition rates. With no input (or input less than 50 Hz), automatic triggering occurs at an approx 50-Hz rate, providing a convenient reference trace.

COUPLING
AC, DC, or AC LF reject.

SOURCES
Internal from oscilloscope vertical amplifier (or direct from a single channel of Type 1A1, 1A2 or 1A4 Plug-In Units), external, or line. 50-V maximum external input (DC + peak AC).

TIME BASE A REQUIREMENTS
0.2-cm deflection or 0.3-V external from DC to 10 MHz, increasing to 2-cm deflection or 3-V external at 30 MHz. Requirements increase below 300 Hz with AC coupling, below 200 kHz with AC low-frequency reject. Automatic operation requires 0.2-cm deflection or 0.3-V external from 300 Hz to 10 kHz, increasing to 2-cm deflection or 3-V external at 1 MHz.

TIME BASE B REQUIREMENTS
0.2-cm deflection or 0.3-V external from DC to 1 MHz, increasing to 1-cm deflection or 1.5-V external at 10 MHz. Requirements increase below 300 Hz with AC coupling, below 200 kHz with AC low-frequency reject. Automatic operation requires 0.2-cm deflection or 0.3-V external from 300 Hz to 10 kHz, increasing to 2-cm deflection or 3-V external at 1 MHz.

OTHER CHARACTERISTICS

AMPLITUDE CALIBRATOR
0.2 mV to 100 V squarewave, 18 calibrated steps (1-2-5 sequence), accurate within 2%. 50-Ω ±2% source resistance from 0.2 mV to 0.2 V. ≈1-μs risetime; 1-kHz ±25% repetition rate; 40% to 60% duty cycle. 100-V DC reference output also provided. Front-panel current loop for 5 mA ±2%, squarewave or DC.

POWER REQUIREMENTS
Wired for 115 V RMS ±10%; rear-panel and internal switches permit operation at 104, 115, 127, 208, 230, or 254 V (±10% on each range); 50 to 60 Hz source having less than 2% harmonic distortion. Approx 650 W maximum power consumption, approx 750 VA maximum.

DIMENSIONS AND WEIGHTS

Height	17 in	43.2 cm
Width	$12\frac{15}{16}$ in	32.9 cm
Depth	$23\frac{7}{8}$ in	60.7 cm
Net weight	$67\frac{3}{4}$ lb	30.8 kg
Domestic shipping weight	≈ 89 lb	≈40.5 kg
Export-packed weight	≈114 lb	≈51.8 kg

INCLUDED STANDARD ACCESSORIES
Two P6006 10X probes (010-0127-00); two BNC-to-BNC 18-in patch cords (012-0087-00); BNC-to-binding post adapter (103-0033-00); 3 to 2-wire adapter (103-0013-00); 3-conductor power cord (161-0010-03); smoke-gray light filter (378-0567-00); two instruction manuals (070-0508-00).

OPTIONAL ACCESSORIES

Optional accessories increase measurement capability and provide added convenience. Cameras, probes, Scope-Mobile® Carts and other major accessories are completely described in the catalog accessory pages.

CAMERA

The standard C-12 camera satisfies most trace-recording requirements. For applications that might require a different viewing system, lens, or back, refer to camera descriptions or consult your field engineer, representative, or distributor.

Standard C-12: f/1.9—1:0.85 lens, no-parallax viewing, Polaroid Land* Pack-Film back
Type 549 to C-12 Camera adapter, order 016-0226-00

PROBES

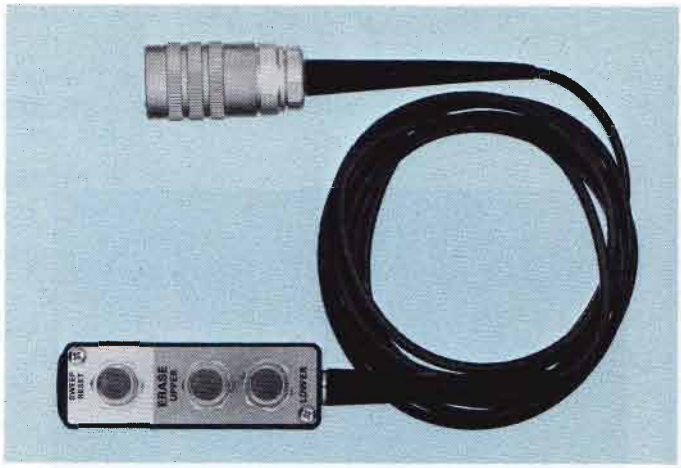
The standard 10X probes supplied with the instrument satisfy most measurement requirements; however, optional probes (recommended on plug-in unit pages) may be better suited for particular applications.

SCOPE-MOBILE® CART

Model 202-2: storage drawer, carrier for 2 plug-in units, 9-position tilt-lock oscilloscope tray

TV ACCESSORIES FOR GENERAL-PURPOSE OSCILLOSCOPES

In addition to the Tektronix line of television instruments, accessories are available for use with many Tektronix general-purpose oscilloscopes. A TV Sync Separator provides stable triggering for the display of composite video signals. A Video Staircase Differentiator allows the amplitude linearity of television systems and their components to be measured. See the catalog accessory pages for additional information.



REMOTE-CONTROL UNIT

Separate controls for erase of upper screen, erase of lower screen, and single-sweep reset. Mates to oscilloscope rear-panel connector, 9-foot cable, order 012-0102-00

REMOTE-CONTROL CONNECTOR

9-pin cable connector for 5 erase and reset functions plus selection of storage or non-storage operation. Mates to oscilloscope rear-panel connector. Cable and control unit not included, order 134-0049-00

RACK-MOUNT ADAPTER

Consists of cradle to support the Type 549 in any standard 19-in relay rack, and mask to fit around the front panel. Requires 17½-in panel height, order 040-0281-00

*Registered Trade-Mark Polaroid Corporation

Please refer to Terms and Shipment, General Information page.