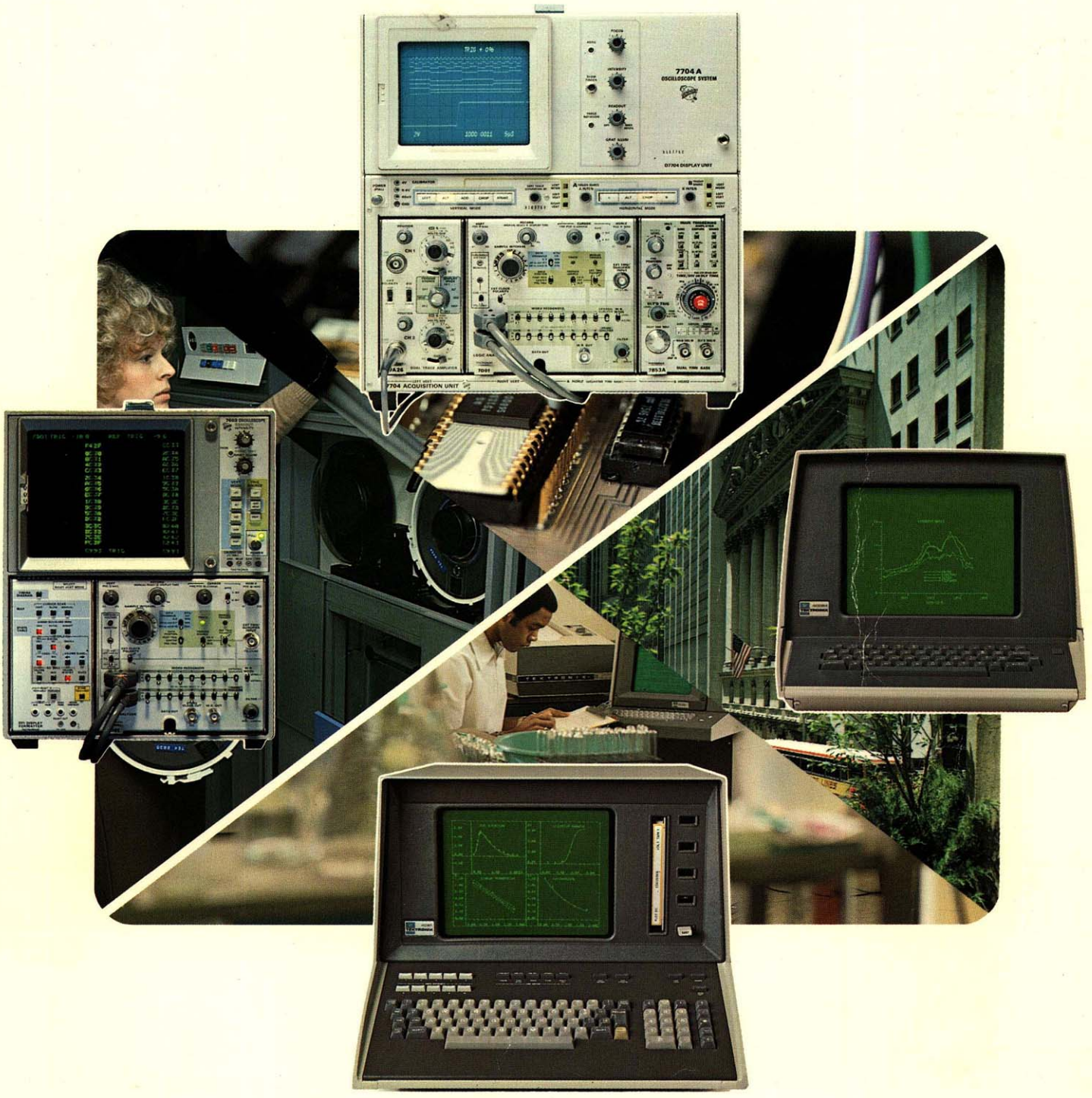
Tektronix®

COMMITTED TO EXCELLENCE



1977

Tektronix, Inc.

An Oregon Corporation with some 13,000 people, 80 company offices in the U.S. and abroad, and 61 international distributors all working to help you.

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Electronic Frontiers

The fact that the microprocessor is compressing computer power into smaller and lower-cost packages is no longer news to the electronics industry. New generations of imaginative products are news.

Take the TEKTRONIX 4051 Graphic System shown at the bottom of the front cover, for example. It's a good example of the trend toward more imaginative "local" intelligence — and what can happen when storage-tube knowhow is combined with calculator expertise and "brains off the shelf."

With the 4051, problem solvers in fields such as those pictured on our front and back cover now have access to low-cost computer graphics. As a personalized, desk-top processor, or as a highly interactive terminal, the 4051 offers users cost- and time-effective alternatives to their problem-solving needs.

The logic analyzers shown on the cover represent the latest in a growing product family dedicated to solving the special problems encountered in the field of digital processing — where smart equipment exchanges information with other smart equipment or components, often at very high speeds and over many channels simultaneously.

The logic analyzer decodes electronic signals into data words, so that the programmer can evaluate the performance of his software while running on its intended hardware. And the designer can isolate trouble areas for examination of possible electronic anomolies, frequently using an oscilloscope as a partner to the logic analyzer for the final electronic analysis.

Whether in design, service, or production, the logic analyzer is fast becoming the essential tool for anyone who needs to quickly sort through masses of digitally processed information.

Since the introduction of its first product, a pioneering laboratory oscilloscope, Tektronix has explored the electronic frontiers, broadening its technological base in anticipation of the need for increasingly sophisticated electronic instruments in all fields.

Cover photos courtesy of:

Control Data Corp.

Bonneville Power Administration

NASA

KGW, Channel 8, Portland, Oregon

Dartmouth College

St. Vincent Hospital, Portland, Oregon

General Dynamics

WHAT WE CAN DO FOR YOU

Whether you're designing, using, or servicing electronic equipment, operating data processing systems, or performing any other measurement or computational task, you'll probably need to call on a variety of supporting electronic devices.

Our purpose at Tektronix is to supply you with the best possible electronic tools for examining and working with electronic signals and computational data. We strive to consistently provide unmatched value in the products and services that we offer to customers.

To you personally, Tektronix can also be individual assistance with your unique measurement problems. Our field staff invites you to give the Tektronix office near you a call.

WE'RE READY AND WILLING TO HELP

If you wish help in selecting a TEKTRONIX product, or just need a recommendation on how we can help solve your measurement problem, please feel free to contact your nearest Tektronix Field Office. You'll find a complete list on pages 260-261. In cases where further advice is needed, local Tektronix personnel can also arrange for additional help from our home office, or put you directly in touch with a specialist in a particular product or application area.

Besides sales advice, your local Tektronix field staff member can also arrange for training, service, special orders, and maintenance. Through our Field Service Centers, we're ready to solve repair problems on our products from calibration through complete instrument reconditioning. Alternately, we will furnish parts if you wish to do the work yourself. And any one of our many offices will be glad to provide you with more detailed catalogs, specification sheets, application notes, and support materials. A request card for this purpose is provided inside the back cover of the catalog.

INTERNATIONAL SALES AND SERVICE

Besides our network throughout the United States, Tektronix, Inc. also maintains field offices in 11 other countries. Distributors and representatives provide additional support for over 40 countries around the world. For a list of these offices, see pages 260 and 261.

CORPORATE OFFICES AND PRINCIPAL PLANT LOCATED AT TEKTRONIX INDUSTRIAL PARK
14150 S.W. KARL BRAUN DRIVE, BEAVERTON, OREGON

Manufacturing subsidiaries located in Guernsey, the Channel Islands; London, U.K.; and Heerenveen, The Netherlands. Joint ventures in Japan (Sony/Tektronix Corporation), and Austria (Rohde & Schwarz-Tektronix, Ges.m.b.H. & Co. KG).

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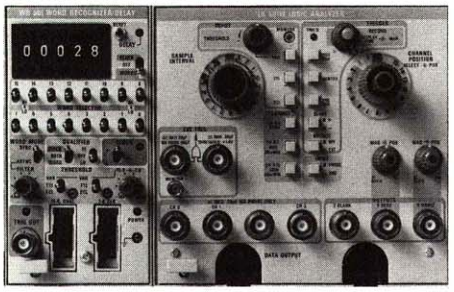
OUR NEWEST PRODUCTS

INSTRUMENTS FOR DIGITAL DEVELOPMENT



LA 501W/WR 501 Logic Analyzer

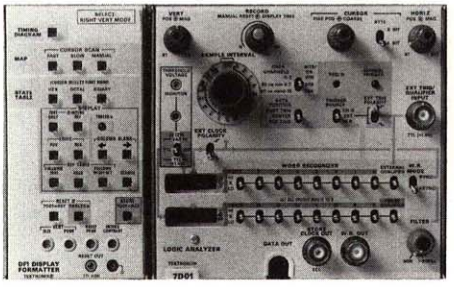
The WR 501 Word Recognizer/Delay can function as an independent word recognizer/digital delay unit, or can be combined with the LA 501 to form the LA 501W Logic Analyzer system. Both units operate in a TM 500 Mainframe/power module.

It accepts the data channels, a system clock and an external qualifier for synchronous or asynchronous word recognition triggering. Furthermore, its output trigger can be delayed by up to 99,999 digital events.

Used independently, its output trigger is available at a front panel BNC jack.

Combined into the LA 501W, its data channels and trigger are internally coupled to the logic analyzer for digital recordings and displays of up to 16 channels.

Complete descriptions of the LA 501W, WR 501 and Tektronix' full line of logic analyzers begins on page 17.



7D01F/7D01 Logic Analyzers

The 7D01 Logic Analyzer, used alone or combined with the DF1 Display Formatter to form the 7D01F, is a 16-channel logic analyzer which plugs into any 7000-Series Oscilloscope Mainframe.

The 7D01 has a 4k-bit formatted memory; has a built-in word recognizer; has pre-trigger, center-trigger and post-trigger data displays; and clocks data into memory synchronously or asynchronously.

The 7D01F displays data not only on a timing ladder diagram, but also in binary state tables, octal state tables, hexadecimal state tables and a data map.

Complete descriptions of the 7D01F, 7D01 and Tektronix' full line of logic analyzers begins on page 17.

COMPUTER TERMINAL PRODUCTS

4081 Interactive Graphic System

The 4081 is the first system to merge refresh graphics and storage graphics within the same tube. It's the first system to combine all hardware, firmware, and operational software required for immediate use.

Imagine the possibilities. The 4081's 32K of local memory (expandable to 64K) lets you minimize mainframe requirements while you move, edit, enlarge, rotate and erase selected portions of a display with our built-in Graphics Operating System software. Interactive Graphics Terminal software (IGT), also standard, enables rapid communication between the 4081 and the host computer. Users of the 4014 graphic display terminal can immediately transmit their current programs to the 4081, thanks to the system's 4014 emulator software.

In addition to the built-in magnetic cartridge tape drive, you can add a mass storage module with flexible and/or hard discs with up to 40 megabytes of memory. And there's a full complement of other peripherals standing by . . . to adapt the first affordable interactive graphics system to your precise needs.

For further information see page 30.

4905 Mass Storage Module

Compatible with the 4081 Interactive Graphic System, the new 4905 Mass Storage Module provides a medium-density, random-access medium through a choice of four options.

The options offer between 630K bytes and 20M bytes storage capacity through a mix-and-match system of flexible and hard discs.

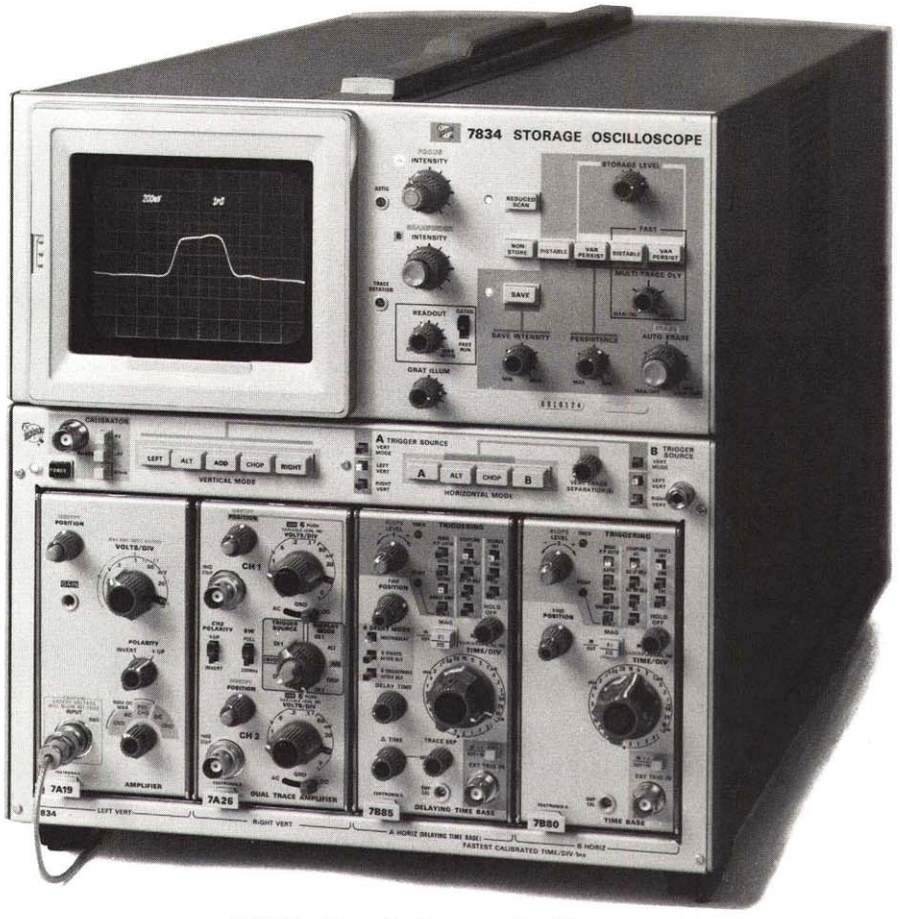
The result is a peripheral storage device you can tailor to your specific needs in your 4081 environment. See page 30.

4931 Modem

The 4931 Modem is available as an option installed internally in 4010 Family terminals or in stand alone form as pictured above. These Bell compatible Modems are available in 300 baud full duplex, 1200 baud half duplex, and 1200 baud half duplex with supervisor channel. All are designed to work on unconditioned voice grade phone lines with a DAA (Direct Access Arrangement).

For further information see page 35.

7000-SERIES PRODUCTS



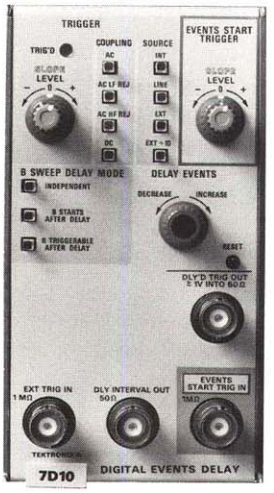
7834 Multimode Storage Oscilloscope

The 7834 Storage Oscilloscope has a stored writing speed of 2500 cm/μs, enabling you to capture single-shot rise times to 1.4 ns. The 7834 features system bandwidths from 160 to 400 MHz depending on the plug-ins selected.

This instrument has multimode storage which combines the benefits of FAST transfer, variable persistence, and bistable storage. FAST variable persistence, for example, provides the maximum stored writing rate of 2500 cm/μs (reduced scan) and storage times of up to 30 s.

The 7834 Storage Oscilloscope has four plug-in compartments. The two horizontal channels allow traces with two different sweep rates to be stored. The four plug-in compartments also provide additional flexibility for configuring a measurement system since you can now choose from over thirty 7000-Series plug-ins.

For further information on the 7834, see page 62.



7D10 Digital Events Delay Plug-in

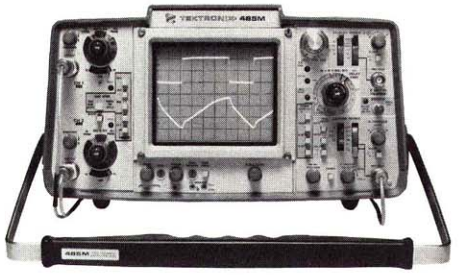
The 7D10 Digital EVENTS Delay Plug-in lets you easily verify and/or identify pulse or word timing in digital systems.

The 7D10 operates in both the digital and analog domain. In the digital domain, the 7D10 lets you identify transient locations or incorrect logic state locations. Using the 7D10 with a logic analyzer, you can expand the effective logic analyzer memory or delay the memory by a specific number of digital words. In this delay-by-events mode, the 7D10 will count arbitrary trigger events, periodic or aperiodic, and deliver an output after the preselected count has been reached. This count can be easily varied from 1 to 10^7 events.

In the analog domain, the 7D10 can be used to eliminate display jitter or wow in mechanical systems.

For further information on the 7D10, see page 77.

PORTABLE OSCILLOSCOPES



Triservice 100 MHz Standard Oscilloscope

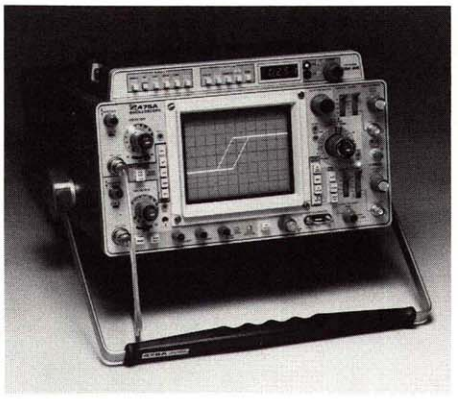
The 465M is the commercially available AN/USM 425, the triservice 100 MHz standard oscilloscope. The 465M is designed and manufactured to meet the Mil-T-28800A, Type II, Class 4, Style C requirements.

With 100 MHz bandwidth at 5 mV/div sensitivity, variable trigger holdoff and delayed sweep, the 465M Dual-trace Portable is packaged in a rugged, mar resistant, reinforced plastic case.

The clearly labeled controls, color coding, and functional group arrangements minimize operator training time.

Since the military catalogs all parts for the military version (AN/USM 425), parts provisioning and logistics support are not problems when specifying the 465M as test equipment in military applications.

See page 113 for further information.



250 MHz Portable Oscilloscope

The 475A Portable Oscilloscope combines 250 MHz bandwidth at 5 mV/div sensitivity, with versatile trigger selection, optional DM44 capabilities and battery operation, all packaged into a compact and rugged portable. In computer servicing applications where timing accuracy can be crucial, the 475A also offers 1% horizontal sweep accuracy.

Readout lights behind knob skirts automatically indicate the proper probe tip deflection factors for recommended 1X and 10X probes.

If line power is not available in your servicing application, you can operate the 475A from optional battery packs or, with option 07, from an external dc source (12-24V).

See page 110 for further information.

DM44 With Built-in Digital Multimeter

The DM44, combined with a 400-Series Oscilloscope, gives you added measurement capabilities 10 times faster than conventional differential time techniques. And 1% accuracy is easily achieved with far less chance for human error. The simplicity of the procedure reduces training time for differential time measurements to minutes. This simple procedure is explained on page 107.

The optional DM44, with a built-in digital multimeter, adds Delta Delayed Sweep and direct numerical readout of displayed time intervals to a selection of five 400-Series Portable Oscilloscopes. These include the 465 (100 MHz at 5 mV/div), 475 (200 MHz at 2 mV/div), 475A (250 MHz at 5 mV/div), 464 (medium speed storage), and 466 (fast storage).

As a bonus, the DM44 adds dc voltage measurement from 0 to 1.2 kV with 0.1% accuracy, resistance measurements from 0 to 20 MΩ with 0.3% accuracy and temperature measurement with a probe from −55° to +150°C.

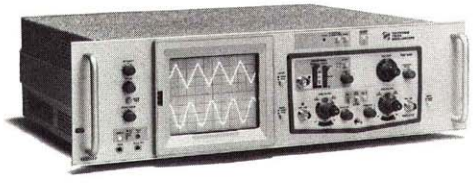
See page 106 for further information.

T900-SERIES INSTRUMENTS

Differential Input Options for T912 and T922

An option for differential input may be ordered with the T922 or T912. In DIFF mode, the T912 displays the difference between Channel 1 and Channel 2 signals. The Channel 2 signal is automatically inverted; the algebraic sum of the Channel 1 signal and the inverted Channel 2 signal is then displayed on the crt. See pages 131 and 132.

T922R Low-cost, Versatile 15 MHz Rackmount Oscilloscope

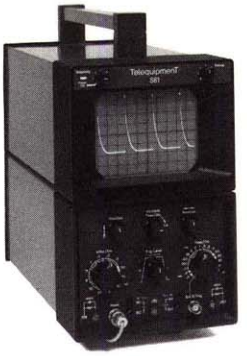


Only 5¼ x 19 x 17 inches (13.3 x 48.2 x 43.2 cm), the T922R 15 MHz, Dual Trace Oscilloscope offers general-purpose oscilloscope functions plus monitoring capabilities at the lowest price consistent with quality construction and reliable performance.

Front or rear panel inputs are front panel switch-selectable, providing instant oscilloscope-to-monitor mode change. The T922R is designed and tested for the more rugged applications a rackmount is often subjected to.

Rackmount operating convenience is enhanced by rear panel inputs/outputs: external trigger input, gate out, sweep out, vertical signal out, Z-axis input. Outputs can be used to drive external recorders or other instrumentation. Signal integrity is guarded by ≥ 80 dB of isolation. See page 134.

TELEQUIPMENT PRODUCTS



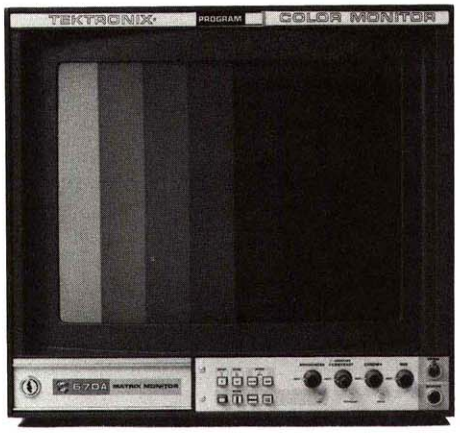
S61 Single-Trace Oscilloscope

The S61 is a low-cost, single trace, 5 MHz oscilloscope. Designed for easy operation, the number of controls has been reduced to a minimum without losing performance flexibility. Front panel controls are easy to understand making the S61 ideal for education applications. Triggering features include variable level and polarity controls plus an automatic mode. Auto mode free runs in the absence of a trigger signal. The S61 features a 5 inch diameter crt which provides an 8 x 10 cm display. See page 140.

TELEVISION PRODUCTS

Tektronix Television Products time, test, measure, correct and display the television signal.

Complete specifications and prices are available in the Television Products Catalog.

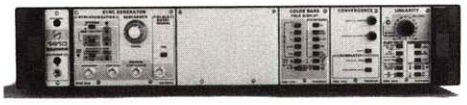


670A Picture Monitors

The new 670A Series consists of precision color picture monitors for NTSC and PAL Television standards.

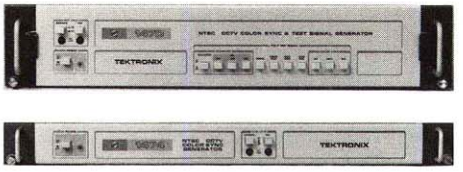
1405 Television Sideband Adapter

The 1405 Television Sideband Adapter is used with a spectrum analyzer, such as the 7L12 or 7L13, to analyze the sideband response of a television transmitter. Versions are available for NTSC and PAL.



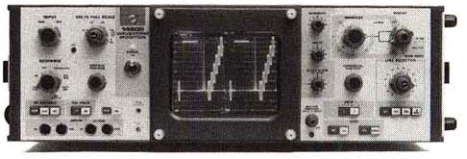
1410 Series NTSC Generators

The new 1410 Series of NTSC Sync Pulse and Test Signal Generators are high-performance instruments offering all the advantages of modularity, at prices generally associated with units of single-piece construction.



1470 and 1474 CCTV Signal Generators

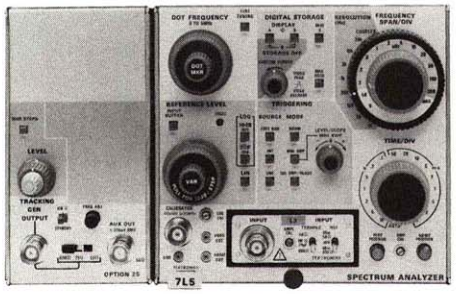
Two new signal generators, the 1470 and 1474, are designed specifically to economically meet the sync and test needs of CCTV operations.



1480R Option 06 Waveform Monitor

The 1480R Option 06 is a high-performance television waveform monitor designed for measurements in long-distance, video transmission systems using 124-Ω balanced lines.

SPECTRUM ANALYZER PRODUCTS



7L5 Option 25 5 MHz Spectrum Analyzer/Tracking Generator

The Option 25 Tracking Generator provides the 7L5 with selectable 50Ω, 75Ω, and 600Ω impedance sources with calibrated frequency output for swept frequency tests from 10 Hz to 5 MHz.

The output of the Option 25 Tracking Generator can be adjusted so it tracks within 10 Hz of the spectrum analyzer frequency. The frequency span and rates are controlled with the spectrum analyzer. The output level is controlled from the tracking generator. Output level is calibrated and controlled in 10 dB and 1 dB steps over a 63 dB range. An Aux Output may be used to drive a frequency counter. The 7L5 with Option 25 is a three-wide unit for the 7000-Series Mainframe. The tracking generator is available in combination with other 7L5 options.

For further information see page 187.

L3 1 MΩ Plug-in Module for 7L5 Spectrum Analyzer

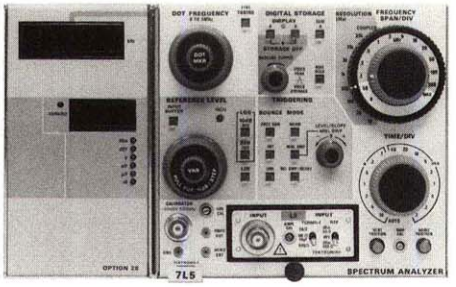
The new L3 plug-in module features a high impedance (1 MΩ/28pF) probe-compatible input with input termination selections of 50 and 600Ω. It is one of a series of modules used with the 7L5 to provide it with various front end capabilities.

For further information see page 187.

7L5 Option 21 Logarithmic Frequency Display

The 7L5 Option 21 is a three-wide version of the normally two-wide 7L5 7000-Series plug-in spectrum analyzer. The additional compartment houses circuitry that generates a logarithmic frequency display covering all 21 proportional bandwidth IRIG telemetry channels. The nominal frequency range is 200 Hz to 200 kHz.

For further information see page 187.

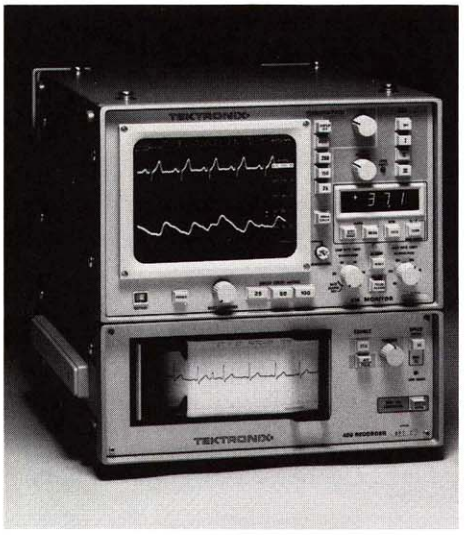


7L5 Option 28 Front Panel Readout

The 7L5 Option 28 is a three-wide version of the normally two-wide 7L5 7000-Series plug-in spectrum analyzer. The additional compartment houses circuitry to provide LED front panel readout of center frequency and reference level. The front panel LED display is automatically disabled when operating in a mainframe that has CRT readout to avoid mutual interference.

For further information see page 187.

MEDICAL MONITOR PRODUCTS



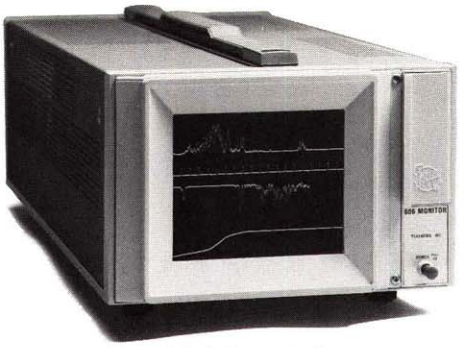
Companion Hardcopy Units for Portable Patient Monitors

These six-pound, 400-Series Recorders attach directly to TEKTRONIX 408, 412 and 414 Portable Patient Monitors and provide thermal printout records of ECG, blood pressure, or peripheral pulse waveforms. Options for analog only, or analog and alphanumeric printout of monitor data are available. See page 215.

DISPLAY MONITORS

50 Minute Gray Scale Storage Display Monitor

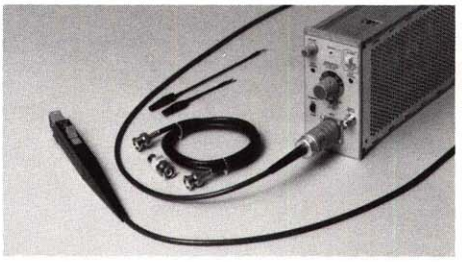
The TEKTRONIX 607 Variable Persistence Storage Display Monitor produces detailed images that may be stored up to 50 minutes, with less deterioration than any other similar monitor. Display persistence is adjustable to allow the image to fade at a rate consistent with the event being monitored. The TEKTRONIX 607 writes at 0.8 div/μs; X- and Y-axis bandwidth is 3 MHz and Z-axis bandwidth is 5 MHz. It features excellent gray scale capability and a 20-mil (.51 mm) stored, and 12-mil (.30 mm) nonstored spot size, measured by the shrinking raster method. Differential inputs are standard; erase, non-store, and save-storage functions may be programmed remotely at TTL logic levels. The 607 may be ordered with a time base option that adds amplitude-versus-time measurement capability. See page 220.



Very High Resolution Display Monitor

An excellent choice for crisp photographs and well-defined displays, the new TEKTRONIX 606 Display Monitor has 5-mil (.13 mm) spot size (measured by the shrinking raster method) and light output is uniform over the entire crt. The linear Z-axis amplifier with 10 MHz bandwidth, allows the many shades of gray necessary for an accurate image. The high resolution of the 606 is most useful in applications such as scanning Auger and electron microscopes, ultrasound systems and gamma camera systems. See page 221.

ACCESSORIES, SCOPE CARTS



The P6302/AM 503 Current Probe System provides current measurement capability ranging from 1 mA to 20 A (50 A Peak) and can be extended to 20 mA to 5000 A/div (50,000 A Peak) with the addition of the CT-5 Current Probe.

Consisting of a P6302 Current Probe, an AM 503 Current Probe amplifier, any TM 500 Power Module and an oscilloscope, the P6302/AM 503 is especially useful when low loading is critical, such as with high impedance points or current dependent devices.

The P6302 operates with no electrical contact (inductive coupling). The probe is easy to use; just open the sliding jaw and place it around the conductor, no need to break the circuit. The probe can also be used to measure the sums or differences of currents in separate wires.

The AM 503 is calibrated in 12 steps and the knob skirt is illuminated to indicate current per division. Bandwidth may be limited to 5 MHz to eliminate unwanted transients.

Any oscilloscope with at least 75 MHz bandwidth and 10 mV sensitivity will display the 50 MHz capability of the P6302/AM 503. The AM 503 output may be terminated with a supplied 50 Ω termination or plugged directly into a 50 Ω oscilloscope amplifier. See page 164.

The TEK Rack Cart Model 7 is a new versatile and rugged equipment cart designed to accommodate standard 19-inch rackmounted systems.

Computers, small systems or test centers assembled into this mobile test system may be mounted to the front or rear of the Model 7. For added versatility, the adjustable rails allow equipment of varying depths to be mounted.

Constructed of aluminum, the Rack Cart Model 7 is designed to be shipped with up to 300 pounds of equipment mounted in place and is UL listed. See page 256.

Modular Probes

Modular probes are an exciting new concept in probe design. The P6101, P6105, P6106, P6108, and P6149 Probes divide into three modules (probe heads, cables, and connector/compensation boxes). The modules snap together making maintenance and repair less expensive, faster, and much easier. Snap-on replacement modules eliminate soldering irons and tools, and modular probes do not have to be sent in to be repaired because spare modules can be ordered and stocked. Strain relief and modular component design make these probes rugged for greater reliability.

The P6101, P6105, P6106, and P6108 are available in three color-coded lengths—blue for one meter, yellow for two meters, and red for three meters. (The P6149 is two meters long.) These probes may be used to acquire high fidelity signals from low source-impedance circuits.

TEKTRONIX Modular Probes are designed for specific TEKTRONIX Instruments, but may be purchased as options for all TEKTRONIX Oscilloscopes with 1 MΩ and appropriate pF inputs as indicated in the chart on page 235. The P6106 is standard with the 475A and 475 oscilloscopes.

The P6149 features a right angle BNC connector. This can be useful when bench space is limited. See page 246.

Reference Information

USING THIS REFERENCE SECTION

The products in this catalog cover a range of capabilities in a number of areas. In many cases you'll have several products from which to choose. These introductory notes are intended to help you review some of the factors involved in making a selection.

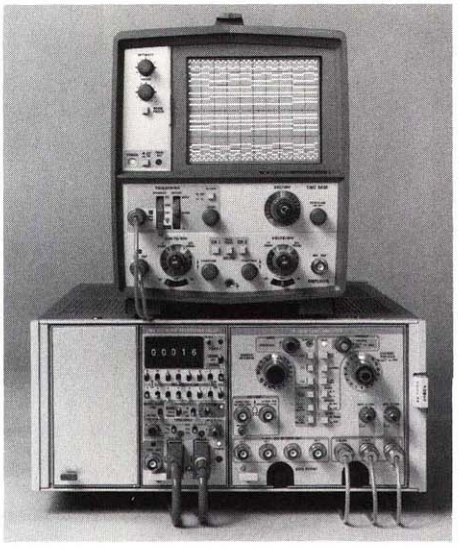
Of course this reference section can only outline some of the major factors involved. If you need more information, contact your local Tektronix Field Office, Representative, or Distributor — we're ready and willing to help.

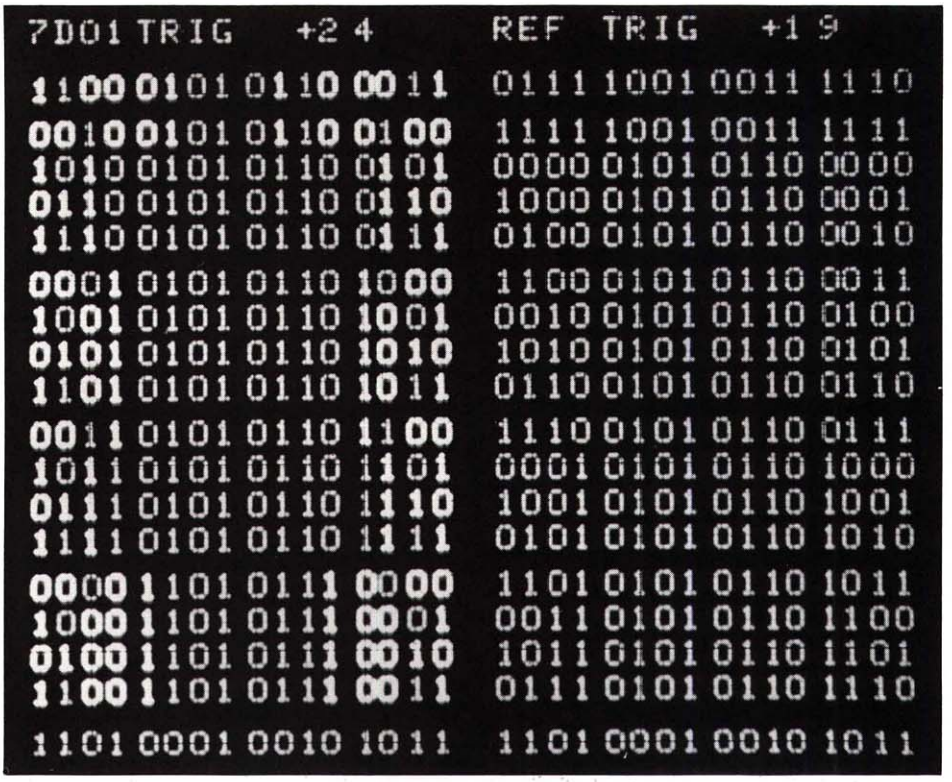
REFERENCE SECTION CONTENTS

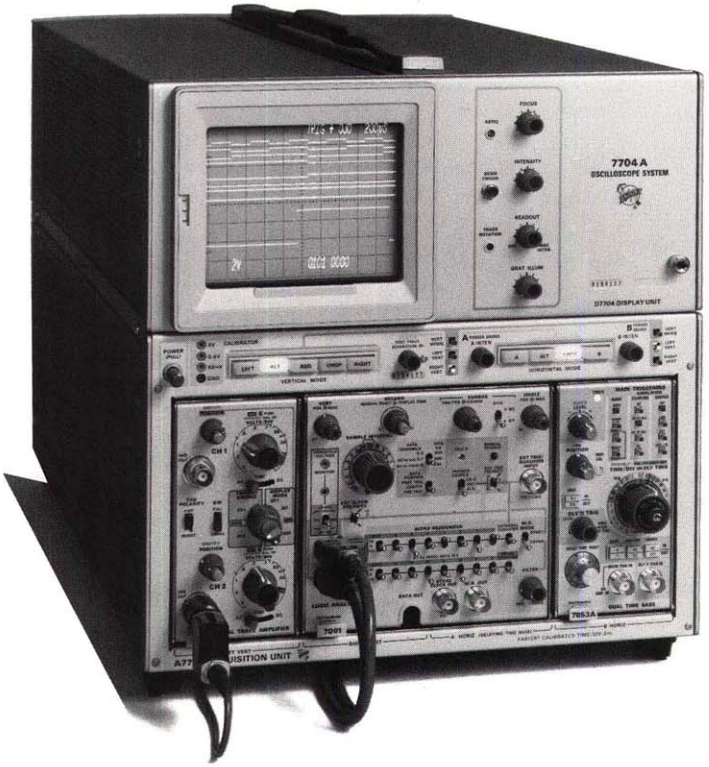
FOR LOGIC ANALYZERS

Applications

Logic analyzers are used to examine the digital state of multiple signal lines. Typical applications include viewing the state of control lines in a digital computer or the status of machine control logic. Unlike an oscilloscope, which shows the actual waveshape, logic analyzers show whether the signals under examination were above or below certain thresholds. The logic analyzer's advantage is that it stores the signal, presents more signals at a time, and has more control features specially tailored to working with digital logic.



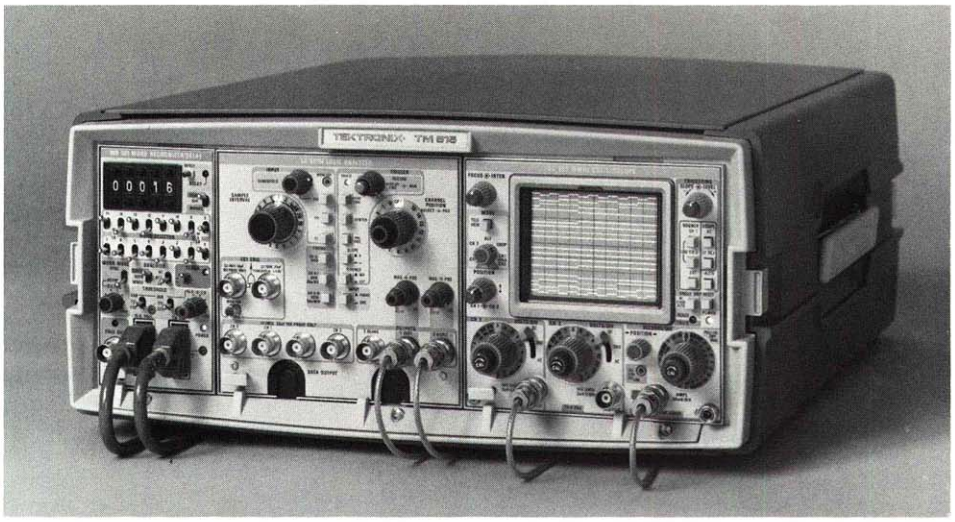




Instrument Packaging

Logic analyzers can be built as entirely separate packages, but more often they are meant to work as a team with an oscilloscope. The logic analyzer's output is a signal intended to drive an amplifier and crt — which the oscilloscope already provides — and the scope is often needed to examine actual problems at the circuit level once the logic analyzer is used to find them.

Tektronix offers two families of logic analyzers. The first, composed of the 7D01 Logic Analyzer, DF1 Formatter, and 7D10/7D11 Digital Delay Units, is designed to work in any 7000-Series Oscilloscope mainframe. The LA 501 Logic Analyzer and WR 501 Word Recognizer are built for use with the TM 500 Modular Test and Instrumentation System. Several quite powerful systems can be assembled using the 7D01-7DF1-7D10, and other 7000-Series Plug-ins, while the TM 500 models feature flexibility and portable configurations. (See the Logic Analyzer section, starting on page 17, for a detailed presentation of each family.)



Signal Acquisition and Memory Size

Logic analyzers capture the state of each bit at the transition of a clock pulse. In the synchronous mode, the clock pulse used is derived from the data source. In the asynchronous mode, the logic analyzer supplies its own clock pulse. Thresholds are normally switch selectable for TTL or variable.

Since logic analyzers store information as discrete digital values, the number of points that can be displayed is determined by the memory size. A desirable feature, however, is to be able to configure the total memory to the desired bit width, thus allowing the maximum length of signals to be acquired. TEKTRONIX Logic Analyzers provide 4,096 bits of memory — switch configurable as 16 x 256, 8 x 512 or 4 x 1024.

Probes for logic analyzers should be small enough to be compatible with dense integrated circuitry. In order to work efficiently with a wide variety of signals, they should have high input resistance and low capacitance. The compact probes developed specially for TEKTRONIX Logic Analyzers offer an impedance of 1 MΩ paralleled by only 5 pF.

Display Types

The information captured in the logic analyzer's memory can be displayed in a number of formats. The most common are binary, octal or hexadecimal state tables, timing diagrams (ladder diagrams), and state mapped displays.

State tables show the value of one or more data points as a digit or series of digits. Although the information is captured in binary, the display may be formatted to present the information in binary, octal or hexadecimal numbers.

A further refinement of this presentation mode offered by the TEKTRONIX 7D01-DF1 combination is "exclusive or". With this feature, a stored state table and a newly captured one are both presented on screen — and any differences between the two are intensified for easy identification.

In a timing diagram display, each signal is shown as a horizontal line, with appropriate segments displaced upwards when the corresponding digital value is in the high state. Used with an asynchronous clock faster than the system rate, this type of diagram is particularly useful for determining whether questionable signals are making state transitions at the right time.

Map displays graph the data points as displacements on the crt screen. Each data word is used to determine the position of a dot on the output crt display. The resulting pattern indicates general system operation. The patterns quickly become familiar, and can aid in quick recognition of normal or abnormal conditions.

Triggering

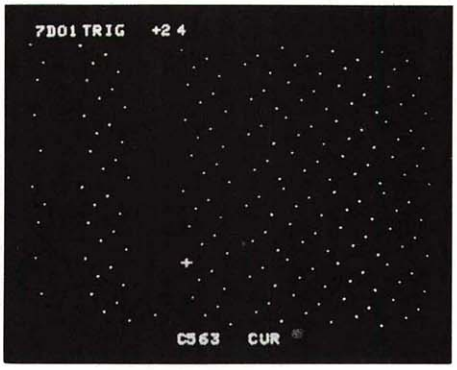
In most applications, a logic analyzer is used to examine logic states resulting in an error condition or states relative to some known starting point. Logic analyzers provide triggering circuitry either internally or as separate accessories.

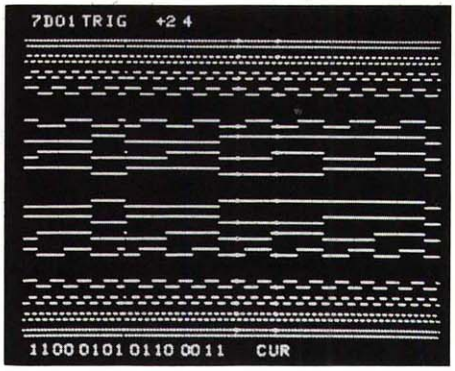
Many logic analyzers can use the trigger signal to signal the start of the period to be displayed, the center of the period, or the end. This allows the viewing of the conditions preceding the error or starting point as well as those following.

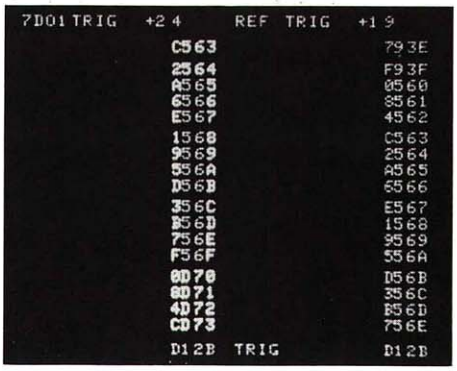
The most common mode of triggering is word recognition. A data pattern which marks the desired spot is set on a series of switches, and when the input data matches that pattern the trigger circuit is activated. In a simpler form of this method the trigger circuit looks for a transition on a single data line or separate trigger input.

Another triggering feature which can be added is digital delay. This circuit delays the trigger which the logic analyzer actually uses to determine when to store captured data for a settable number of clock pulses past the initial trigger signal.

More detailed information about the specific features of TEKTRONIX Logic Analyzers starts on page 17.







FOR GRAPHIC AND ALPHANUMERIC DISPLAY TERMINALS

Display Technology

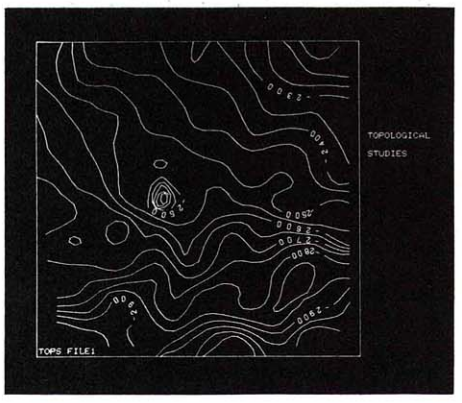
There are three technologies in common use for computer display terminals. They are: Direct-view storage, raster-scan, and directed beam (sometimes called vector) refreshed.

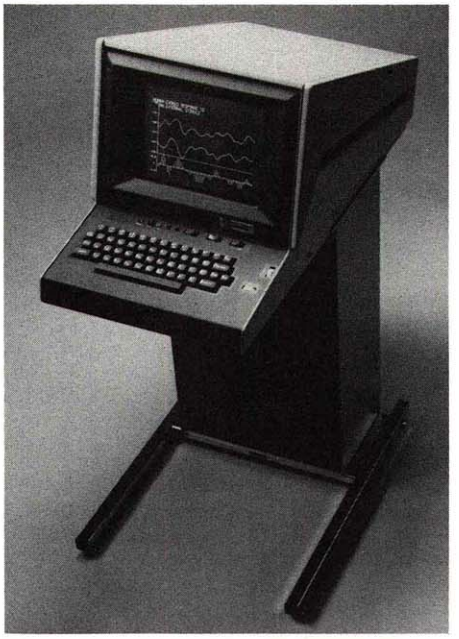
Direct-view storage, based upon the proprietary TEKTRONIX bistable storage CRT, provides the most detailed pictures at the lowest cost and requires the least supporting circuitry. Because the storage tube retains the graphic and alphanumeric elements drawn by the computer without requiring external storage or complex controllers, terminals based on this technology are easy to use and require very little special software. Images are quite clear, with several thousand alphanumeric characters or many thousands of graphic points, or a combination of both, typically available on a single screen. Because the image is stable, there is no flicker.

The second type of storage technology, raster-scan refreshed, uses an internal memory to store both alphanumeric characters and a limited set of graphic elements. These are translated into a video signal which sweeps across the screen like a television signal. The strengths of this type are the rapidity with which images can be altered, and its capability to drive parallel separate displays using its video output.

Directed beam refreshed terminals use special controllers to draw lines between any selected points on the screen. Their advantages are speed of display updating, variable intensity of line segments, and flexibility. The drawback, however, is that this type of terminal requires a special internal controller, a significant amount of storage, and a more complex software or hardware interface. Because memory and data transfer rates are finite, terminals of this type have a limit to the amount of points and total line segments which they can display.

Recent advances at Tektronix have made it possible to combine the advantages of both direct-view storage and directed beam refreshed displays in the same system. The new TEKTRONIX 4081 Interactive Graphics System allows some data to be plotted on the screen and stored by the bistable phosphor, while other data is temporarily written on the terminal's internal memory and may be updated and changed as often as desired.





Display Capacity

One specification commonly given for terminals is the number of points or vectors that can be displayed at one time. A larger number means that more detailed figures can be presented on the screen. Comparisons are not always easy, however, since each of the three display technologies has a different method of characterizing the number of elements in the display.

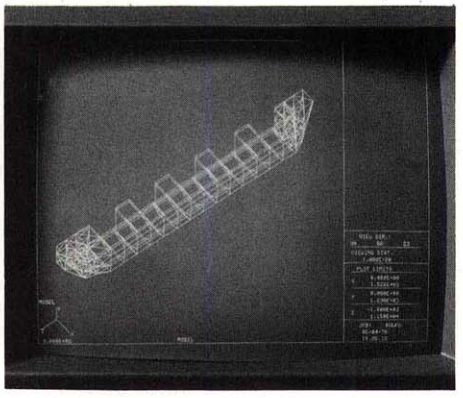
On direct-view storage terminals the number of addressable points determines the resolution of the display. Since any point can be used as part of any vector, the number of theoretical vectors is limited solely to the number of possible inter-connections between those points. However, writing more than 25% of any small area does cause some temporary degradation in tube performance.

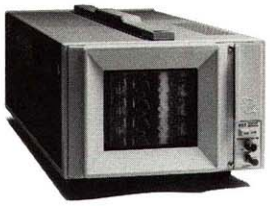
On directed beam refreshed terminals, the number of vectors and their total length is determined by the speed of the processor and the memory available to it. For raster-scan refreshed terminals, the number of graphic elements is limited to the size of the local memory available.

For all types, the maximum number of alphanumeric characters is explicitly specified, usually giving number of characters per line, number of lines, and total characters.

Software Support

Although the engineering of the terminal sets its outside performance limits, it is the software that determines how much you will be able to get out of it in normal use. Alphanumeric terminals, and combination graphic alphanumeric terminals operating in the alphanumeric mode, should have an available software library which permits them to be used with standard data processing protocols. Graphic terminals require much more sophisticated routines to bring out their maximum capability in the graphics mode. The availability of such supporting software is an important factor to consider. Tektronix provides extensive software for our entire line of terminals.





FOR DISPLAY MONITORS

Image Characteristics

Elements that may be important to you in obtaining the best image from a display monitor include the brightness of the image, the resolution or spot diameter, the size of the image, and the phosphor type used and its characteristics.

Brightness depends on the type of crt used, the phosphor, and the accelerating voltage. In general, higher brightnesses can only be obtained at the cost of lower resolution or slower writing speed. On some monitors, a separate intensity or Z-axis input is available to modulate the brightness of the beam. Resolution is specified either by spot size or by number of line pairs in a given distance. Smaller spot sizes or greater numbers of line pairs in general mean a more detailed image can be displayed.

Screen size and the size of the graticule on conventional monitors is normally comparable to that offered on laboratory oscilloscopes (up to 8 by 10 cm). Tektronix also offers special storage monitors with 11 inch diagonal CRTs (see page 17). For much larger displays, image conversion techniques are used to prepare the display for raster-scan type television monitors (page 17). Phosphor characteristics can be selected to optimize viewing or photography, and to match desired image decay rates. See the phosphor selection section (on page 17) for more details.

Storage

Storage is an essential feature on monitors when the information to be presented is transitory or the image to be built up is too complex for the source to communicate all at one time. Tektronix offers both bistable storage monitors and variable persistence models. See the storage section (on page 17) for more details on the advantage of each type of storage.

Vertical and Horizontal Amplifiers

The amplifiers in display monitors must faithfully translate the input signal to a deflection on the CRT screen. Two important characteristics are the bandwidth of the amplifier and the linearity, each of which contributes to how faithfully the signal will be reproduced on the screen. The common-mode rejection ratio and the phase difference determine how closely two signals can be graphed against one another and how well they can be extracted from extraneous background noise. See the general characteristics section (on page 17) for further details.

CONFIGURATION

TWO BASIC APPROACHES

There are two basic configurations for test and measurement instruments. Modular instruments, more often called plug-in or laboratory models when referring to oscilloscopes, combine a mainframe and one or more interchangeable plug-in subassemblies. Integrated instruments, such as monolithic oscilloscopes, are one-piece units.

Although portable instruments are traditionally designed as integrated units, not all monolithic instruments meet all the objectives of portability. On the other hand, some modular systems, such as the TEKTRONIX TM 500 Modular Test and Measurement Line, are designed for easy transport right into the field — See the reference section on portability for more details.

Modular Design

Versatility is the primary advantage of a modular instrument. Many more functions than could be economically or practically combined in a single unit can be made available in separate plug-ins. You the user, can then choose the ones that serve you best.

Because a modular instrument is so versatile, it can also make use of advances in instrument design. New plug-ins or mainframes can be added that, within the basic limitations of the other units, add new functions or higher performance.

Modularity also allows plug-ins and mainframes to be shared between various uses. For example, with the TM 500 Line, the same general test and measurement plug-ins used in the lab for design work can be quickly inserted into a portable mainframe and easily carried to a service problem. Alternately, where demand warrants it, the identical model plug-ins can be supplied to both field service and laboratory personnel, assuring the repeatability of measurements and minimizing training time.

Plug-ins can also extend the original instrument range to other functions. Digital multimeters, curve tracers, spectrum analyzers and logic analyzers are just a few examples of the many specialized plug-ins Tektronix offers for modular oscilloscopes.

MODULAR NON-STORAGE OSCILLOSCOPES

Model Number	Bandwidth**	Minimum Deflection Factor	Number of Trace Operation	Maximum Sweep Rate	Delayed Sweep	Page	Price*
7904 R7903	500 MHz†	10 mV/div at BW 10 μV/div 1 mA/div	up to 4	500 ps/div	X	52	4500 4150
7844	400 MHz†	20 mV/div at BW 10 μV/div 1 mA/div	up to 4 Dual-Beam	1 ns/div	X	54	6800
7704A Opt 09	250 MHz	20 mV/div at BW 10 μV/div 1 mA/div	up to 4	2 ns/div	X	55	2900
7704A	200 MHz	10 mV/div at BW 10 μV/div 1 mA/div	up to 4	2 ns/div	X	57	2900
7603	100 MHz	5 mV/div at BW 10 μV/div 1 mA/div	up to 4	5 ns/div	X	59	1850
5440	60 MHz	5 mV/div at BW 10 μV/div 0.5 mA/div	up to 8	5 ns/div	X	91	1425
5112	2 MHz	1 mV/div at BW 10 μV/div 0.5 mA/div	up to 8 Dual-Beam	100 ns/div	X	96	1225
5110	2 MHz	1 mV/div at BW 10 μV/div 0.5 mA/div	up to 8	100 ns/div	X	96	700
7603N11S	Ruggedized oscilloscope system [meets or exceeds MIL-0-24311 (EC) (AN/USM 281 Specs)]	5 mV/div at BW	up to 2	5 ns/div	X	59	3450

*Price does not include plug-ins.

†1 GHz with 7A21N direct-access plug-in.

**Bandwidths are real time.

Sampling plug-ins that extend bandwidths to 14 GHz are available for most mainframes.

Oscilloscopes

There are two lines of TEKTRONIX modular oscilloscopes to choose from. The TEKTRONIX 5000 Series uses two amplifier plug-ins plus one time base. The TEKTRONIX 7000 Series, which offers higher performance in a number of areas, can accept up to two vertical-channel plug-ins and two time bases or other horizontal units simultaneously. In-depth coverage begins on page 43.

Test and Measurement Instruments

In the general test and measurement field the TEKTRONIX TM 500 Test and Measurement Line is our modular system. One, three, four, five, and six-compartment mainframes accept a broad selection of plug-in units. The mainframe unit provides a common primary power supply, keeping total instrument weight, size, and cost down. Just as importantly, TM 500 Mainframes also provide a signal control and data interface between modules. This allows TM 500 units to work either individually or together as integrated measuring systems. The TEKTRONIX TM 500 Modular Test and Measurement Line is extensive: more than 30 units, including power supplies, signal sources, oscilloscope modules, a logic analyzer, digital multimeters, counter/timers, and more. Custom plug-in kits allow you to add your own unique circuits. With this feature, you can also apply TM 500's capability to unusual applications. In-depth coverage begins on page 141.

Other Modular Devices

Logic Analyzers	page 17
Digital Processing Oscilloscopes	page 40
Waveform Digitizing Instruments	page 41
Spectrum Analyzers	page 183
Curve Tracers	page 204

Integrated and Monolithic Devices

Taking the other design approach to instrument design, integrated instrument are optimized for a single range of functions. One-piece instrument design provides reduction in weight, increased ease of use, smaller size, and usually lower power requirements when a definite function is required.

Many oscilloscopes of this type are particularly designed for portable use, with rugged cases, environmental protection, and internal or external battery power. In-depth coverage begins on page 103.

TEKTRONIX also offers many other one-piece products designed to be used alone or as elements of larger systems. Each performs its specialized task economically yet fully because it is designed for a specific type of use:

Graphic Terminals	page 29
Tv Products	page 181
Display Monitors	page 217

To sum up, modular instruments feature versatility, opportunities for tailor-made selection of functions, and a wide range of measurement capability. Integrated designs are strongest in economy for single functions, ruggedness, and portability.

PORTABILITY

Any instrument not actually permanently bolted down is in some sense portable, but in most cases by "portable" we mean something more.

Portable Oscilloscopes

For oscilloscopes, a combination of factors must be considered. Small size and light weight are obviously important, but the degree depends on the application and the uses. Similarly, ruggedized cases or dust covers may be required. The TEKTRONIX 200-Series Oscilloscopes, for example, are less than 8 x 14 x 23 cm (3 x 6 x 9 in), weigh less than 2 kg (3½ lb) and are specifically designed and packaged for field use. The 300-Series all weigh less than 5 kg (11 lb). The high-performance TEKTRONIX 400-Series models, 10.5 to 11.8 kg (21 to 26 lb), are still very much designed to be portables, too.

For many applications, internal battery power is often essential. On the other hand, the weight of internal batteries can be a disadvantage if they are rarely needed. In some applications power is always available, since it must be provided to the equipment being tested. TEKTRONIX Portable Oscilloscopes cover the full range of power options. The 200-Series has internal batteries. Two 300-Series models have internal batteries and two are line operated. High performance portables, like the TEKTRONIX 400-Series, are line operated. However external battery packs are available as accessories for both the 300-Series and the 400-Series

Portable Test and Measurement Instruments

Many of these same factors apply to other instruments besides oscilloscopes. The TM 500 Model Test and Measurement Line, for example, has several configurations designed for portability. The TM 515 Traveller Mainframe travels like luggage but works like a lab bench set-up. Although it is attractive and convenient enough to treat as carry-on luggage (it will even go beneath your seat in most airplanes), the TM 515 is designed to take rugged travel. It carries up to five TM 500 plug-in instruments. Again, relatively light weight, rugged construction, and convenient size are the key to portability.

Plug-ins include: pulse generators, function generators, other signal generators, amplifiers and filters, oscilloscopes and monitors, lab power supplies, digital counter/timers, digital multimeters, special plug-ins, and custom plug-ins.

All of the more than 30 TM 500 plug-ins are portable when used with portable TM 500 Mainframes: TM 515 5-compartment Traveller Mainframe, TM 503 3-compartment Mainframe with carrying case or protective cover, TM 504 4-compartment Mainframe with carrying case or protective cover.

In-depth coverage of TM 500 products begins on page 141.

PORTABLE NON-STORAGE OSCILLOSCOPES

Model Number	Bandwidth	Minimum Deflection Factor	Dual-Trace	Maximum Sweep Rate	Delayed SWEEP	Page	Price
485	350 MHz	5 mV/div at BW	X	1 ns/div	X	108	$4900
475A New	250 MHz	5 mV/div at BW	X	1 ns/div	X	110	3300
475	200 MHz	2 mV/div at BW	X	1 ns/div	X	110	3000
465	100 MHz	5 mV/div at BW	X	5 ns/div	X	110	2145
465M New	100 MHz	5 mV/div at BW	X	5 ns/div	X	112	2195
455	50 MHz	5 mV/div at BW	X	5 ns/div	X	112	1745
335	35 MHz	10 mV/div at BW 1 mV/div	X	20 ns/div	X	118	1875
326	10 MHz	10 mV/div at BW 1 mV/div	X	100 ns/div		120	1975
221	5 MHz	5 mV/div at BW	X	100 ns/div		123	975
323	4 MHz	10 mV/div at BW 1 mV/div	X	500 ns/div		121	1400
213	1 MHz	20 mV/div at BW 5 mV/div		400 ns/div		124	1425
212	500 kHz	10 mV/div at BW 1 mV/div	X	1 μs/div		126	1000
T935	35 MHz	2 mV/div at BW	X	10 ns/div	X	135	1395
T932	35 MHz	2 mV/div at BW	X	10 ns/div		135	1195
T922	15 MHz	2 mV/div at BW	X	20 ns/div		132	850
T921	15 MHz	2 mV/div at BW		20 ns/div		132	695
D61A*	10 MHz	10 mV/div at BW	X	100 ns/div		139	595
D32*	10 MHz	10 mV/div	X	100 ns/div		138	750
S61*	5 MHz	5 mV/div at BW		1 μs/div		140	375

*TELEQUIPMENT

Our Other Portables

Still other TEKTRONIX portable instruments meet special requirements far above simple movability. The 1502 and 1503 TDR-Cable Testers, for example, are designed to work outdoors in any weather, including pouring rain.

TEKTRONIX Portable Patient Monitors provide hours of battery-powered operation so they can keep on providing data on vital functions not only during surgery but right through patient transport.

For movement within limited area, TEKTRONIX SCOPE-MOBILE® CARTS and Lab Carts are available in several configurations. A typical setup might include a 400-Series Oscilloscope on the top shelf with two TM 503 Mainframes underneath. These carts are particularly useful for in-plant servicing, school and research laboratories, and similar applications.

For more information, see the following pages:

Logic Analyzer	page 17
TDR — Cable Testers	page 178
Spectrum Analyzers	page 183
Portable Patient Monitors	page 215
SCOPE-MOBILE® Carts	page 254

ENVIRONMENTAL CHARACTERISTICS

The environmental characteristics listed in instrument specifications may include some or all of the following: temperature, altitude, humidity, vibration, shock, and electromagnetic compatibility (emc, previously rfi or emi).

The specifications for humidity, vibration, shock, and transportation are intended to be beyond what can be expected in use, and operation at these extremes may cause minor physicial deterioration. Such operation, however, should not cause electrical performance to deteriorate outside specifications.

The specifications for temperature and altitude are such that continual use at the limits will not cause significant short-term deterioration. Naturally, higher temperature operation can be expected to reduce longterm reliability and should be avoided if possible. The emc test is completely nondestructive.

Sample production instruments are tested periodically as part of a continual quality-control process. Complete tests on every production instrument are undesirable as well as uneconomical.

For more specific information on the environmental characteristics and how they apply to given instruments, please refer to the page covering that instrument.

POWER SOURCE CONSIDERATIONS

In general, instruments are factory wired for the nominal voltage of the country of manufacture. Most TEKTRONIX instruments provide wide-range regulated supplies, or quick change line-voltage selectors for convenient selection of line-voltage operating ranges. Transformer taps in other instruments can be changed to accommodate specific line-voltage operating ranges or can be factory wired for a specific range if specified on the purchase order. Many TEKTRONIX instruments are designed with electronically regulated power supplies to compensate for changing line-voltages.

Most TEKTRONIX instruments are designed for operation from a power source with its neutral at or near ground (earth) potential. They are not intended for operation from two phases of a multiphase system or across the legs of a single-phase three-wire system (220 V).

Except for some double-insulated instruments, most TEKTRONIX instruments are equipped with either a three-conductor attached power cord or a three-terminal power-cord receptacle. The third wire or terminal is connected directly to the instrument chassis to protect operating personnel.

Power-cord coding follows one of the two following schemes:

	Scheme 1	Scheme 2
Line	Black	Brown
Neutral	White	Light blue
Ground (safety earth)	Green-yellow	Green-yellow

STORAGE

Storage crts can continue to display a waveform after the input signal ceases. The period of image retention runs from a few seconds to several hours depending on several factors mentioned below. The stored display may be erased to make way for storage of a later waveform. Storage tubes may also be operated as conventional (nonstorage) tubes.

Storage oscilloscopes allow easy, accurate evaluations of slowly changing phenomena that would appear only as slow moving dots. They are also needed for viewing rapidly changing nonrepetitive waveforms whose images would otherwise flash across the crt too quickly to be evaluated. Storage can reduce the time to photograph scope traces by allowing you to "compose" the picture. Unwanted displays can be erased as many times as necessary before the photograph is taken.

Storage crts are used in other TEKTRONIX products, too. For terminals, crt storage provides an economical means of retaining graphic and alphanumeric display without requiring refresh circuitry. Curve tracers with a storage crt show a wider range of waveforms. And monitors with storage find a wide variety of applications.

TYPES OF STORAGE

TEKTRONIX products use three types of storage crts — the TEKTRONIX proprietary bistable phosphor storage tube, a variable persistence tube (sometimes called halftone storage), and a new fast transfer tube. The last device can also provide operating modes similar to the simpler bistable and variable persistence types.

Although storage writing speeds are not quite as fast as conventional crt speeds yet, they are catching up: recent developments in transmission storage tubes at Tektronix have resulted in a fast stored writing speed of 2500 cm/μs.

BISTABLE

The bistable-phosphor crt utilizes a special phosphor with two stable states: written and unwritten.

The storage mode allows waveforms to be stored and displayed a minimum of several hours (in some cases much longer) or until erased by operator.

Bistable storage is often the easiest kind of storage to use. It is also usually the most inexpensive. Some principal applications include mechanical measurements, signal comparisons, and data recording. Most bistable phosphor crts have a split-screen viewing area which allows each half to be used independently for storage displays. The split-screen feature provides many unique advantages. With this system, a reference waveform can be stored on one half of the screen and the other half can be used to store the effect that calibration adjustments or the insertion of filters, etc, have on circuit operation. If desired, this technique can be used where the reference portion operates in the stored mode and the other half of the display, operating in the nonstored mode, monitors an external input.

An example of the usefulness of the split-screen feature is in speech therapy. The normal speech pattern is recorded on the upper half of the storage screen and the patient's attempts to match this pattern are recorded on the lower half. With split-screen operation, the lower half showing the trial waveform can be erased as many times as desired without affecting the stored information on the upper screen.

VARIABLE PERSISTENCE

Variable persistence storage allows a continuous gradation between the bright written level and the dark reference.

The variable persistence mode also allows for the selection of the time a stored image will be retained. The storage persistence can be adjusted so the entire waveform can be viewed, yet the stored trace fades from view just as the new waveform is being plotted. With the save feature, an entire display can be stored for further analysis if desired.

Applications for variable persistence storage include real time, spectrum analysis, time-domain reflectometry, sampling, and other measurements which require slow sweep displays. For fast repetitive sweeps, the storage persistence can be set so multiple traces are displayed before the first trace fades from view. Then you can view changes in signal response with changes in circuit conditions, time, or adjustments. This method can also be used to provide display integration so that only the coincident portions of a repetitive signal are displayed. Any aberration or jitter not common to all repetitive traces will not be stored or displayed. Low-repetition rate, fast-rise-time signals that are not discernible on conventional crts can be easily viewed.

This type of storage provides the best display when storing displays with varying intensities, such as delayed sweep or with Z-axis intensity modulation. Variable persistence storage provides very good displays for photographs due to the high contrast between dark background and bright waveforms.

FAST TRANSFER

Fast transfer storage uses a tube with a special intermediate mesh target. This target, which is optimized for speed, captures

the waveform and then transfers it to a slower, longer-storing electrode. The second target can be designed to offer bistable or variable persistence modes, in combination with the transfer mesh or by itself.

Several TEKTRONIX Oscilloscopes use this combination of capability to provide unique multimode storage. By front-panel controls, users of these instruments can select the operating mode suited to the specific measurement situation.

DIGITAL STORAGE

Although not directly comparable in some respects, digital storage is also a useful technology for waveform retention. More information is given in the sections on digital oscilloscopes and logic analyzers.

CATHODE-RAY TUBE PHOSPHOR DATA

HUMAN EYE RESPONSE

An important factor in selecting a phosphor is the color or radiant energy distribution of the light output. The human eye responds in varying degrees to light wavelength from deep red to violet. The human eye is most sensitive to the yellow-green region; however, its responsiveness diminishes on either side in the orange-yellow area and the blue-violet region. The eye is not very receptive to deep blue or red.

If the quantity of light falling on the eye is doubled, the brightness "seen" by the eye does **not** double. The brightness of a color tone as seen is approximately proportional to the log of energy of the stimulus.

The term **luminance** is the photometric equivalent of brightness. It is based on measurements made with a sensor having a spectral sensitivity curve corrected to that of the average human eye. The SI (international metric standard) units for luminance are candelas per meter squared, but the English footlamberts are still used extensively in the U.S. One footlambert = 0.2919 candelas/m^2. The term **luminance** implies that data has been measured or corrected to incorporate the CIE standard eye response curve for the human eye. CIE is an abbreviation for "Commission Internationale de L'Eclairage" (International Commission on Illumination). The luminance graphs and tables are therefore useful **only** when the phosphor is being **viewed.**

PHOSPHOR PROTECTION

When a phosphor is excited by an electron beam with an excessively high current density, a permanent loss of phosphor efficiency may occur. The light output of the damaged phosphor will be reduced, and in extreme cases complete destruction of the phosphor may result. Darkening or burning occurs when the heat developed by electron bombardment cannot be dissipated rapidly enough by the phosphor.

The two most important and controllable factors affecting the occurrence of burning are **beam-current density** (controllable with the Intensity, Focus, and Astigmatism controls) and the length of **time** the beam excites a given section of the phosphor (controllable with the Time/Div control). Of the total energy from the beam, 90% is converted to heat and 10% to light. A phosphor must radiate the light and dissipate the heat, or like any other substance, it will burn. Remember, burning is a function of intensity and time. Keeping the intensity down or the time short will save the screen.

SELECTING A PHOSPHOR

The catalog description of each oscilloscope indicates the phosphor normally supplied or offered as an option. Special phosphors are available for applications which require different characteristics. For example, P11 is excellent for waveform photography but due to its short persistence it is not well suited for applications requiring visual observation of low-speed phenomena. For more specific information regarding the best-suited phosphor for your particular applications, please confer with your Tektronix Field Engineer, Representative, or Distributor. He or she will know the factors that must be considered in selection of a phosphor for any given application.

Phosphors are rated in several parameters, such as color of fluorescence or phosphorescence, decay, etc. The following table describes the more commonly used phosphors.

CRT STORAGE OSCILLOSCOPES
(in order of Stored Writing Rate)

Model Number	Maximum Stored Writing Rate	Maximum View Time	Type of Storage	Band-width**	Minimum Deflection Factor	Number of Trace Operations	Delayed Sweep	Plug-in	Page	Price
7834 New	5500 div/μs	30 s ††	Fast Variable Persistence	400 MHz	20 mV/div at BW 10 mV/div at 325 MHz	up to 4	X	X	62	$6900
	776 div/μs	30 min minimum	Fast Bistable							
	12 div/μs	30 s ††	Variable Persistence							
	0.2 div/μs	30 min minimum	Bistable							
466	3000 div/μs	15 s ††	Fast variable persistence	100 MHz	5 mV/div at BW	up to 2	X		114	4600
	3 div/μs	15 s ††	Variable persistence							
7633	2200 div/μs	30 s ††	Fast variable persistence	100 MHz	5 mV/div at BW 10 μV/div 1 mA/div	up to 4	X	X	64	4725
	400 div/μs	30 min minimum	Fast bistable							
	3 div/μs	30 s ††	Variable persistence							
	2 div/μs	30 min minimum	Bistable							
7623A	150 div/μs	30 s ††	Fast variable persistence	100 MHz	5 mV/div at BW 10 μV/div 1 mA/div	up to 4	X	X	64	3750
	50 div/μs	30 min minimum	Fast bistable							
	0.5 div/μs	30 s ††	Variable persistence							
	0.03 div/μs	30 min minimum	Bistable							
464	110 div/μs 0.5 div/μs	15 s †† 15 s ††	Fast variable persistence	100 MHz	5 mV/div at BW	up to 2	X		114	3950
7613	5 div/μs	1 hr	Variable persistence	100 MHz	5 mV/div at BW 10 μV/div 1 mA/div	up to 4	X	X	66	2950
5441	5 div/μs	1 hr	Variable persistence	60 MHz	5 mV/div at BW 10 μV/div 0.5 mA/div	up to 8	X	X	92	2595
7313	5 div/μs	30 min minimum	Bistable split screen	25 MHz	5 mV/div at BW 10 μV/div 1 mA/div	up to 4	X	X	67	2850
434	5 div/μs	4 hrs	Bistable split screen	25 MHz	10 mV/div at BW 1 mV/div	up to 2			116	3150
5115	0.8 div/μs	10 hrs	Bistable split screen	2 MHz	1 mV/div at BW 10 μV/div 0.5 mA/div	up to 8	X	X	97	1375
5113	0.2 div/μs	10 hrs	Bistable dual-beam split screen	2 MHz	1 mV/div at BW 10 μV/div 0.5 mA/div	up to 8	X	X	97	1825
5111	0.02 div/μs	10 hrs	Bistable split screen	2 MHz	1 mV/div at BW 10 μV/div 0.5 mA/div	up to 8	X	X	97	1300
214	0.5 div/μs	1 hr	Bistable	500 kHz	10 mV/div at BW 1 mV/div	up to 2			126	1425
314	0.25 div/μs	4 hrs	Bistable	10 MHz	2 mV/div at BW	up to 2			122	2385

**Bandwidths are real time. Sampling plug-ins that extend bandwidths to 14 GHz are available for most mainframes.
††View times are at full stored display intensity. They may be increased by using reduced intensity in the save display mode.

PHOSPHOR DATA CHART

Phosphor	Fluorescence	Phosphorescence Where Different from Fluorescence	Relative Luminance[1]	Relative Photographic Writing Speed[2]	Decay to 10%	Decay to 1%	Decay to 0.1% (in ms)	Relative Burn Resistance	Comments	Ordering Information Option
P1	Yellowish-green	—	50%	20%	24 ms	48 ms	95	Medium	Replaced by P31 in most applications	Special order
P2	Bluish-green	Yellowish-green	55%	40%	75 μs	—	120[3]	Medium high	Good compromise for high- and low-speed applications. Replaced by P31 in most applications	Special order
P4	White	—	50%	40%	60 μs	470 μs	20	Medium high	Television displays	74
P7	Blue	Yellowish-green	35%	75%	0.3 s	3 s	8 sec	Medium	Long decay, double-layer screen	76
P11	Purplish-blue	—	15%	100%	80 μs	—	20	Medium	For photographic applications	78
P31	Yellowish-green	—	100%	50%	38 μs	250 μs	32	High	General purposes, brightest available phosphor	80

[1]Measured with TEKTRONIX J16 photometer and J6523 luminance probe which incorporates a CIE standard eye filter. Representative of 10 kV aluminized screens. P31 as reference.

[2]P11 as reference with Polaroid 410 film. Representative of 10 kV aluminized screens.

[3]Low level lasts over one minute under conditions of low ambient illumination.

KEY SPECIFICATIONS AND FEATURES

for oscilloscopes and related equipment

AMPLIFIER CONSIDERATIONS

RISE TIME AND BANDWIDTH

One vital capability generally sought in an oscilloscope is sufficient bandwidth and adequate rise time.

Although rise time is usually the more important parameter when working with faster waveforms, signal bandwidth is commonly specified for lower speeds. Constraints make the two numerically related in well-designed general-purpose oscilloscopes. Bandwidth in megahertz multiplied by rise time in nanoseconds is approximately 0.35. Therefore, if your needs are defined in terms of one factor, dividing it into 0.35 will produce the other.

Bandwidth is of course defined as the frequency range in which signals are handled with less than a 3-dB loss compared to midband performance. Since modern oscilloscopes work well at low frequencies down to dc, bandwidth here commonly refers to the highest frequency which can be displayed with a 3-dB or less error.

Most oscilloscope designs make use of gradual roll-offs at the high-frequency end, so in many cases a scope will be useful far beyond its specified bandwidth. Waveshapes may be altered and amplitudes reduced somewhat.

In terms of rise time, scopes ideally should have a vertical system capable of responding at least five times as fast as the fastest applied step signal (thus having a rise time less than 1/5 as great). In such a case, the rise time of the signal indicated on the scope will be in error by less than 2 percent.

Using the 1/5 and 0.35 factors together, the minimal requirements for scope bandwidth for accurate rise time measurements can be estimated using the following rule of thumb:

$$\text{Bandwidth (minimal)} \simeq \frac{1.70}{\text{Fastest Rise Time}}$$

Very accurate absolute rise time measurements are not always important. When simply comparing the rise times of two signals, scopes with a rise time equal to the rise time of the signals applied are usually considered adequate.

Besides indicating bandwidth for the vertical channel, many oscilloscope specifications also include a bandwidth figure for the horizontal and trigger channels.

Bandwidth and rise time figures also apply to many other TEKTRONIX instruments. Signal sources, probes, amplifiers, TDR systems, and many other test instruments are characterized in part by rise time. Frequency response figures are given for portable patient monitors, spectrum analyzers, and many tv products. The specifications will indicate values where these figures are relevant.

SENSITIVITY (DEFLECTION FACTORS)

Although sensitivity specifications are most often associated with oscilloscope vertical channels, specifications can also be provided for horizontal channels and trigger circuits with external inputs. Similarly, various other instruments may have a sensitivity specification relating minimum input level to some function or output level.

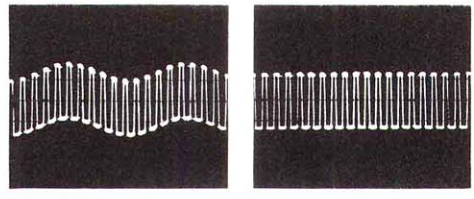
Sensitivity, in the case of oscilloscopes, refers to the input needed to produce a stated deflection of the spot on the crt. Specifications typically are given in millivolts per centimeter or division.

At a given state of the art, sensitivity is a tradeoff with bandwidth. The small amount of noise in even the best input circuit will mask signals which are too weak. Raising the bandwidth increases the noise picked up by the amplifiers, requiring more of a signal to create a clear display.

As a consequence of this relationship, many high-sensitivity scopes provide bandwidth-limiting controls to allow you to make better low-level, moderate frequency measurements. For these and other models, a set of sensitivity specifications may be given for limited frequencies as well as over the full range.

Many times, external noise will be the problem. Differential amplifiers are often used to lessen the effects of external noise and common-mode signals, thus improving the useful measurement sensitivity range.

DIFFERENTIAL, BALANCED, OR PUSH-PULL INPUTS



Differential or balanced amplifiers provide a feature beyond mere accommodation of push-pull signals: they have the ability to cancel or reject, to a high degree, any signal components equal in amplitude and phase that appear at both inputs. Such amplifiers provide a simple and accurate means of measuring the difference between two sig-

nals. They also provide a means of rejecting most unwanted signal components common to both inputs, such as power line "hum."

MULTIPLE INPUTS

It is quite often useful to be able to view any one or several of a number of input signals without disturbing connections to the oscilloscope. Several types of multiple-input amplifiers which display more than one signal on the same crt display are available.

Common applications include input-output comparisons, checking a signal against a standard, or working with complex circuits.

Two Techniques: Dual-Beam and Dual-Trace

Two techniques, dual-trace or dual-beam circuitry, are commonly used for creating two traces on a single crt. The dual-trace scope incorporates electronic switching to alternately connect two input signals to a single deflection system. The dual-beam scope, however, has two independent deflection systems within its crt. (Some models do share horizontal systems, though.) There are distinct advantages to both dual-beam and dual-trace scopes. A dual-beam scope can display two input signals separately and simultaneously. Therefore, it can show two nonrecurrent signals of short duration. Also, models with independent horizontal deflection can display nonrecurrent signals on different time bases.

The principal advantages of dual-trace scopes are lower cost and intrinsically better comparison capabilities. This comes from using a single horizontal amplifier and one set of deflection plates. On the other hand, since a transient event might occur on one input channel while the beam is tracing the other, dual-trace scopes are not recommended for viewing fast one-shot phenomena.

Extension of the dual-trace principles has produced newer multiple-trace oscilloscopes capable of displaying up to eight traces.

TIME BASES

SWEEP RATES AND SWEEP TYPES

Except in special cases, oscilloscopes have built-in sawtooth sweep generators for producing constant-speed horizontal beam deflection. In early scopes, these generators ran continuously, and horizontal calibration was based on their repetition **frequency.** In most modern laboratory scopes, sweeps 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."

This technique permits:

1. Direct measurement of time between events.
2. Viewing and measuring small portions of pulse trains.
3. Viewing and measuring random or aperiodic events.
4. Viewing and measuring single non-recurrent events.

Distances representing time are measured on the scope's graticule, the ruled scale built into the display. The internal graticule built inside the crt face on modern scopes is preferable, as it eliminates parallax.

A major graticule division may be an inch, centimeter, or some other length. Some instruments have different distance-units for the vertical and horizontal scales. Graticules often have small markings which subdivide the major divisions to assist in making accurate measurements. Such subdivisions should **not** be interpreted as the distance unit in a specification.

Strictly speaking, sweep specifications are rates properly expressed as time/length. However, the term **sweep speed** (implying length/time) is often used synonymously.

RELATING SWEEP SPEEDS, HIGH FREQUENCIES, AND RISE TIMES

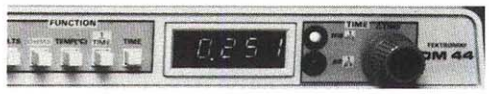
The appropriate sweep rate for frequency-specified measurements is based on the nature of the investigation. Given a moderate frequency, a sweep is usually considered adequate if it is capable of displaying one cycle across the full horizontal scale. At high frequencies, however, scopes seldom have sweeps that fast. To measure rise time as accurately as possible, a step signal (square wave, rectangular pulse, etc) should occupy most of the full vertical scale, and the rising portion of the signal should be displayed at nearly a 45° slope. This objective can be met only if the fastest sweep is able to move the beam a horizontal distance nearly equal to the full vertical scale in a time interval equal to the rise time of the vertical deflection system. Because of the compounding difficulties and cost of providing extremely fast sweeps which are both linear and accurate, this goal must be tempered somewhat in scopes having the very best vertical deflection system rise time capabilities.

In some cases rise time measurements are not made to determine actual rise time, but are done to decide whether certain limits are met or exceeded. In such cases, an adequate comparison with a standard signal of known rise time can usually be made even with a sweep which provides a fairly steep display, provided of course that the vertical deflection system rise time is good enough.

DELAYING/DELAYED TIME BASES

Delaying-sweep measurements use two linear calibrated time bases. The first time base, commonly called the delaying sweep, allows the operator to select a specific delay time. When this time is reached, the second time base, called the delayed sweep, starts. The delayed sweep is typically set a decade or two faster than the delaying sweep, and therefore offers additional resolution. The combination of these two time bases also offers increased accuracy of time interval measurement.

DIGITAL TIME DISPLAYS



You can make delay and interval time measurements with digital ease on several TEKTRONIX oscilloscopes. The DM44 option for the 400 Series allows you to read the delay time, interval frequency, or temperature right from an LED readout, with no calculation or interpolation required. The 7B85 and 7B80 Plug-ins for 7000-Series Oscilloscopes provide Δ time (dual-delayed sweep) measurements. With this feature, both ends of the selected interval which can be independently positioned on the trace are shown by intensified regions. The time interval between those points is shown on the screen using the 7000-Series crt-readout capability.

SAMPLING

Sampling is a powerful technique for examining very fast repetitive signals. It is similar, in principle, to the use of stroboscopic light to study fast mechanical motion. Progressive samples of adjacent portions of successive waveforms are taken; then they are "stretched" in time, amplified by relatively low-bandwidth amplifiers, and finally shown, all seemingly at one time, on the screen of a cathode-ray tube. The graph thus produces a replica of the sampled waveforms. The principal difference in appearance between displays made by sampling techniques and conventional displays is that those made by sampling are comprised of separate segments or dots. This technique is limited to depicting repetitive signals, since no more than a portion of the signal is captured and displayed each time the signal recurs.

The sampling method, however, provides a means of examining fast-changing signals of low amplitude that cannot be examined in any other way. The system is capable of resolving events that occur in less than 30 picoseconds on an "equivalent" time base of less than 20 picoseconds per division and less than 5 mV of peak amplitude.

Tektronix uses the random sampling technique which differs from conventional sampling because it does not require a delay line or pretrigger for lead time to be visible in the display. The benefits afforded by this feature are:

1. Signals with no source of pretrigger can be observed.
2. The inherent rise time limitation of signal delay lines is eliminated.
3. It is no longer necessary to work into the 50 Ω characteristic impedance of a delay line, so high impedance can be retained.
4. External triggers may occur before, coincident with, or after the displayed signal, with lead time still visible in the display.
5. Display time jitter otherwise caused by pretrigger-to-signal jitter is eliminated.

Instruments for Digital Development

Logic Analyzers are probably the fastest developing group of instruments today — keeping pace with the rapid incorporation of digital electronics into all aspects of our jobs and our lives. Following a brief general discussion of logic analyzers, you'll find details on the latest instruments for logic analysis from Tektronix.

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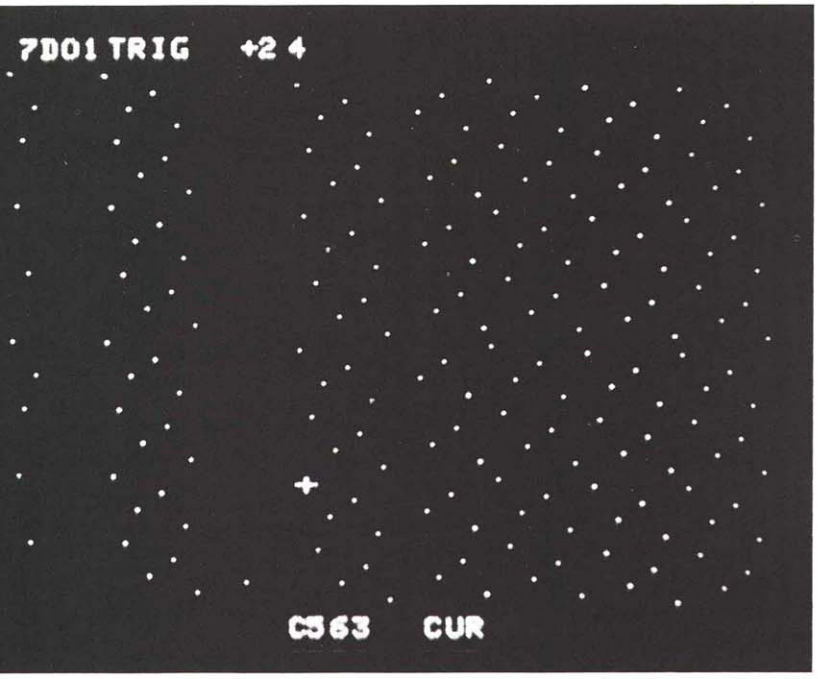
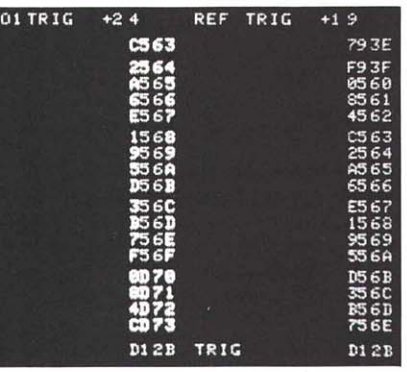
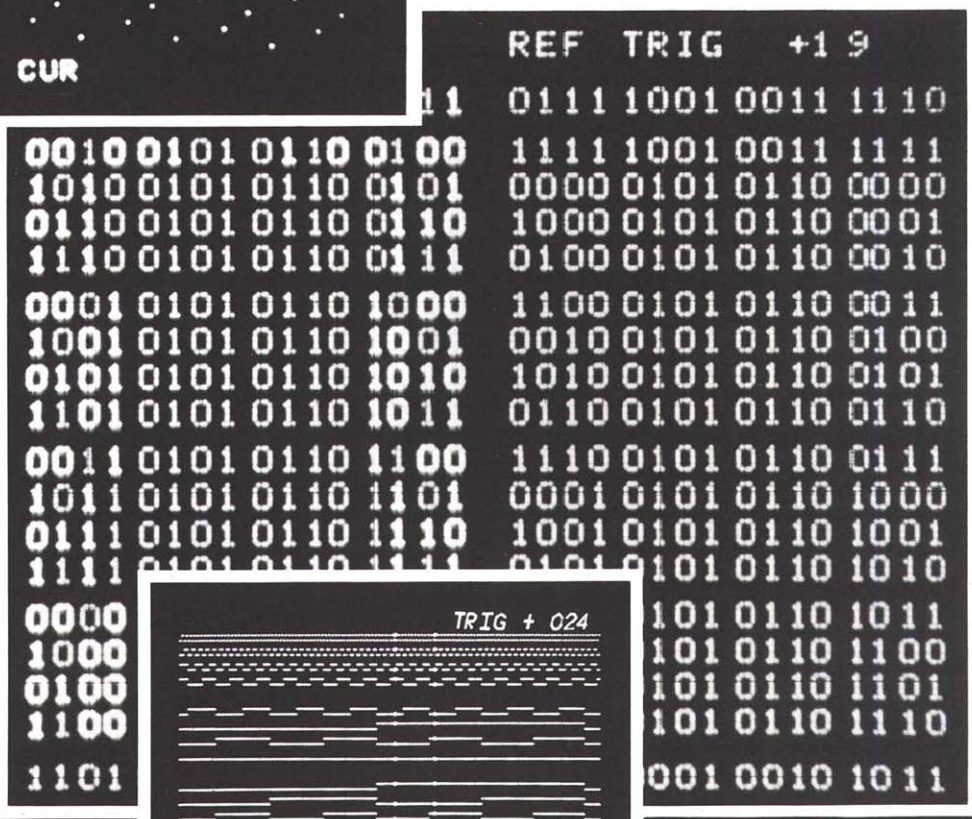
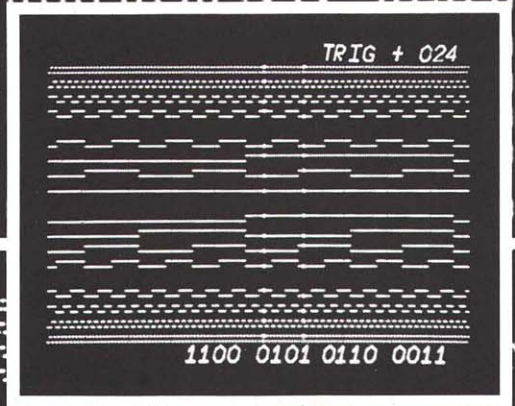
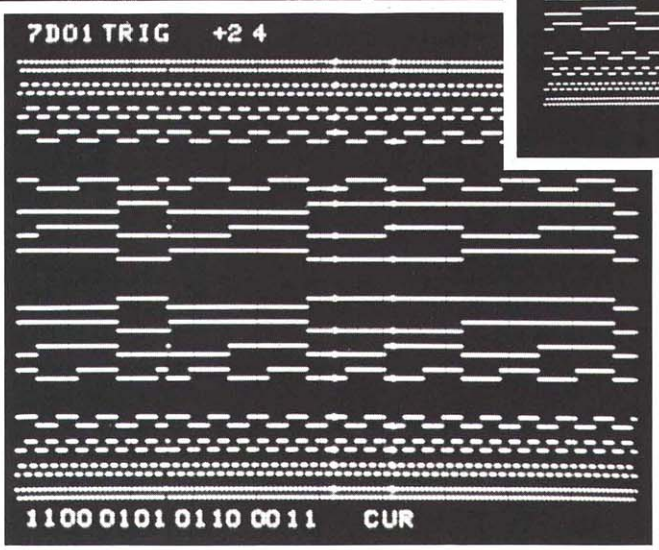
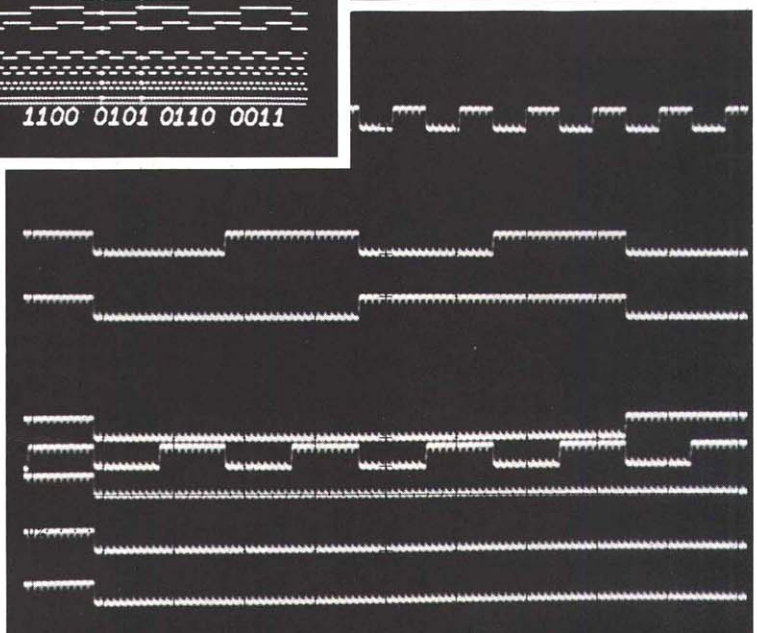








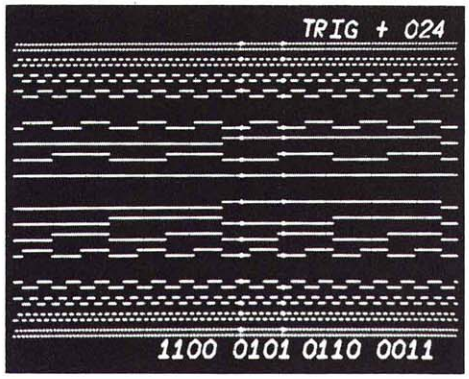




Why consider logic analyzers?

Why can't I use a good oscilloscope instead of a logic analyzer? This is the first question most of us ask when first shown a logic analyzer. An oscilloscope is still the best general purpose instrument ever developed for analyzing an electrical signal.

Digital systems, however, depend not on a single electrical signal, but on a combination of many such signals. The signal does not carry information, but rather the unique *combination* of signals at a given point in time conveys digital information, or data. This is where a logic analyzer is a necessity.



The 7D01 displays 16 Channels of information, intensifies the trigger point, intensifies a movable cursor point on the data stream and displays its location and binary state equivalent on the crt.

What does a logic analyzer do?

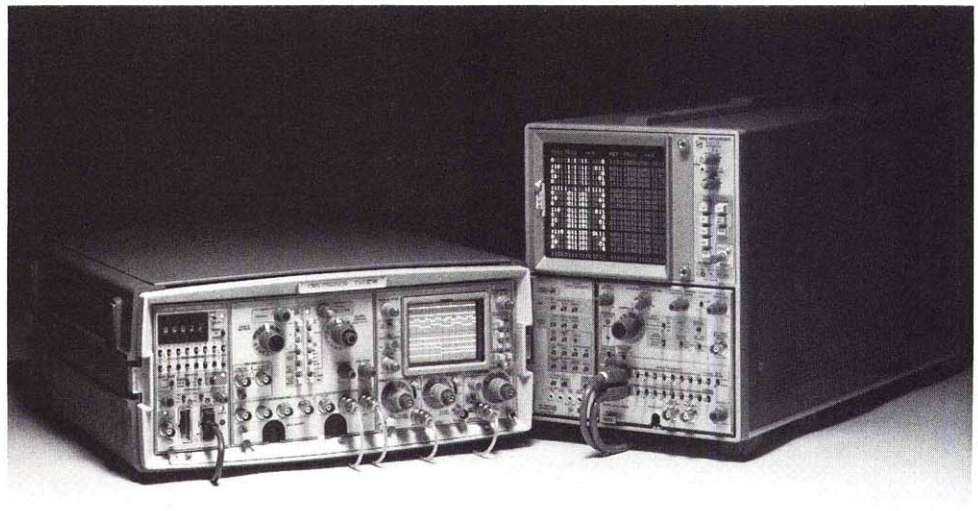
A logic analyzer does one important thing for you. *It saves you time.* In design and development, in service and maintenance, in troubleshooting hardware, in evaluating software, logic analyzers save you time and money by displaying logic in terms of data combinations rather than as individual signals.

To analyze signal combinations, a logic analyzer acquires signals from many channels simultaneously, and then at an appropriate trigger stores the signals as data levels for later display. Storage holds the data so that you can use as much time as you wish to analyze it.

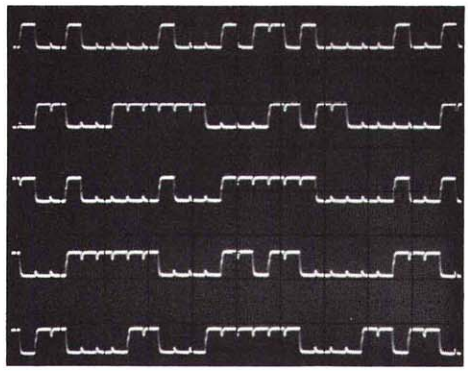
Sequentially shifting data into storage allows you to display data occurring before your trigger. Since the condition you're examining may be the result of earlier data combinations, you may need to look back in time from your trigger point to see what led up to it. This we call pre-trigger display of data (or sometimes, negative time) — the unique ability to display data that occurred before an error trigger was generated.

Likewise you can select a trigger point to display data that occurs after the trigger — — post-trigger display. Or, you can view a balanced display of pre- and post-trigger data — center trigger display.

But what about that error trigger. Since data is the combination of many signals, the trigger event is most likely a combination of signals. A logic analyzer needs word recognition — the ability to recognize a unique data word and generate a trigger when the word occurs.



Tektronix offers high performance logic analyzers from two configurable instrument families.



Data as displayed by the LA 501 provides tick marks to speed your data timing analysis. Biphase ticks indicate whether your levels are high or low.

The logic company

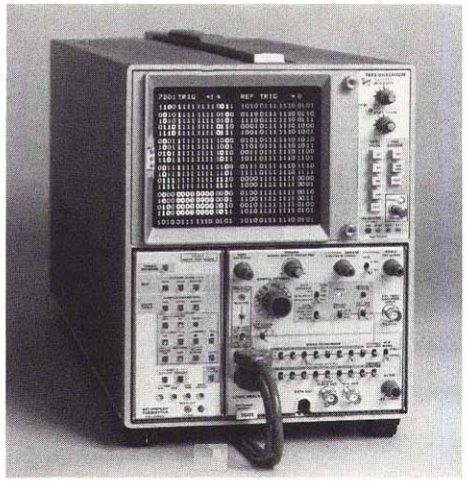
Logic analyzer systems are available within two configurable instrument families from Tektronix. Each family offers a selection of logic analyzer elements so that you can choose only as much analysis capability as you need. Each set of logic analyzers is compatible with an expanding line of instrumentation components so that you can match your logic analyzer needs to your overall instrumentation needs. In both the 7000-Series of oscilloscope-based instruments and the TM 500 Family of configurable multipurpose instruments, you can match your instrument-selection to your needs today. And you can expand your system as your needs grow or as we continually add new measurement capability to our equipment families.

You can choose high performance logic analyzers from either TEKTRONIX Instrument Family. Both offer:

- 16-Channel Operation to store and monitor signals on up to 16 data lines.
- 15-ns Asynchronous Timing Resolution — each bit in memory can represent the presence or absence of signals 5 ns long.
- Deep Memory to Store Pre-trigger Data; Formattable with data rates for resolution of timing problems:
  16 channels x 256 bits at 20 MHz
  8 channels x 512 bits at 50 MHz
  4 channels x 1024 bits at 100 MHz
  asynchronous; 50 MHz synchronous
- High Impedance Probes that won't load down most circuits.
- Word Recognition using 16 channels and 2 qualifiers.
- Split thresholds for working with different logic families.

7000-Series Logic Analyzers

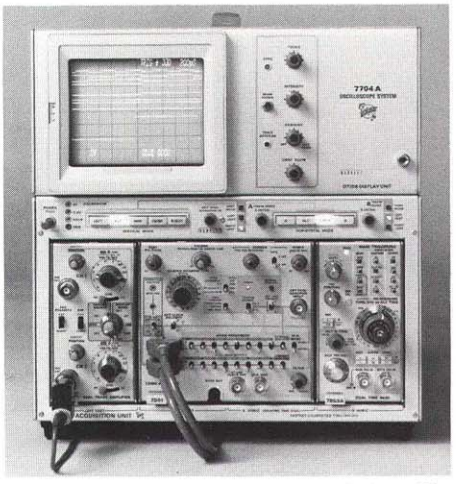
Plug-in compatibility within the family enables you to convert *any* existing 7000-Series oscilloscope mainframe into a high-performance logic analyzer. Conversely, the logic analyzer system (mainframe and logic analyzer plug-in) which you buy today can be converted later to a high-performance oscilloscope or spectrum analyzer merely with the addition of a plug-in or two. Consequently, your equipment investment is



The 7D01 Logic Analyzer with the DF1 Display Formatter converts any 7000-Series mainframe to a logic analyzer with five ways to look at logic.

safe longer, and upgrading is cheaper, than it would be with monolithic instruments.

The display formatter removes any necessity for you to make a commitment as to the type of display that might be best for you; it gives you all five ways to look at logic, in one package. You can use a map display for an overview of digital system performance. Whether you use 16, 8, or 4 channels the Tektronix map is reconfigured for a full screen matrix. Or select a state table with binary, hexidecimal or octal words. Or display your data on a timing or ladder diagram for close examination of timing relationships between data lines.



The 7D01 can be combined with a vertical amplifier and a time base in a 7000-Series Four-Compartment Mainframe to produce a single display combining 16 channels of logic and a real-time analog waveform.

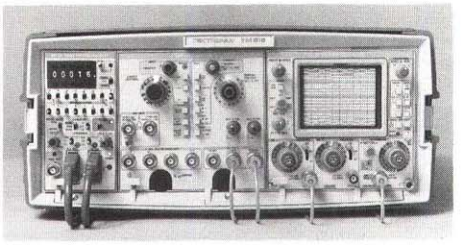
Only with the TEKTRONIX 7000-Series can you simultaneously display an analog waveform with 16 channels of logic analysis *on one crt*. The tremendous versatility of a four-compartment mainframe (7700-, 7800-, or 7900-Series) physically accommodates a logic analyzer with amplifier and time base.

TM 500 Family Logic Analyzers

Configurability and portability are the key concepts for every instrument in the TM 500 Family. The LA 501 Logic Analyzer, for example, can be used with any 50 kHz bandwidth oscilloscope or X-Y monitor. This means you probably can use your present oscilloscope to display logic. Since the oscilloscope is externally coupled, you can leave your logic analyzer alone with your digital system, waiting in a babysitting mode for a fault to occur. Babysitting becomes easier and cheaper using the LA 501, and it frees the designer for more important tasks. Only when the logic analyzer has acquired and stored sufficient data do you need to connect your oscilloscope for displaying. In the meantime your oscilloscope has been free for other uses.

Using the TM 515 Traveler Mainframe, your logic analyzer becomes a *go anywhere* system. This fully portable power module/mainframe can accommodate not only the logic analyzer and word recognizer but an oscilloscope as well. As a travelling test station, your oscilloscope retains its general purpose usefulness; it becomes dedicated to the logic analyzer only when you choose to display data.

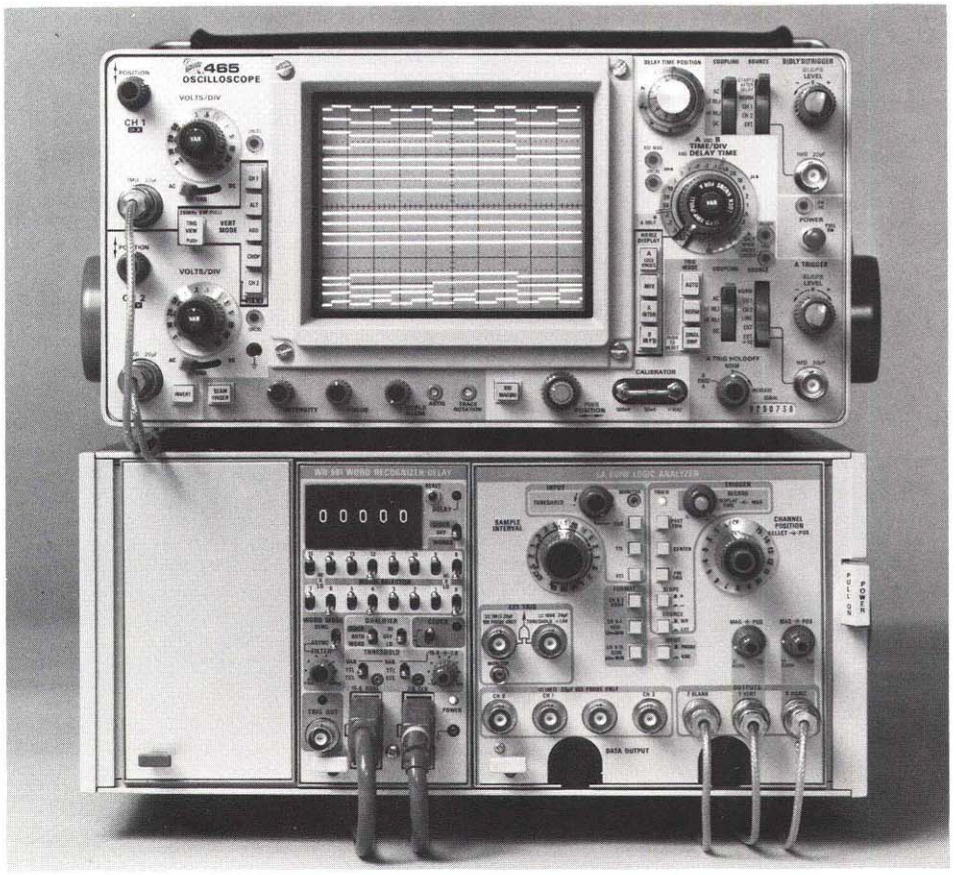
Another unique feature of logic analysis in the TM 500 Family allows triggering from a different set of 16 channels than the 16-data lines being displayed. For example, you can display the contents of a data bus, but trigger from an independent address bus. Additionally, a delay of up to 99,999 clock pulses or word triggers can be inserted before the LA 501 receives a trigger.



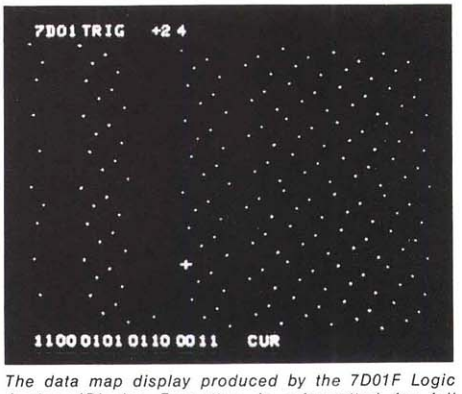
An LA 501W Logic Analyzer with Word Recognizer combines with an SC 502 Oscilloscope in a TM 515 Traveler Mainframe to produce a go anywhere logic analyzer system.

Both the 7000-Series and TM 500 Family Logic Analyzers use the modular instrument packaging system. Interchangeability of packages within each family lets you minimize your investment. Both systems are continuing to grow both in logic analysis and general purpose measurements; today's investment will not become obsolete with improvements in technology.

TEKTRONIX Logic Analyzers are engineered to provide swift solutions to your logic problems. The heritage of supporting your application needs, that Tektronix developed with oscilloscopes, continues into the digital world of logic analyzers.

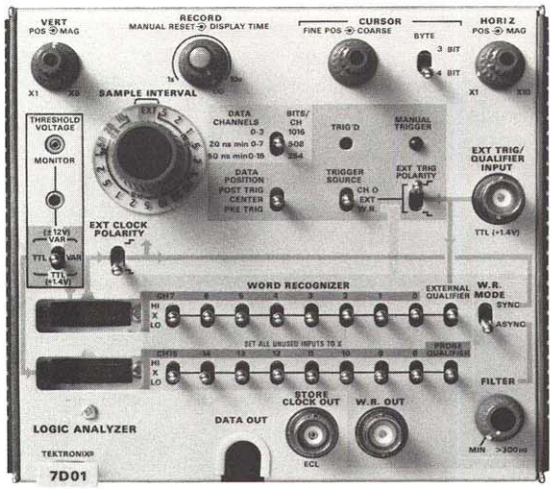


Use virtually any general purpose oscilloscope or X-Y display monitor with the LA 501W Logic Analyzer with Word Recognizer.

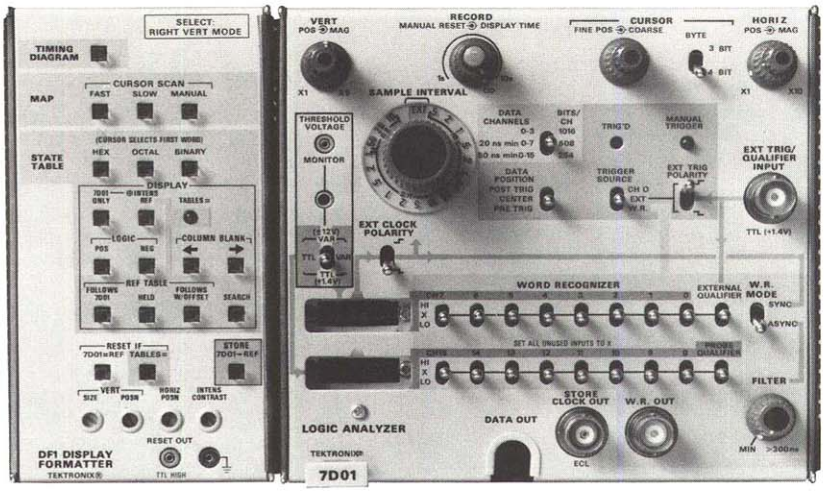


The data map display produced by the 7D01F Logic Analyzer/Display Formatter, is reformatted for full screen display whether you choose to use 4, 8 or 16 data channels.

Details on each of TEKTRONIX' Logic Analyzers are presented on the following pages. For additional guidance in selecting the logic analyzer that best fills your needs, contact your local Tektronix Field Engineer. A list of local Tektronix offices begins on page 260.



7D01 Logic Analyzer



7D01F Logic Analyzer with Display Formatter

The logic analyzer is rapidly becoming a necessary tool for digital design and troubleshooting, but, until now, it has been display limited: to choose each different display format, you needed to choose a different instrument. With the addition of the DF1 Display Formatter to the 7D01 Logic Analyzer, one instrument package, the 7D01F, offers all five data display formats: timing (ladder) diagrams, mapping diagrams, and state tables in binary, hexidecimal and octal formats. But first, let's examine the basic 7D01 Logic Analyzer.

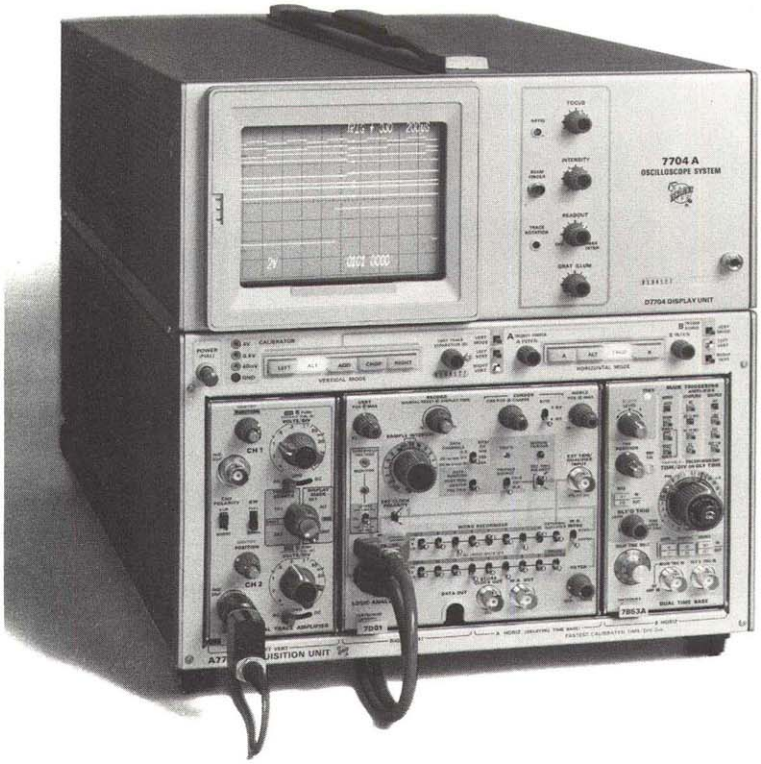
The 7D01 is a dual-wide plug-in instrument which occupies one vertical amplifier compartment and an adjacent time base compartment in any 7000-Series Oscilloscope Mainframe. With such compatibility, you can convert your existing 7000-Series Oscilloscope to a logic analyzer, or, if you use a four-compartment mainframe, you can combine your logic analyzer with your analog oscilloscope and display the outputs of both at the same time.

The 7D01 acquires up to 16 channels of data into its 4096-bit memory at asynchronous sample intervals from 10 ns to 5 ms, or synchronously with a clock of up to 50 MHz.

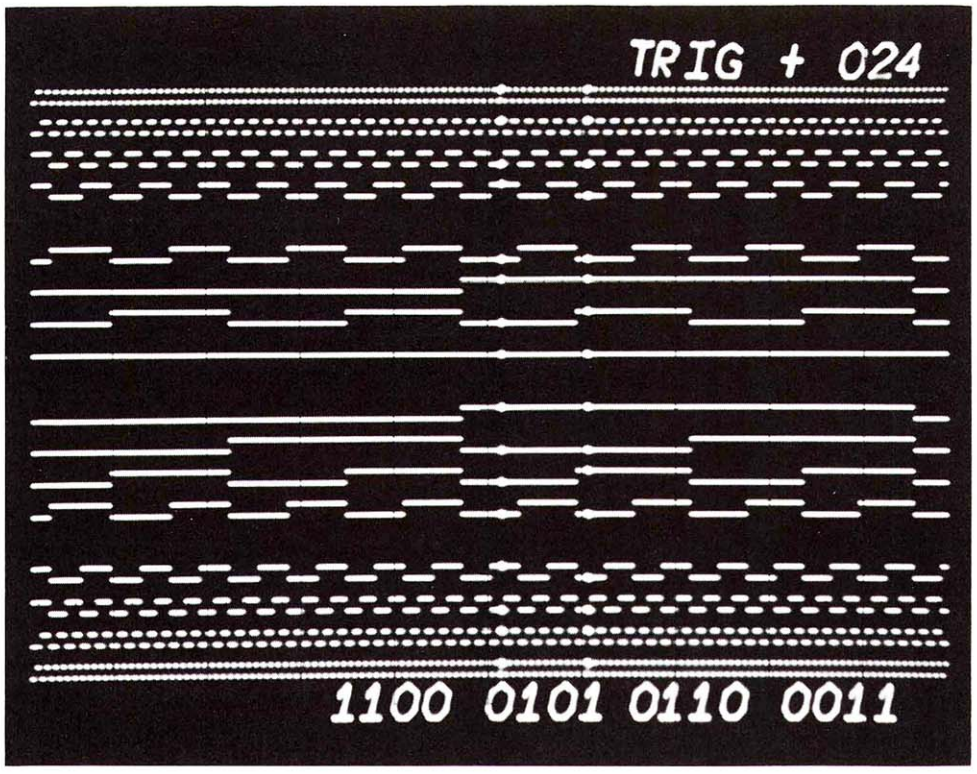
In order to get efficient use of the memory at all times, the 7D01 memory is formatted according to the number of input channels used. You can select: 16 data channels of 254 bits each at a 20 MHz sample rate, 8 data channels of 508 bits each at a 50 MHz sample rate or 4 data channels of 1016 bits each at an asynchronous sample rate of 100 MHz or a synchronous sample rate of 50 MHz.

Four methods of obtaining a trigger to store and display data are available. First, a trigger can be generated by a unique data combination using the word recognizer (W. R. position). Second, you can use the manual trigger button as a trigger source, even if no data has been acquired, so that you can center the traces and set intensity levels. Third, a trigger can be generated by the first positive going transition on data channel 0 (CH 0 position). Or fourth, trigger (of either polarity) can be received through a front panel BNC jack (EXT position).

The built-in word recognizer samples the qualifier and 16 display inputs from the active probes and an additional EXTERNAL qualifier. The two qualifiers allow you to trigger on words up to 18 bits wide. An asynchronous filter rejects false triggers which might be caused by spurious glitches or data skew. Each of the inputs — data and qualifiers — has an individual switch to select a trigger on the occurrence of a data HI, a data LO or any signal level (X, or don't care position).



The 7D01 Logic Analyzer can be combined with general purpose oscilloscope plug-ins to produce a complete system capable of logic analysis and analog measurements at the same time.



The 7D01 displays up to 16 channels of timing data along with the binary state and location of the word at the movable cursor position.

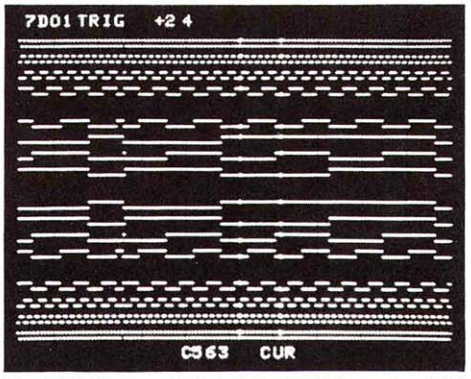
Data displays can feature data which occurs before the trigger (PRE TRIG selection stores 15/16 of the memory with data occurring before the trigger), data which occurs after the trigger (in POST TRIG only 1/16 of the memory is loaded before the trigger) or data balanced between pre-trigger and post-trigger (CENTER position selection).

The trigger location is displayed with a column of intensified dots, one on each data channel. A second column of intensified dots is positioned anywhere on the display with a movable cursor (COARSE cursor moves the dots in increments of 16 sample intervals or data clocks; FINE POS moves it in single increments). An alphanumeric readout at the top of the display locates the cursor relative to the trigger (in sample or clock intervals). A second readout at the bottom of the display identifies the data word at the cursor location, in binary state (1's and 0's). For your convenience in reading the display, the binary state word can be grouped into 3-bit or 4-bit bytes at your selection.

Data is acquired into the 7D01 thru two P6451, 9-channel, high impedance, active probes. Each probe has eight data input channels, an external clock or qualifier channel and a ground lead. In order to minimize loading on test circuits, probe impedance is 1 MΩ paralleled by 5 pF. Grabber tips conveniently clip onto adjacent DIP leads, or by removing the grabber tip, the probe leads connect directly to 25-mil pins.

Logic input thresholds can be selected at a pre-set TTL level or at any variable level between ±12 V. Additionally one probe may be set to TTL, while the threshold of the other is varied. To assure you've selected the proper level, the threshold voltage can be continuously monitored at a front-panel jack.

DISPLAY FORMATTER

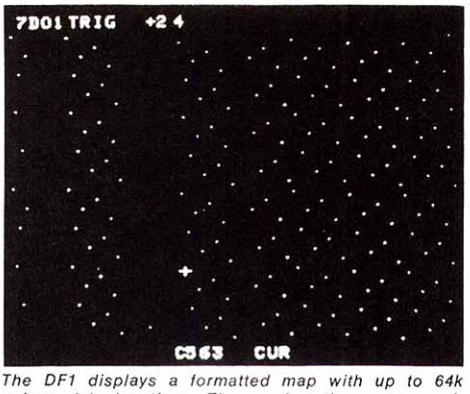


The DF1 displays timing data similarly to the 7D01 except that state readout can be binary, hex or octal, as desired, and that the mainframe need not be equipped with crt readout.

The DF1 Display Formatter is a dedicated plug-in for use with the 7D01; it occupies one vertical compartment adjacent to the 7D01 in the 7000-Series Mainframe, but does not function by itself — it connects to and plugs into the 7D01, forming a 7D01F. In formatting the logic display, the DF1 provides complete alphanumeric character generation so that the logic analysis package can be used in mainframes without crt readout.

The timing diagram formatted by the DF1 is virtually identical to that of the 7D01 except that the state display of the cursor word may be presented in binary, hexidecimal or octal.

Mapping provides a quick overview of system operation; most experienced operators learn to recognize data patterns amazingly fast. By positioning each word on the vertical axis using the most significant half of its digits, and on the horizontal axis using its least significant half, the map can display up to 64k unique word locations.

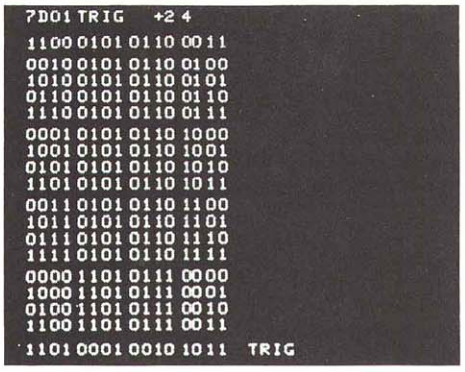


The DF1 displays a formatted map with up to 64k unique data locations. The word at the cursor position (+) is displayed in the state readout.

A significant feature of the DF1 map is that it is formatted. That is, if 16 channel operation is selected, the map portrays all 64k possibilities. However, if only 8 channels are used, the map is reformatted to use the entire display area for 8-bit words (a 4-bit by 4-bit matrix); and similarly, the map is also reformatted for full crt use if 4-channel operation is selected.

In FAST, or SLOW modes a + symbol automatically scans the map data, moving from point to point in the same order in which data was loaded into memory. A state display beneath the map (binary, hexidecimal or octal) shows the word at the + symbol location. In MANUAL mode, the + symbol is moved across the map using the 7D01 cursor control; cursor location is displayed at the top of the display, as it is for the timing diagram cursor.

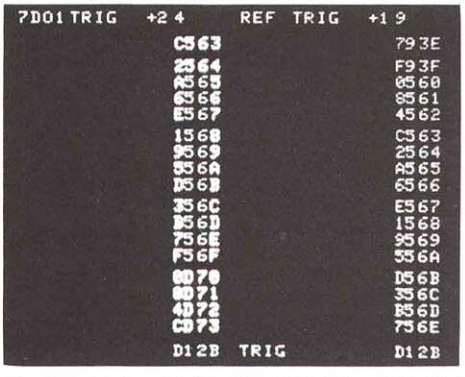
STATE TABLES



The DF1 displays a binary state table consisting of the word selected by the cursor and the 16 following words. The 18th word at the bottom is the trigger word.

With the Display Formatter, you can display state information in the format best suited to your application: binary, hexidecimal or octal. Each display presents 17 data words. Additionally, an 18th word, the trigger word, is displayed at the bottom of the crt. If the trigger word occurs on the display, it flashes. Cursor FINE POS steps through data displays, one word at a time. Similarly, COARSE cursor control moves the display 16 words at a time. Cursor location, relative to the trigger word, is displayed at the top.

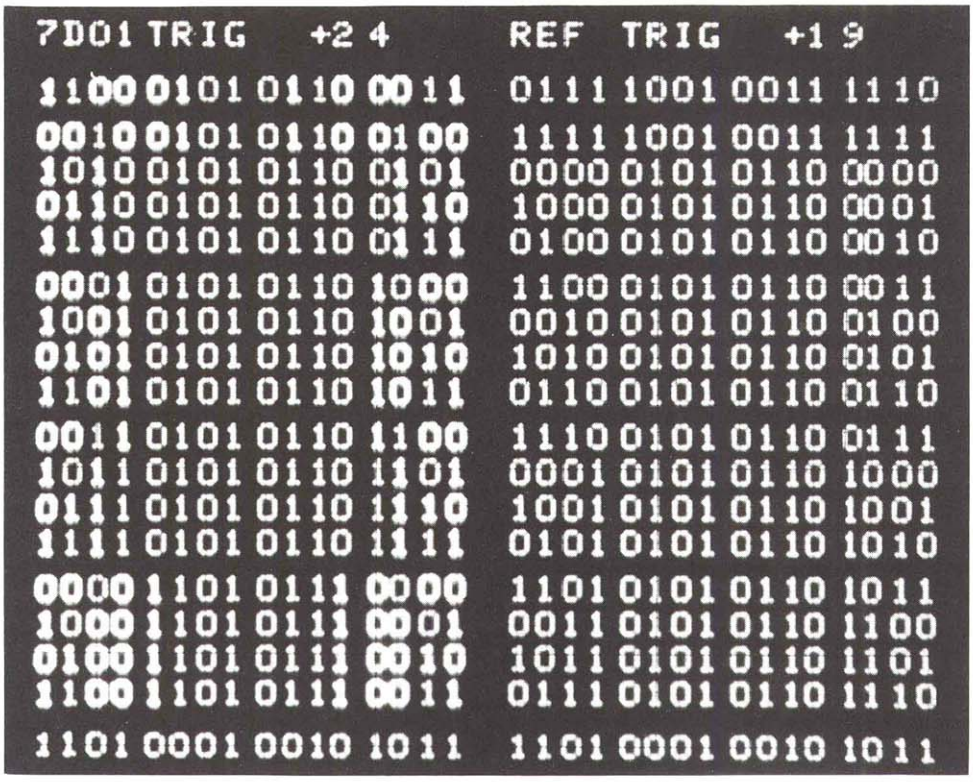
The Display Formatter takes advantage of a second 4k memory in order to store reference data for side-by-side comparisons. Data from the 7D01 memory is transferred into the DF1 memory as a reference (STORE 7D01 REF button). DF1 reference data is displayed on the right; newer 7D01 data on the left.



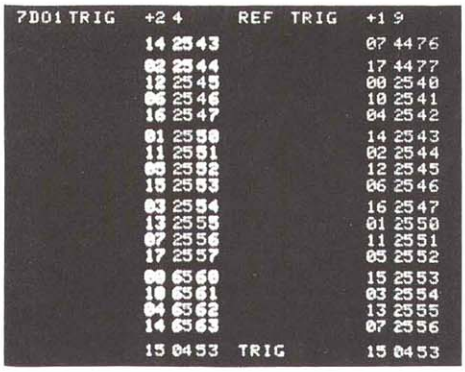
The DF1 displays hexidecimal state data, comparing it to stored reference data.

Using the *exclusive or* feature, new data is compared, bit-by-bit, against reference data, and any unlike bits are intensified on the 7D01 (left) table.

If both tables are equal, a TABLES = light on the front panel tells you at a glance that the data matches. The DF1 will compare automatically, and will reset if tables are equal or memories are equal. A reset will provide a RESET OUT trigger when data is equal. Column blanking allows you to remove, both from the display and from consideration in comparison, any number of



The DF1 displays state data comparing new data (on left) to stored reference (on right). Any differences between the two state tables are intensified on the new data.



The DF1 displays octal state data for convenience to operators who prefer to work in octal-based systems.

digit columns, working from the most significant digit down.

Additionally, these features can augment each of the state displays: reference table follows 7D01, reference table held, reference table follows with offset, and search.

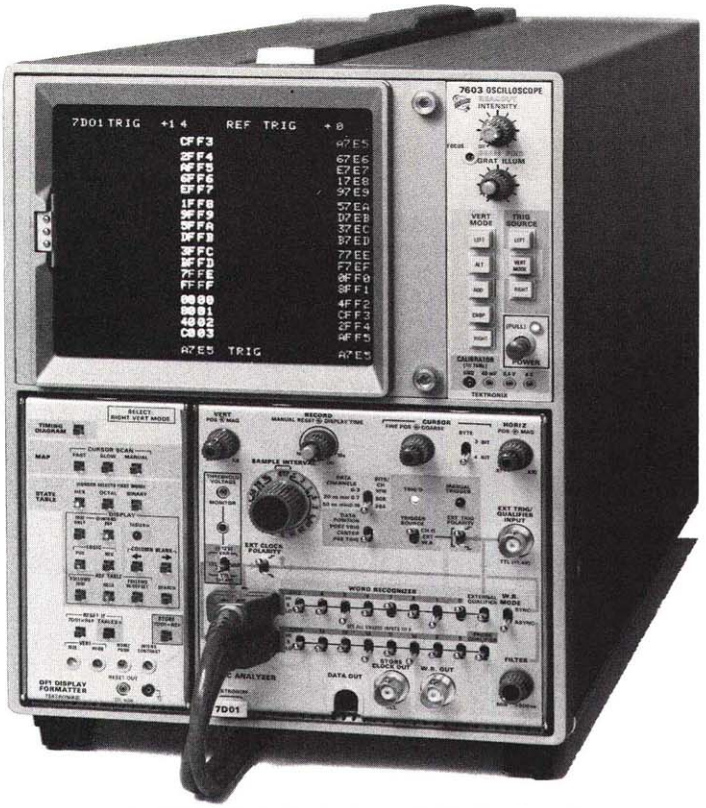
When the reference table follows the 7D01, both tables begin at the same cursor location, so that you can make comparisons between both 4k memories, one page at a time.

When the reference table is held, the cursor shifts the 7D01 data display independently of the reference table so that you can compare one page in reference memory to any page in the new data. The amount of offset between the two tables is evident from the cursor locations displayed above both tables.

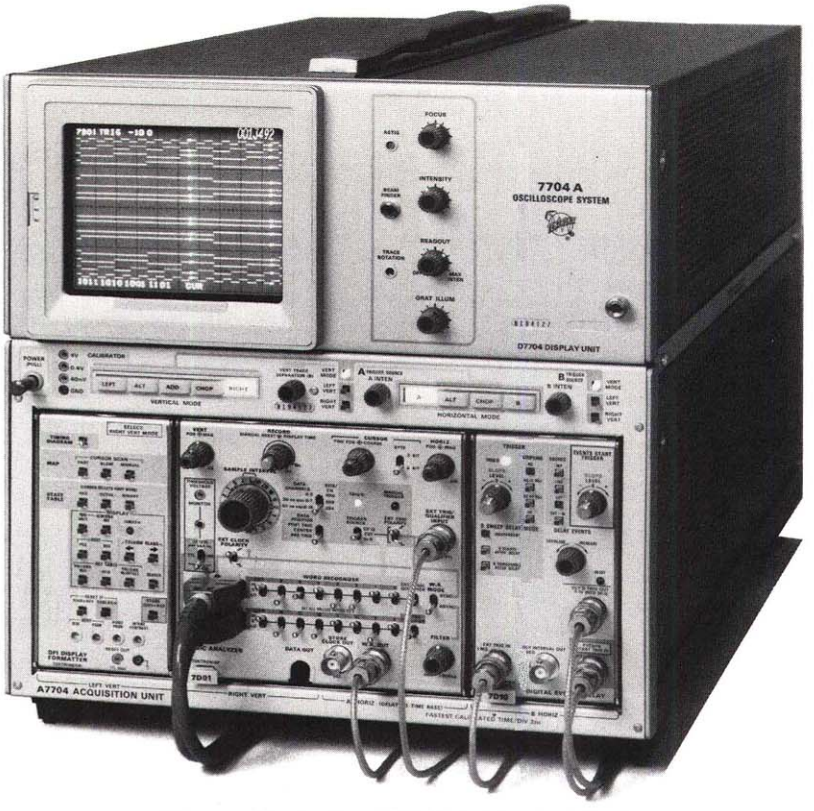
Once an offset is selected in the HOLD mode, FOLLOWS WITH OFFSET maintains a constant offset between the two tables. The cursor shifts both displays keeping their relative locations constant.

Search mode examines the 7D01 data for the next occurrence of the reference cursor word. This is especially useful in searching the memory for each occurrence of a particular word. First put the same data into both memories and use the cursor in the follows mode to advance the desired word to reference cursor position. Pressing SEARCH will advance the 7D01 data until the reference cursor word shows up in the data cursor position. Each time SEARCH is pressed, the data will be advanced until that word is again found.

Whether you select the 7D01 Logic Analyzer or the 7D01/DF1 Logic Analyzer/Display Formatter combination, you can choose any 7000-Series Mainframe for a powerful logic analysis system that is fully compatible with an extensive oscilloscope measurement system. Performance characteristics of the 7D01/DF1 are listed here; characteristics of the mainframes may be found on pages 51 through 60.



The 7D01/DF1 Logic Analyzer with Display Formatter makes a complete, basic logic analysis system when installed in a 7603 Mainframe.



When combined with a 7D10 Digital Events Delay in four-compartment mainframe, the 7D01/DF1 System obtains additional triggering flexibility, whereby the trigger to the logic analyzer can be delayed by up to 10^7 events.

7D01 CHARACTERISTICS

The 7D01 acquires 4, 8, or 16 channels of data and stores the data in a 4k memory. Data storage format is selectable as 4 channels x 1016 bits, 8 channels x 508 bits, or 16 channels x 254 bits.

Data sampling can be asynchronous (internal clock) or synchronous (external clock). In asynchronous modes, sampling rates can be selected up to 100 MHz in the 4 channel mode, up to 50 MHz in the 8 channel mode, or up to 20 MHz in the 16 channel mode. External sampling clocks up to 50 MHz can be used in the 4, and 8 channel modes up to 25 MHz in the 16 channel mode.

An invalid light (blinking light behind knob skirt) warns the operator that he has selected:

1. A sampling rate greater than 20 MHz in the 16 channel mode; or
2. A sampling rate greater than 50 MHz in the 8 channel mode.

SIGNAL INPUTS

Input Impedance — 1 MΩ paralleled by 5 pF (at probe head).

Sensitivity at Probe Tips — 500 mV minimum, centered around threshold.

Threshold at Probe Tips — Fixed TTL (+1.4 V ±0.2 V), or variable (±12 V).

Minimum Logic Swing — 500 mV plus 2% of threshold voltage p-p or less, centered on the threshold voltage.

Maximum Safe Input Voltage — ±60 V.

MEMORY

Format — Front panel selectable.

Data Channels Displayed	Bits per Channel
0-3	1016
0-7	508
0-15	254

SAMPLING RATE

Asynchronous (internal clock) — Sampling intervals are selectable from 10 ns to 5 ms in 18 steps using a 1-2-5 sequence.

Data Channels Displayed	Maximum Sampling Rate	Minimum Sampling Interval*	Min. Data Pulse Width*
0-3	100 MHz	10 ns	15 ns
0-7	50 MHz	20 ns	25 ns
0-15	20 MHz	50 ns	55 ns

*Minimum data pulse width to insure recording is one sample interval +5 ns.

Synchronous (external clock) — + or − edge of clock pulse can be selected to initiate sample.

Data Channels Displayed	Max. Clock Freq.	Minimum Clock Width*	Data Set-up Time Required	Data Hold Time Required
0-3	50 MHz	10 ns	20 ns	0
0-7	50 MHz	10 ns	20 ns	0
0-15	25 MHz	20 ns	23 ns	0

*High and low clock width.

WORD RECOGNIZER

Word Recognizer — 16 data inputs, Probe Qualifier and External Qualifier. Output is true when input conditions match settings (HI, X, LO).

Format	Input Pulse Width (Asynchronous Mode)
Any Single Channel	10 ns or less
Channels 0-3	15 ns or less
Any Other Combination	20 ns or less

Inputs — 16 data input channels plus 2 qualifiers.

Synchronous Mode —

Characteristic	Time
Minimum Setup Time	12.5 ns
Minimum Hold Time	8.5 ns

Async Filter — Rejects recognized words that remain true for less than an operator selected time period. Period is variable from 10 ns to 300 ns.

Output Connector (W. R. OUT) — A recognized word produces a displayed trigger marker and a front panel output for triggering external circuitry.

Output	Requirement
HI Level	≥1.9 V
LO Level	≤0.1 V
Impedance (Output)	50 Ω ± 10%

TRIGGER

Source — Channel 0, external (External Trigger/Qualifier Input), or internal word recognizer. A display can also be obtained with front panel MANUAL TRIGGER pushbutton.

Channel 0 — Triggers on rising edge of CH 0 data.

External Trigger/Qualifier Input Connector (EXT TRIG/QUALIFIER INPUT) —

Characteristics	Requirement
Threshold	+1.4 V, ±0.2 V (TTL Level)
Minimum Pulse Width	15 ns
Maximum Safe Input Voltage	−5 V or less, to at least +10 V

Triggered Light — Indicates display trigger has occurred.

Trigger Marker — Trigger position on crt display is marked by an intensified spot. Spot appears on all displayed channels.

DISPLAY

Type — Data is displayed as a timing diagram with one word (at cursor location) additionally displayed in 4-bit or 3-bit bytes of binary state.

Display Time — Variable from less than 1 s to at least 10 s. A detent position provides indefinite storage of data. A new record cycle can be started at any time by pushing the MANUAL RESET button.

Vertical Display Controls (VERT POS/MAG) — A variable vertical magnifier control magnifies the on-screen display from X1 to X5. A concentric vertical position control positions the display within the graticule area.

7D10 | Digital Events Delay
7D11 | Digital Delay
DD 501 | Digital Delay

Horizontal Display Controls (HORIZ POS/MAG) — A variable horizontal magnifier control magnifies the on-screen display from X1 to approximately X10. A concentric horizontal position control positions the display within the graticule area.

DATA OUTPUT

Connector — A 25-pin connector (inside 7D01) provides output of stored data from the 7D01. It also provides control signals necessary for transfer of that data to other equipment.

Parallel Data — 16 pins provide parallel access to stored data. ECL levels.

Serial Data — One pin provides serial access to stored data. ECL levels.

Flag — A positive-going edge on this pin indicates the end of each channel. ECL levels.

Format — 2 pins are used to identify the stored format as 4 channels x 1016 bits, 8 channels x 508 bits, or 16 channels x 254 bits.

Frame — Occurs every 16th sweep. A positive-going edge indicates end of channel 3.

Display/Store Mode — Store HI
Display LO

Trigger Marker Output — LO = marker point in data stream.

External Display Clock Input — Allows data output at externally selected rates 1 Hz-2 MHz. All at ECL levels.

POWER

Line Voltage Ranges — Determined by the 7000-Series Oscilloscope Mainframe.

Power Consumption — 34 W at nominal line voltage.

ENVIRONMENTAL

Temperature — Operating: 0°C to +40°C. Nonoperating: −40°C to +75°C.

Altitude — Operating: to 15,000 feet. Nonoperating: to 50,000 feet.

Vibration — With the 7D01 and DF1 combined, frequency swept from 10 to 50 cps at one minute per sweep. Vibrate for 15 minutes along each of the 3 major axes at 0.015 inch total displacement. Hold 3 minutes at any major resonance, or if none, at 50 cps. Total time, 54 minutes.

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 s duration, 2 shocks in each direction along 3 major axes, for a total of 12 shocks.

INCLUDED ACCESSORIES

Two, P6451 Data Input Probes (010-6451-00).

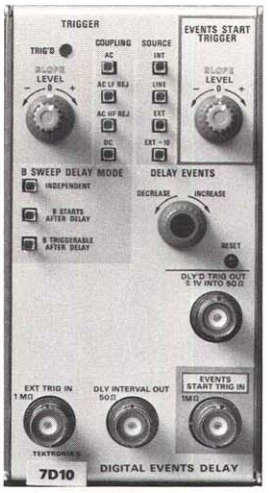
DF1 CHARACTERISTICS

The DF1 reformats the output of the 7D01 into a choice of displays, and as such imposes no significant electrical characteristics on the 7D01 which affect measurement parameters.

ORDERING INFORMATION

7D01F Logic Analyzer with Formatter **$4390**
7D01 Logic Analyzer **$3195**
7D01 Option 49 (Deletes one P6451 Data Input Probe) **$2895**
DF1 Display Formatter **$1195**
7603 Oscilloscope* **$1850**
7704A Oscilloscope* **$2900**

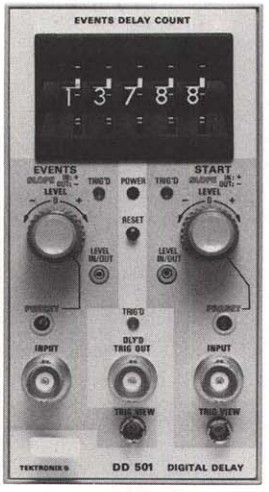
*See pages 57 through 68 in this catalog for details on these and additional 7000-Series Mainframes. See pages 69 through 86 for details on complementary 7000-Series Plug-ins.



7D10 Digital Events Delay

The 7D10 or 7D11 let you add delay to your 7D01 Logic Analyzer trigger. The 7D11 has all of the features of the 7D10, plus it delays by time as well as digital events. Both units provide a trigger pulse output upon counting a preselected number of digital pulses.

For example, you can start the delay counter with the W.R. out pulse, count some number of clock pulses, and then supply an external trigger to the 7D01. See page 77 for complete details.



DD 501 Digital Delay

Delay by Events Counting Rate to 65 MHz

Divide by N Mode with Counting Rate to 20 MHz

Delays by up to 99,999 Events

Companion Unit for Any Logic Analyzer

The DD 501 provides delay by events in a plug-in for TM 500 Mainframes. Using five thumbwheels on the control panel, the operator can set any desired delay from 1 through 99,999 events. When the number of input events reaches the preset count, the DD 501 will put out a trigger pulse which can be used for triggering a logic analyzer, oscilloscope, or counter.

The logic analyzer memory window is easily delayed from the trigger by a selected count using the DD 501.

Because the DD 501 creates its delay by counting a number of pulses rather than by analog timing of an interval, jitter is not a problem, even when viewing pulses toward the end of a long train. Events can be counted at frequencies up to 65 MHz. With the selected number of events clearly displayed on the thumbwheel dials, the operator knows at all times what part of a pulse train he is viewing on the accompanying logic analyzer or oscilloscope.

EVENTS DELAY

Count — 1 to 99,999 events.

Max Count Rate — 65 MHz.

Insertion Delay — 30 ns or less from final event to trigger output pulse.

Recycle Time — 50 ns or less.

Reset — Manually resets delay counter.

INPUT CHARACTERISTICS

(All characteristics apply to both events and start inputs.)

Input Impedance — 1 MΩ, 20 pF.

Slope — Either + or −, selectable.

Sensitivity — 85 mV p-p @ 30 MHz.

Frequency Response — Up to 65 MHz at 120 mV sensitivity.

Minimum Detectable Pulse Width — 5 ns.

Threshold Level Range — From −1.5 V to +1.5 V (−15 V to +15 V with 10X probe). Can be externally programmed or monitored at front panel jacks.

Trigger View Out — Threshold detector output, at least 0.5 V (200 Ω or less source impedance).

Events Triggered Light — Visual indication that events are being detected.

Start Triggered Light — Visual indication that delay is in progress.

TRIGGER OUTPUT

Pulse Width — Width of events pulse plus 6 ns or less.

Voltage Swing — + 0.8 V or less to at least + 2.0 V with 3 TTL loads (≃ 5 mA).

Light — Indicates output trigger.

GENERAL

Temperature — Operating 0°C to +50°C. Non-operating: −40°C to +75°C.

Altitude — Operating: to 15,000 ft; Nonoperating to 50,000 ft.

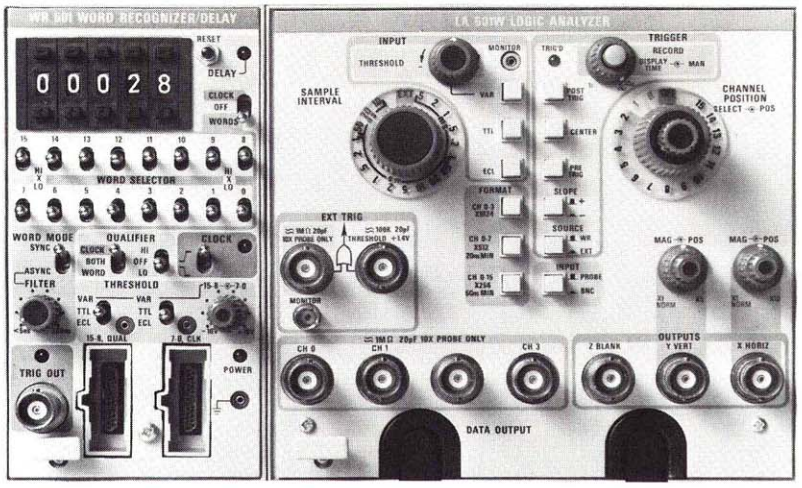
Shipping Weight — 3 lb.

Dimensions — 2.6 in wide, 5 in high, 12.2 in deep (6.6 x 12.7 x 31 cm).

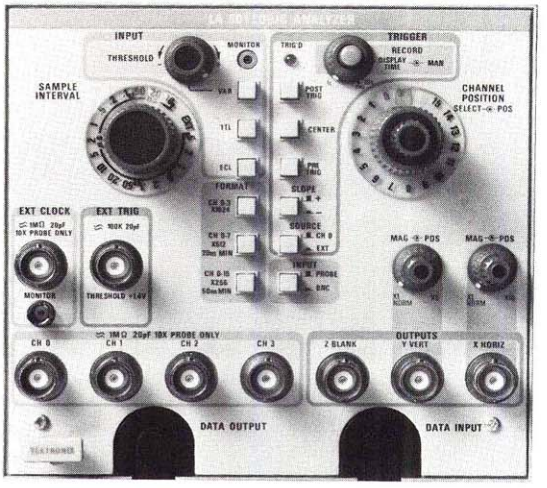
ORDERING INFORMATION

DD 501 Digital Delay ***$725**

*The DD 501 must be plugged into a TM 500 Mainframe to achieve a working unit.



LA 501W Logic Analyzer System

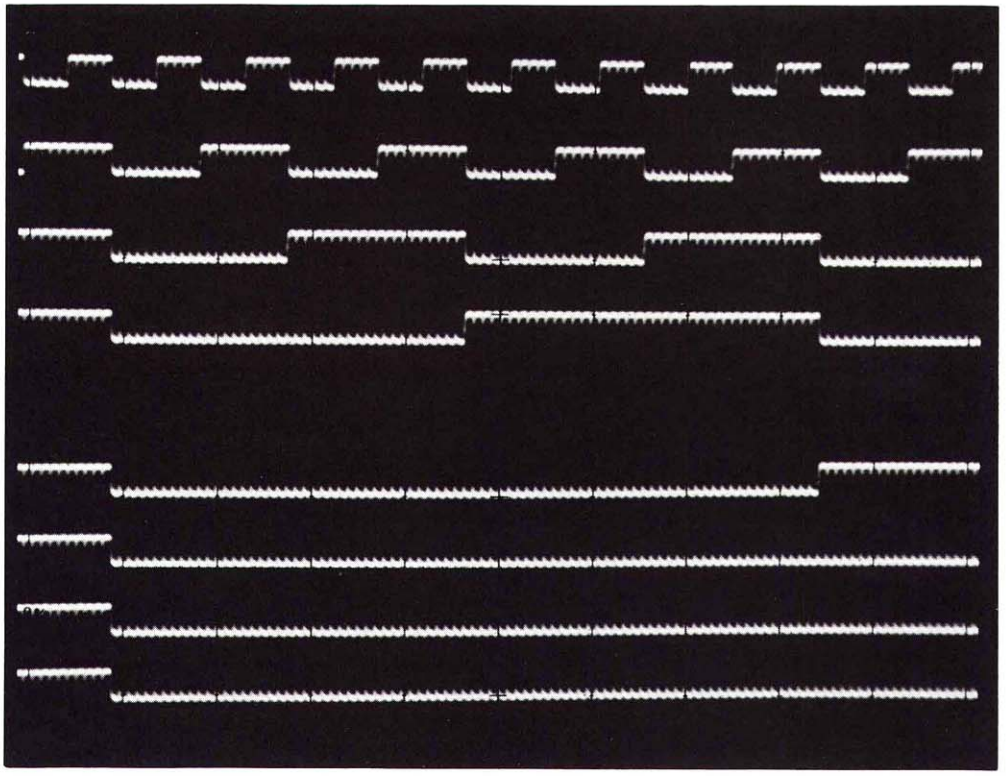


LA 501 Logic Analyzer

The LA 501W Logic Analyzer System, made up of the LA 501 Logic Analyzer and WR 501 Word Recognizer Plug-ins, operates in any 3, 4, 5, or 6-compartment TM 500-Series Power Module Mainframe. This combination complements virtually any oscilloscope or X-Y monitor to provide a versatile logic analysis system.

4096 bits of storage may be formatted as 4 channels x 1024 bits, 8 channels x 512 bits, or 16 channels x 256 bits to best fit your application. With a selectable asynchronous sampling rate of up to 100 MHz (for 4-channel operation), the LA 501 provides timing resolution to 15 ns. Data can also be synchronously (externally) clocked to 50 MHz. Pre-, center-, or post-trigger data can be recorded at a sample rate from 10 ns to 5 ms.

Two active P6451 probes feature a high input impedance — 1 MΩ paralleled by 5 pF. They provide a total of 18 inputs to the WR 501 — 16 data input channels, one clock input, and one qualifier input. There are separate threshold controls (TTL, ECL, and variable ±10 V) for each probe.



The LA 501W display includes biphase tick marks. These are an aid in timing comparisons (each is equivalent to one sample interval or synchronous clock), and as a quick indication of whether a line is high or low.

Word Recognizer with Digital Delay

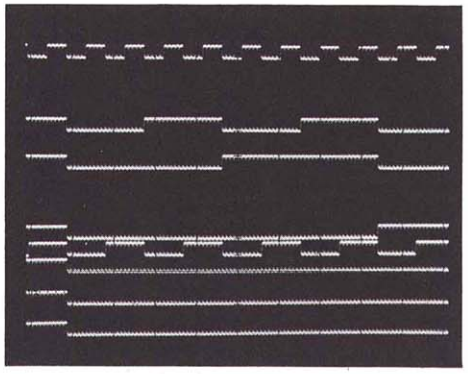
Stored data is displayed as a timing diagram in groups of four. Each trace displays high and low logic states. Vertical and horizontal position and magnifier controls provide the capability to zoom in on any segment of the timing diagram. Biphase timing tick marks on each channel provide excellent visual resolution and also indicate whether an inactive line is high or low. Channel-to-channel timing comparisons are easy because any trace can be moved vertically and thus positioned next to any other.

The WR 501 16-bit parallel Word Recognizer with Digital Delay produces trigger pulses when a preselected parallel word occurs. This gives you fast access to almost any unique word in the data stream.

Either the LA 501 or the WR 501 may be purchased and operated separately. The LA 501 is a good choice in logic analysis when triggers are readily available from the system under test. The LA 501, when purchased separately, comes with a P6450, 16-channel passive probe.

For minimal circuit loading when using the LA 501 above, four front-panel BNC connectors provide high impedance inputs for 10X probes. They drive channels 0 through 3 when the INPUT selector is in the BNC position.

The WR 501 can be used separately as a word recognizer to generate triggers for oscilloscopes or other measurement instruments.



A CHANNEL/POSITION selector allows you to vertically reposition any trace anywhere on the display for easier timing comparisons. Here channel 1 is repositioned between channels 4 and 5.

LA 501W CHARACTERISTICS

LA 501W characteristics apply to both LA 501 and WR 501 separately, except where functions of each are described separately.

The LA 501W acquires 4, 8 or 16 channels of data and stores the data in memory. Data storage format is selectable as 4 channels x 1024 bits, 8 channels x 512 bits, or 16 channels x 256 bits.

DATA INPUTS

Data Channels — 16 channels divided between two probes. Channels 0-7 (and clock) are in probe 1. Channels 8-15 (and qualifier) are in probe 2.

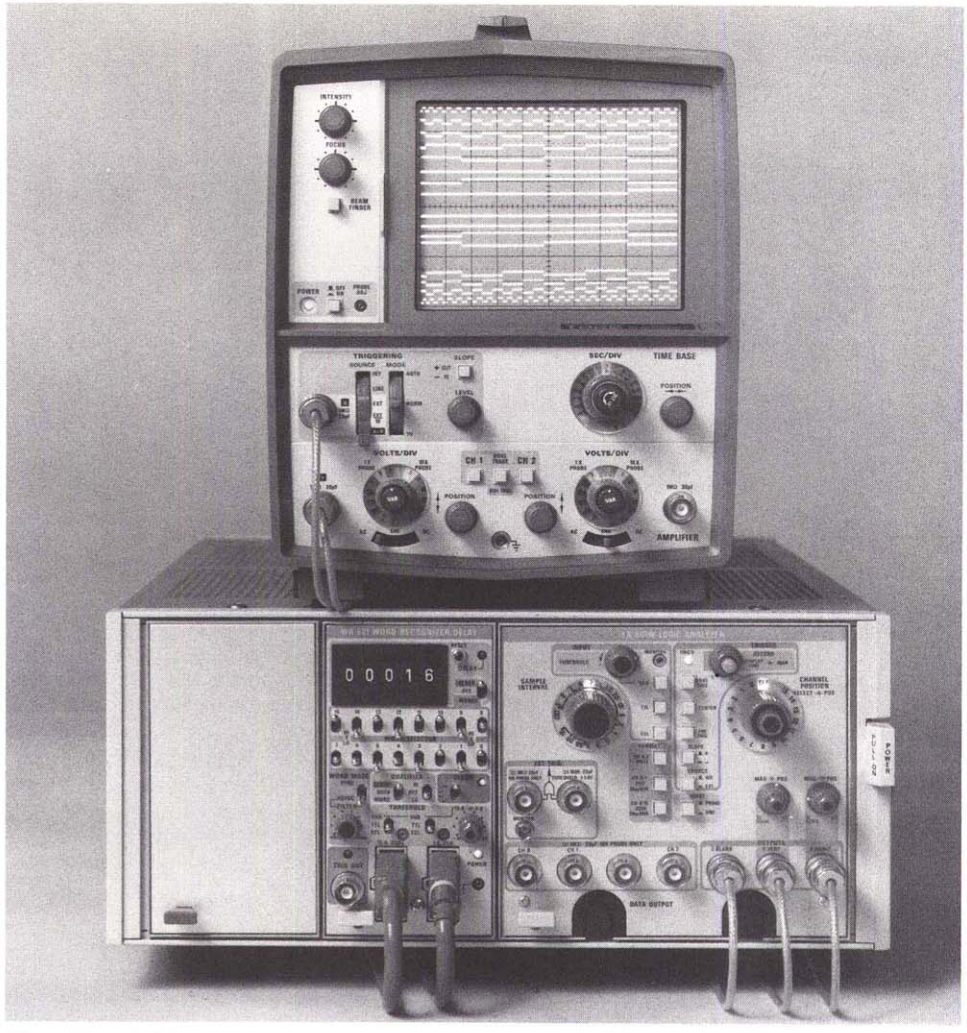
Input Impedance — 1 MΩ paralleled by 5 pF.

Sensitivity at Probe Tips — 500 mV p-p minimum centered around threshold.

Threshold at Probe Tips — Fixed TTL (1.4 V ±0.2 V) or ECL (−1.26 V ±0.05 V), or variable (at least −10 V to at least +10 V).

Maximum Safe Input Voltage — ±60 V.

Interface — A high-speed interface provides transfer of the incoming data signals to the LA 501 Logic Analyzer through internal cables. This enables the WR 501 probes to provide input for both plug-ins.



The modular LA 501W can be used with any oscilloscope or X-Y monitor with 500 kHz bandwidth. Here its display is shown on a low cost T922.

MEMORY

Format — Front Panel Selectable.

Data Channels Displayed	Bits per Channel
0-3	1024
0-7	512
0-15	256

DATA TIMING

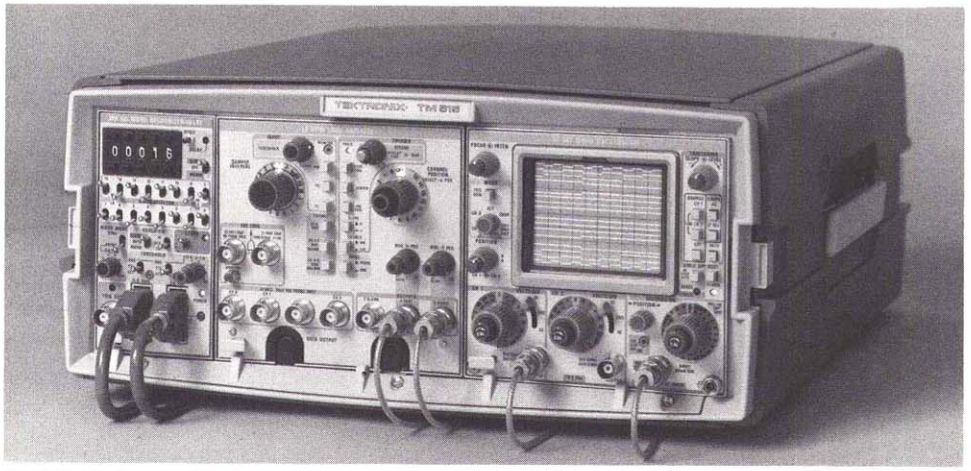
Asynchronous (internal clock) — Sampling intervals are selectable from 10 ns to 5 ms (±0.005%) in a 1-2-5 sequence.

Data Channels Displayed	Maximum Sampling Rate	Minimum Sampling Interval	Minimum Data Pulse Width
0-3	100 MHz	10 ns	15 ns
0-7	50 MHz	20 ns	25 ns
0-15	20 MHz	50 ns	55 ns

Synchronous (external clock)

Data Channels Displayed	Maximum Clock Freq.	Minimum Clock Width*	Minimum Data Setup Time	Minimum Data Hold Time
0-3	50 MHz	10 ns	18 ns	0 ns
0-7	50 MHz	10 ns	18 ns	0 ns
0-15	20 MHz	25 ns	23 ns	0 ns

*High and low clock width.



The TM 515 Traveler Mainframe accommodates the LA 501W and an SC 502 Oscilloscope to make a complete portable logic analysis system.

TRIGGER

Source — WR 501 or External Trigger inputs.

Triggered Light — Indicates display trigger has occurred.

Slope — Selects positive or negative slope as the active edge external triggers. Selects word or word on WR (internal) triggers with digital delay set at 0 or OFF.

WORD RECOGNIZER (WR 501)

Inputs — 16 data inputs plus a clock and qualifier.

Word Selection — Made using sixteen three-position toggle switches. Positions are HI, X (don't care), and LO.

Qualifier — Can expand the word recognizer to 17 bits, act as a gate for the external clock or do both.

Clock — Selects positive- or negative-going edge of clock input signal. Used for synchronous operation.

Modes — Front panel selection of synchronous word recognition (a trigger is produced only when the operator selected word occurs at a clock edge. Either position, positive or negative edge, may be selected), or asynchronous word recognition (a trigger is produced anytime the recognized word occurs).

Synchronous Mode —

Minimum Set-up time	18 ns
Minimum Hold time	0 ns

(Filter is automatically disabled)

Asynchronous Mode and Filter —
Minimum coincidence time is variable from 15 ns or less to 200 ns or more.

DIGITAL DELAY

Delay Selection — Five thumbwheel switches provide selection of any delay-by-events or delay-by-words from 0 to 99,999.

Modes — Two delay modes (delay-by-events count or delay-by-word triggers) or OFF.

Indicator — An LED is lit during the delay interval.

Reset — Pushbutton resets the delay counter.

Output Connector (TRIG OUT) — The trigger from the WR 501 is available via the internal interface to the LA 501, or at a front panel BNC connector. This produces a trigger after word recognition and the delay selected. The signal is TTL compatible.

Output	Requirement
HI Level	≥2.4 V
LO Level	≤0.4 V
Impedance	≃50 Ω

Maximum Trigger Delay —

Word Recognition Mode	Delay to front panel Trigger Output (referred to probe tips — digital delay set to 00,000)
Synchronous	≤50 ns from edge of clock input and word pattern match.
Asynchronous	≤50 ns + selected filter time from word pattern match.

DISPLAY

Type — Data is displayed as a timing diagram.

Display Time — Variable from less than 1 s to at least 10 s. A detent position provides indefinite storage of data. A new record cycle can be started at any time by pushing the MANUAL Pushbutton.

Vertical Display Controls (VERT POS/MAG) — A variable vertical magnifier control magnifies the on-screen display from X1 to X5. A concentric vertical position control positions the display within the graticule area.

Horizontal Display Controls (HORIZ POS/MAG) — A variable horizontal magnifier control magnifies the on-screen display from X1 to approximately X10. A concentric horizontal position control positions the display within the graticule area.

DATA OUTPUT

Connector — A 25 pin connector (inside LA 501W) provides output of stored data from the LA 501W. It also provides control signals necessary for transfer of that data to other equipment.

Parallel Data — 16 pins provide parallel access to stored data. ECL levels.

Serial Data — One pin provides serial access to stored data. ECL levels.

Flag — A positive-going edge on this pin indicates the beginning of each channel. ECL levels.

Format — 2 pins are used to identify the stored format as 4 channels x 1024 bits, 8 channels x 512 bits, or 16 channels x 256 bits.

POWER

Line Voltage Ranges — Determined by the TM 500-Series Mainframe.

Power Consumption — 45 W (LA 501W) at nominal line voltage.

ENVIRONMENTAL

Temperature — Operating: 0-40°C (0-50°C only in TM 506). Nonoperating: −40°C to +75°C.

Altitude — Operating: to 15,000 ft. Nonoperating: to 50,000 ft.

Vibration — With the operating instrument, vibration frequency swept from 10 to 50 to 10 cps at one minute per sweep. Vibrate for 15 minutes along each of the three major areas at 0.015 inch total displacement. Hold three minutes at any major resonance, or if none, at 50 cps. Total time 54 minutes.

Shock — Operating and nonoperating: 30g's, ½ sine, 11 ms duration. Two shocks in each direction along three major areas, for a total of 12 shocks.

Transportation — Qualified under National Safe Transit Committee test procedure 1A, Category 11.

DIMENSIONS AND WEIGHTS (LA 501W)

Weight	kg	lb
Net Weight	3	6.6
Dimensions	**cm**	**in**
Height	12.5	4.9
Width	20.1	7.8
Depth	30.0	11.8

ORDERING INFORMATION

LA 501W* Logic Analyzer $4450

LA 501W OPT 5*
(Add one TM 515 Power Module) $4775

LA 501W OPT 49*
(Delete one P6451 probe) $4150

LA 501 Logic Analyzer $3250**

WR 501* Word Recognizer $1500

WR 501 OPT 49*
(Delete one P6451 probe) $1200

040-0806-00 LA 501/WR 501
Interface Mod Kit $185

P6108 Probe, 10X Attenuation,
2 Meter Cable (010-6108-03) $49

*Included Accessories, LA 501W and WR 501 — Two 9-channel P6451 Acquisition Probes.

**Included Accessories, LA 501 — One 16-channel P6450 Passive input probe.

TM 515* Power Module $325**

TM 506* Power Module $240**

TM 504* Power Module $180**

TM 503* Power Module $160**

RTM 506* Rackmount**
Power Module $325

***Operation of the LA 501W, LA 501 or the WR 501 requires a TM 500 Series Power Module. Details on these as well as the full line of TM 500 Series instrumentation begins on page 141. Additionally, operation of the LA 501W or LA 501 requires an X-Y display monitor or an oscilloscope.

OPTIONAL ACCESSORIES

P6108 — A 10X probe (10 MΩ, 13 pF), for use with the LA 501 or DD 501 Digital Delay. Order four probes for use with the four high speed data channels of the LA 501. For the external clock input of the LA 501, order one additional probe.

(010-6108-03) **$49**

P6450 Probe Package — Replacement probe for LA 501 Logic Analyzer.

(010-6450-01) **$250**

P6451 Probe Package — Replacement active probe for LA 501W, WR 501, 7D01 or 7D01F. (Two probes are needed for 16-channel operation).

(010-6451-01) **$375**

Lead Sets — Color coded replacement lead set for the P6450 Probe or the P6451 Active Probe. 10 leads/set. Connects probe head to 0.025 in square pins.

(012-0655-01) **$35**

Same lead set with hook tips.

(012-0670-00) **$36**

BNC Cable — 50 Ω, 18 in.

(012-0076-00) **$11**

Probe Holder — Clip-on holder accommodates probe pod from P6450 or P6451.

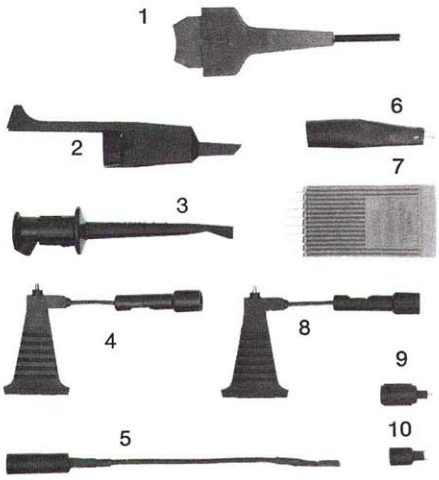
(352-0473-01) **$2.40**

Lab Cart, Model 3

A rollabout cart which carries any 7000-Series Mainframe with 7D01F Logic Analyzer, or any laboratory or portable oscilloscope, on its top tray. Two underslung trays accept up to two TM 504 Mainframes with LA 501W Logic Analyzer and other TM 500-Series modular instrumentation.

Model 3 Lab Cart $295

Probe Tips



1. Miniature Retractable Hook Tip — Suitable for attaching P6450 to compact electronics.
(206-0222-00) **$5**

2. Retractable Hook Tip — Suitable for use with P6401 Logic Probe.
(013-0106-00) **$6**

3. Pomona Hook Tip to 6-32 —
(344-0267-00) **$2.60**

4. Probe Pin Tip — Accepts 0.025 in IBM SLT pin. Slip on.
(206-0209-00) **$2.50**

5. Probe Tip — Flexible probe tip to fit 0.025 in square pin.
(206-0193-00) **$5.00**

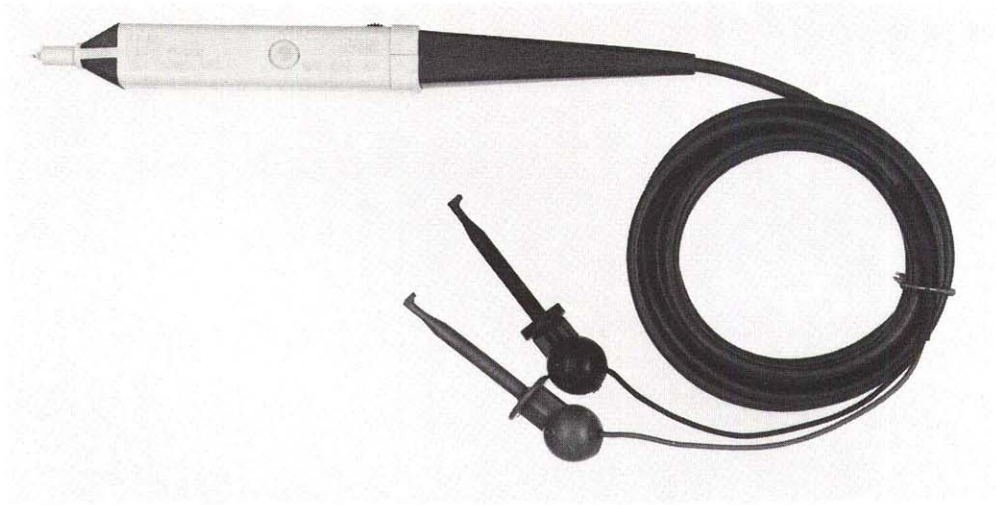
6. Miniature Alligator Clip —
(344-0046-00) **$1.00**

7. Clothes Pin IC Clip —
(003-0709-00) **$24.00**

8. Probe Pin Tip — Accepts 0.025 in IBM SLT pin. Screw on.
(206-0134-03) **$3.00**

9. Probe Ground Lead Adapter — #6-32 to 0.025 in IBM SLT square pin.
(206-0137-01) **$1.30**

10. Miniature Probe Tip Adapter — For testing integrated circuits. Package of 10.
(015-0201-01) **$2**



P6401 Logic Probe

TTL/DTL Compatible

Detects Steady Logic Levels

Detects Trains of Logic Pulses

Detects Abnormal Conditions

Strobed Detection of Logic Pulses

Store Mode

Protected against Overvoltage

The small, lightweight, hand-held P6401 indicates the state of logic levels in TTL, DTL, or any other system with threshold between 0.7 and 2.15 volts. A strobe input can be used to detect the coincidence of logic signals at two points. An indication of whether a logic pulse has or has not occurred can be obtained in a "store" mode.

Power may be obtained from the unit under test or any 5 V supply.

Two bright lights in the probe tip indicate condition of the logic signal.

State or Condition	Indication
Steady high state	Steady red light
Steady low state	Steady green light
Pulse trains (normal logic switching)	Blinking red and green light at full intensity
Abnormal state (between high and low)	No lights
Open circuit	No lights
Excessive input voltage greater than 6 V	Both red and green lights lit
Alternating between high state and indeterminate state	Blinking red light
Alternating between low state and indeterminate state	Blinking green light
Single or very low duty cycle logic pulse	Using STORE mode, one light will be on initially. Event has occurred when second light is lit.

SPECIFICATIONS

Low State Input Voltage Range — 0 V to +0.7 V ±0.125 V.

High State Input Voltage Range — 2.175 V ±0.125 V to Vcc.

Minimum Recognizable Pulse Width — 10 ns.

Impedance — ≈ 7.5 kΩ paralleled by ≈ 6 pF.

Minimum Circuit Resistance for Open Circuit Indication — 10 kΩ.

Max Safe Input — ±150 V (dc or rms).

Minimum Recognizable Strobe Pulse Width — 20 ns.

Max Safe Strobe Input — ±30 V (dc or rms).

Strobe Input Impedance — 5.6 kΩ within 20%.

ORDERING INFORMATION

P6401 5 ft Probe (010-6401-01) **$90**

Includes: Hook Tip (206-0114-00)
Strobe Lead (175-0958-01)
Strobe Lead (175-0958-00)
Probe Tip to 0.025 in square pin adapter (206-0137-01)
White Plug (348-0023-00)
2 Alligator Clips (344-0046-00)
Accessory Pouch (016-0537-00) not shown

Information Display Group Products

Tektronix Information Display Group offers a wide range of graphic systems, terminal, and peripheral products to meet your professional and processing needs. Included in the following pages are a few of the Group's most recent developments as well as our successful, time-proven products presently at work in a variety of applications. Whether the 4081's interactive graphics, the 4051's computational, desktop capability, or the 4006-1's low-cost, graphics capability fit your particular application, you can rely upon Tektronix to provide a full line of low-cost equipment for your graphic needs.

For additional product information and details on interface, software, and accessory support, please indicate your interest on the postcard at the back of the catalog.

Information Display Group Products

Interactive Graphics Terminal and Mass Storage Module

Tektronix has merged two significant graphics technologies to create a technological first. The new 4081 Interactive Graphics Terminal is a picture manipulation tool with potential for more productive man/machine interaction. Refresh tube technology provides motion; storage tube technology offers high-resolution graphics, even of complex images.

They come together in the 4081 — you get the advantages of both refresh and storage in one tube. Better still, all the hardware, firmware, and software needed to do the job are combined into an integrated package. You're not buying individually priced components, then linking them.

It's one complete system. The necessary interfaces between hardware and application programs are already built in. Powerful operational software smooths the path from the 4081 to the host computer—and frees your programmers from months of tedious work.

It's the time-saving, cost-saving approach to problem solving for both users and management. System users get an immediate and powerful tool; management gets a fast return on capital investment.

Now, for the first time, sophisticated operational software matches versatile hardware. Together, they form a powerful, functional, and interactive graphics terminal.

Together, refresh and storage graphics create a more effective work environment. Better overall cost effectiveness starts with better man-machine effectiveness. With the 4081, you can work with both fixed and variable factors at the same time. You can move, change, enlarge, rotate, or delete selected portions of a display, while the rest of the picture remains fixed. You can explore alternatives, manipulate, and work with large amounts of data in a more meaningful way when you see both the action and the effect of change.

As a powerful stand-alone picture manipulation tool, or as an intelligent terminal, the 4081 can support any number of diversified working environments. It's designed for optimum flexibility—both for the people who use it, and for the communications environment in which it operates.

The 4081's picture processor and local storage capability combine to lower communications overhead, timesharing costs, and host loading charges. When you work with the 4081, you can do more, faster and without the host, so it measurably reduces the man-hours per job.

Adding optional peripherals takes a couple of extra steps: plugging them in and turning them on.

You get permanent, dry, easy-to-work-with hard copies of information displayed in storage mode on the 4081 screen from the convenient 4631 Hard Copy Unit.

You have several options for adding memory. Start with 32k bytes more on the picture processor, for a total of 64k bytes. A second digital cartridge magnetic tape drive supplements local storage with an additional 256k bytes. And you can go further. Use the 4905 Mass Storage Module to create a total capacity of over 40 megabytes of memory. And, there is a full complement of other peripherals standing by ready to support your precise needs.

The 4641 Printer gives you a quick, quiet, alphanumeric printout—with complete form and format versatility.

The microprocessor-controlled 4662 Interactive Digital Plotter expands your graphics plotting capability with high-speed accuracy and repeatability.

Graphic tablets come in two sizes (11 x 11 or 40 x 30)—either the 4953 or 4954 will provide a fast, accurate, highly versatile way to capture graphic information directly to the 4081.

There's even more: an expansion package with additional power supply; power/fail protection; a programmer's hexadecimal display panel and a variety of PLOT 80 Software products. Enough software for all your applications.

SPECIFICATIONS

Display Medium — Storage and refresh combined on a 19-inch diagonal crt.

Addressable Points — 2048 x 1536 displaceable raster units.

Write Rate — 56,000 vector/cm in refresh and 14,000 vector/cm in storage.

Graphics Resolution — 16 line pairs/cm.

Spot Size — 20 mils, maximum.

Display Processor — 16 general purpose registers, 16 bit words, 104 instructions, 8 interrupt levels, 32k byte MOS memory accommodating up to 8 DMA peripherals.

Display Controller — Maintains a refreshed picture with 352 unique hardware dash patterns; displays a maximum of 64 gray scaling intensities.

Standard System Features —

Asynchronous RS-232 communications interface operating at 110 to 4800 baud in full duplex mode.

Cartridge magnetic tape drive with 256k byte storage capacity.

Alphanumeric keyboard with full upper and lower case ASCII characters.

Twelve programmable function keys.

Joyswitch with terminator button.

Four system status lights.

Graphic Operating System for local picture manipulation and storage.

4014 terminal simulation.

Input Power — 115 volts, 30 amperes at 60 Hz, single-phase power (220 V, 50 Hz also available).

Power Consumption — 3450 watts (11,782 btu/hr).

Temperature — +10°C to +35°C (+32°F to +95°F)

Humidity — 0 to 20% (non-condensating).

Altitude — To 15,000 feet (4572 m).

Shock — 20 g's (non-operating).

ORDERING INFORMATION*

4081 Interactive Graphics Terminal . . $27,000

Option 22	32k Byte Additional Picture Data Storage	+3,950
Option 31	Expansion Package	+1,800
Option 32	Power Fail Protection	+600
Option 33	Second Digital Cartridge Tape Drive	+2,495

4905 Mass Storage Module (not shown) $600

Option 31	Dual Flexible Disc	+5,400
Option 32	Two Dual Flexible Discs	+10,800
Option 33	Single Hard Disc	+17,500
Option 34	Dual Hard Disc	+26,500

PERIPHERALS

4631	Hard Copy Unit	$4,295
4641	Printer	$4,495
4662	Interactive Digital Plotter	$3,995
4953	Graphic Tablet (11 x 11 inch)	$3,195
4954	Graphic Tablet (40 x 30 inch)	$5,295

ACCESSORIES

067-0772-00	Hexadecimal Display Panel	$700
067-0794-00	Prom Bootstrap Loader	$1,275
067-0795-00	Custom Extender	$90
062-2775-00	4081 Operators Manual Package (Vol 1)	$425
062-2776-00	Intelligent Graphics Terminal Package (Vol 2)	$400
062-2777-00	4081 Diagnostic Package (Vol 3)	$300
062-2778-00	4081 Overlay Package	$25

SOFTWARE

4080A01 PLOT 80:	Programming Support Package	$3,000
4080A02 PLOT 80:	FORTRAN IV Compiler	$1,500
4080A03 PLOT 80:	Graphics Function Manager	$2,500

*The 4081 and 4905 may not be available in some areas of the world. Consult your Distributor or Representative.

4051

Desktop Computational Power

Alphanumerics and Graphics

High-level BASIC

Up to 32k Work Space

Off-line Intelligence in a Graphics Terminal

A compact, comprehensive package with built-in computational power and high-density desktop graphics.

Up to 32k of work space. Conversational interactivity with high-level BASIC. Complete on-line option. Plus graphic capability. Standard interfacing and peripheral support.

8k of Self-sufficient Processing Power

You can expand your 4051's work space in 8k increments, and tailor your processing power to your application needs. The standard 8k of work space packs enough power to plot over 300 1-inch vectors simultaneously, with room to spare.

BASIC Vocabulary

We've enhanced easy, English-like BASIC with some ordinarily unBASIC graphics extras . . . including functions like WINDOW, VIEWPOINT, and ROTATE, plus file system data access, formatting commands, and a unique interrupt control of the IEC peripherals.

More for The Money

The basic package also includes a built-in 300k-byte capacity cartridge tape unit for extra storage; 20 user-definable functions; ten liner editor functions; full 128-character ASCII with upper-lower case keyboard; IEEE standard (488-1975) rear connector, and much more.

Accessories

Our Data Communications Interface Option makes the 4051 perform functions of our famous 4012 Graphic Display Terminal: edit offline in any language; send and receive in batch, via the internal magnetic tape unit, at asynchronous speeds up to 2400 baud. The RS-232-C Connector Option drives your choice of printer, printing terminal or other compatible peripheral. Add on plug-to-plug peripherals like our 4631 Hard Copy Unit; the 4924 Auxiliary Magnetic Tape Unit for fast data I/O and tape copying; the 4641 Printer for reliable performance at speeds up to 180 cps; the 4662 Interactive Digital Plotter for speed, precision and resolution; the 4956 Graphic Tablet available in a 20″ x 20″ GRIB tablet and a 36″ x 48″ version; the 4952 Option 02 Joystick for positioning the graphic cursor.

Special cables, dust cover, viewing hood, and other accessories are available.

CENTRAL PROCESSING UNIT

Type — LSI Microprocessing Unit.

Work Space Size — 8k bytes standard expandable to 32k bytes.

Programming Language — BASIC with integrated operating system, built-in graphics, and numerous other extensions.

Numeric Accuracy — 14 decimal digits.

Numeric Range — 1 x 10 $\pm^{308}$

INTERNAL PERIPHERALS

Keyboard —

Complete upper and lower case alphanumerics with autorepeating keys. Full ASCII. 128 characters.

10 Function Keys with SHIFT for up to 20 separate function calls.

Five editing keys with SHIFT, control 10 different editing functions used to modify BASIC source programs.

Calculator key pad including 10 key numeric pad, 5 math operator keys, decimal point, and parenthesis.

Control keys — AUTO NUMBER—generates program line numbers automatically; STEP—executes program steps one at a time; AUTO LOAD—automatically loads and runs File 1 on tape; REWIND—rewinds tape; MAKE COPY—activates optional 4631 Hard Copy Unit.

DISPLAY CHARACTERISTICS

Type — Direct view storage crt.

Dimensions — 8 in wide by 6 in high (20.3 cm x 15.2 cm).

Alphanumeric Format — 72 characters per line, 35 lines; 2520 total.

Character Set — Full ASCII character set, including upper/lower case. Also includes Scandinavian, German, General European, and Spanish fonts.

Graphic Resolution — 1024 x 780 points.

Hard Copy — Compatible with our 4631 Hard Copy Unit.

TAPE DRIVE

Type — 3M DC300A cartridge.

Capacity — 300k bytes max (dependent on number of files).

System Characteristics — File structures for storage of programs or data. Access is via 4051 BASIC operating system.

GENERAL-PURPOSE INTERFACE BUS (GPIB)

Specifications — Conforms to IEEE standard 488-1975. Byte serial, bit parallel transfer mode.

Control Mode — External devices can be serviced via interrupt procedures available in the BASIC operating system. Enable/disable, polling, and data transfer commands are available under program control.

4051R01 Matrix ROM — Supplements the 4051 with five commonly used matrix functions: multiply, transpose, inverse, determinant, and identity.

4051R05 Binary Program Loader ROM — May be used to rapidly store and load programs in binary machine code allowing the programs to bypass translation during a SAVE process.

4051R06 Editor ROM — May be used to expand the capabilities of the 4051 by editing text that is collected and stored on the 4051 tape.

PHYSICAL CHARACTERISTICS

Height — 13.6 in (34.5 cm).

Width — 18.3 in (46.5 cm).

Length — 32.5 in (82.6 cm).

Net Weight — 65 lb (29.5 kg).

Shipping Weight — 81 lb (36.8 kg).

ORDERING INFORMATION

4051 Graphic System $7500
Option 01 Data Communications Interface . . add $1500
Option 10 RS-232 Printer Interface . . . . . add $550
Option 20 4051 with 16k byte memory* . . . . . add $2150
Option 21 4051 with 24k byte memory* . . . . . add $3350
Option 22 4051 with 32k byte memory* . . . . . add $4550

SOFTWARE

4050A01 PLOT 50: Statistics, Vol. 1 . . . . . $350
4050A02 PLOT 50: Statistics, Vol. 2 . . . . . $350
4050A03 PLOT 50: Statistics, Vol. 3 . . . . . $600
4050A10 PLOT 50: Statistics. Vol. 4 . . . . . $600
4050A13 Statistics Library $1550
4050A04 PLOT 50: Mathematics, Vol. 1 . . . . . $300
4050A05 PLOT 50: Mathematics, Vol. 2 . . . . . $400
4050A14 Mathematics Library $600
4050A15 Scientific Library $2400
4050A06 PLOT 50: Electrical Eng., Vol. 1 . . . . . $300
4050A07 PLOT 50: Graph Plot $350
4050A08 PLOT 50: Gen. Util. Prgm., Vol. 1 . . . . . $275
4050A09 PLOT 50: Business Planning & Analysis, Vol. 1 . . . . . $350

ROM PACKS

4051R01 Matrix Function ROM Pack $350
4051R05 Binary Program Loader ROM Pack $200
4051R06 Editor ROM Pack $600

**The same item ordered after the 4051 is delivered is available as an accessory at a higher price because of field installation or special handling.*

4006-1

High Resolution

Graphics and Alphanumerics

The 4006-1 sets a new standard in the development of low-cost graphics. It is the first terminal to consolidate graphics, alphanumerics, and Tektronix quality at a price competitive with terminals offering alphanumerics alone.

A software package that makes graphics easy for nonprogrammers, and which multiplies the capabilities of the experienced programmer, the PLOT 10 Interactive Graphing Package (IGP), provides easy-to-learn, English language structured commands that enable the user to construct, edit, save, and recall graphs in a conversational relationship with the computer.

The IGP software package provides the power to read data and commands from file; edit graphic data points; and update and compare graphs from storage.

Peripherals for the 4006-1 include the 4631 Hard Copy Unit, or the 4923 Digital Cartridge Tape Recorder for 200k-bytes of data storage on each tape.

SPECIFICATIONS

Display Medium — Direct view bistable storage crt.

Display Area — 7.5 in wide x 5.6 in high (19.1 cm x 14.2 cm).

Alphanumeric Mode Format — 35 lines, 74 characters per line, 2590 characters full screen.

Character Set — 63 printing characters (TTY ASCII Code).

Character Generation — 5 x 7 dot matrix.

Cursor — 8 x 8 dot matrix.

Graphics Display Mode — Vectors only. Vector drawing time, 3.6 ± 0.2 ms.

Information Density — 1024 X by 1024 Y addressable points. 1024 X by 780 Y viewable points.

Baud Rate — Transmit and receive independently selectable from 75 to 4800 baud.

Input Power — 110/240 V ac (Low, Medium, High) 50 to 440 Hz, 105 W.

Interfacing — The 4006-1 is shipped with a Standard Data Communication Interface, with inputs and outputs conforming with EIA RS-232-C.

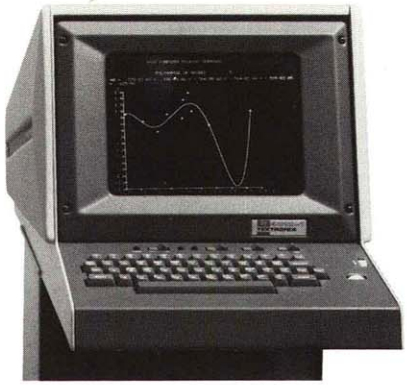
Peripherals — The 4006-1 is compatible with the 4631 Hard Copy Unit, for dry, high-quality, 8½ x 11 in copies of any information displayed on the 4006-1 screen.

The 4923 Digital Cartridge Tape Recorder, a low-cost off-line data storage device, is also compatible with the 4006-1.

ORDERING INFORMATION

4006-1 Computer Display Terminal . . . $2995

Option 01, Half Duplex Module . . . . . Add $325



4010-1

Supports Alphanumeric Plus Low-Cost Computer Graphics

Convenient Pedestal Design for User Environments

Flicker-Free Storage Display

Complete PLOT 10 Software Support

With its low price, the 4010-1 Computer Display Terminal is a data-handling tool of great capacity and flexibility. The pedestal minibus design opens the way to a variety of system concepts.

A wide variety of peripherals can be interfaced easily: 4631 Hard Copy Unit, 4662 Interactive Digital Plotter, 4923 Digital Cartridge Tape Recorder, 4953/4954 Graphic Tablets, and 4921/4922 Flexible Disc Memory Units.

The Keyboard — The 4010-1 has a TTY style keyboard featuring 63 printing characters (including upper case alphanumerics), and standard ASCII control characters. Independently operated X and Y axis thumbwheels position the Graphic Cursor in the Graphic Input Mode.

Operating Modes — Three operating modes can be selected from the keyboard or the computer. In Alphanumeric mode, 35 lines of 74 characters each constitute a full display screen. In Graphic Display mode, the terminal produces clear, accurate vector displays in response to computer commands. In Graphic Input Mode, operator/computer interactivity is permitted.

DESIGN CHARACTERISTICS

Screen Size — The screen is a direct-view storage 7-1/2 inches wide x 5-3/5 inches high.

Format — The 4010-1 allows 74 characters per line, and 35 lines (2590 characters) per full screen.

Character Set — Includes 63 printing characters (TTY ASCII Code).

Character Generation — 5 x 7 dot matrix. Up to 1200 characters per second.

Graphic Display Mode — Vectors only. There are 1024 X by 1024 Y addressable points, and 1024 X by 780 Y viewable points.

Graphics Input Mode — A thumb-wheel controlled cursor for 3 through 1023 X, and 0 through 780 Y addressable points.

ORDERING INFORMATION

4010-1 Computer Display Terminal with Standard Data Communications Interface $4950

4012

High Resolution Flicker-Free Graphics

Attractive Upper and Lower Case Alphanumerics

Proven High Quality and Performance

The 4012 Computer Display Terminal offers all the capabilities of the 4010-1 plus several valuable enhancements. For attractive alphanumerics, the 4012 offers the full ASCII set of 96 upper and lower case printing characters, drawn using a 7 x 9 dot matrix, plus the standard ASCII control characters. By enabling a special TTY lock key, you may use a TTY upper case subset. For convenience, all keys offer character repeat when held down. The 4012 is also easily interfaced to the same peripherals as the 4010, and supported by the complete PLOT 10 Family of software products.

Operating Modes — Alphanumeric mode uses the full upper and lower case ASCII character set, or the TTY upper case subset. In Graphic Display mode, vector displays are drawn in response to computer commands. In Graphic Input mode, the thumbwheel controlled cross-hair cursor can be positioned on the display, for operator/computer interactivity.

DESIGN CHARACTERISTICS

Screen Size — The screen is a direct-view storage crt 8¼ in wide x 6⅜ in high.

Character Set — The 4012 has 96 printing characters on a 7 x 9 dot matrix. (Full ASCII Code).

Graphic Display Mode — Vector drawing time, 2.6 ms.

Graphic Matrix — There are 1024 X by 1024 Y addressable points, and 1024 X by 780 Y viewable points.

Graphics Input Mode — A thumb-wheel controlled cross-hair cursor.

ORDERING INFORMATION

4012 Computer Display Terminal with Standard Data Communications Interface $6350

R4012 Computer Display Terminal with Standard Data Communications Interface (Rackmount) $6750

4013

4012 High Performance Plus APL Character Set

APL (A Programming Language) is a highly interactive, problem-solving language which lends itself ideally to graphic display of computer data.

The 4013 Computer Display Terminal is especially designed to be used with APL, in addition to the complete ASCII upper and

lower case character set and the TTY subset. The 88 symbol APL set includes the complete upper case italic alphabet, number set, special APL function symbols, and APL composites.

The Keyboard — The 4013 has APL symbols on the top surfaces of the keys, and the ASCII symbol differences on the forward surfaces. Graphic cross-hair cursor controls and character repeat are also featured on the 4013 keyboard.

Operating Modes — The 4013 offers Alphanumeric mode, Graphic Display mode for computer outputs, and the interactive Graphic input mode.

DESIGN CHARACTERISTICS

Screen Size — The screen is a direct-view storage crt 8¼ in wide x 6⅜ in high.

Character Set — Includes 96 printing characters on a 7 x 9 dot matrix (full ASCII code), and 88 character APL set.

Graphic Display Mode — There are 1024 X by 1024 Y addressable points, and 1024 X by 780 Y viewable points.

Graphics Input Mode — The 4013 has a thumb-wheel controlled cross-hair cursor.

ORDERING INFORMATION

4013 Computer Display Terminal with Standard Data Communications Interface . $6850

R4013 Computer Display Terminal with Standard Data Communications Interface (Rackmount) $7250

PLOT 10 SOFTWARE
FOR 4010-SERIES TERMINALS AND THE 4006-1

Tools for easy use of graphic and alphanumeric capabilities of TEKTRONIX Terminals.

4010A01 PLOT 10 Terminal Control System $650

4010A10 PLOT 10 Terminal Control System, Implementation for IBM with TSO $850

4010A11 PLOT 10 Terminal Control System, Implementation CDC SCOPE/Intercom with Option 20 Interface $850

4010A12 PLOT 10 Terminal Control System, Implementation for PDP-11 with DOS $850

Versatile software to graph your data using a powerful set of FORTRAN IV sub-routines.
4010A02 PLOT 10 Advanced Graphing II $850

Powerful graphing through English language commands for the non-programmer.
4010A03 PLOT 10 Interactive Graphing Package $1200

Correct your graphics easily with a TEKTRONIX Terminal before plotting.
4010A04 PLOT 10 Preview Routines for CalComp Plotters $110

Provides complete flexibility of character definition, including rotation, scaling, and special characters.
4010A05 PLOT 10 Character Generation System . . $160

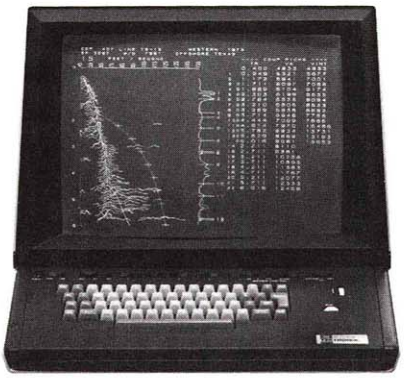
Point by point TEKTRONIX 4953 and 4954 support, plus pencil and paper input ease for many computer systems.
4010A06 PLOT 10 Graphic Tablet Utility Routines $125

Support for graphic files and easy installation are featured by current software.
4010A07 PLOT 10 Flexible Disc Utility Routines . . $160

Individual addressing of up to 12 Tektronix displays.
4010A08 PLOT 10 Display Multiplexer Utility Routines $110

Complete support for TEKTRONIX 4013 and 4015 with self documenting commands, for the APL Programmer.
4010A09 PLOT 10 APL GRAPH-II $650

4010A13 PLOT 10 APL GRAPH-II, Implementation for APL/360 . . . . . $850



4014-1

Large Screen Direct-View Storage Display

Program-Selectable Formats in Alphanumeric and Graphic Modes

Vector and Discrete-Plot Graphic Modes

High-Resolution, Attractive, Flicker-Free Interactive Graphics

This TEKTRONIX 19-inch Computer Display Terminal is the most effective way to display a large data base. The 4014-1 offers the complete ASC11 upper and lower case character set, plus the TTY upper case subset.

The 4014 is easily interfaced to our same full line of peripherals as the 4010 and supported by the PLOT 10 family of software products.

The Display — A direct view 19-inch storage display tube allows up to 8512 alphanumeric characters, and four different character sizes. The 4014-1 has two display modes and the option of five vector types for graphic display.

DESIGN CHARACTERISTICS

Screen Size — A direct-view storage crt, 15 in wide x 11 in high.

Character Set — Includes 96 characters (full ASCII upper and lower case, plus a TTY subset).

Vector Mode — There are 1024 X by 1024 Y addressable points, and 1024 X by 780 Y viewable points.

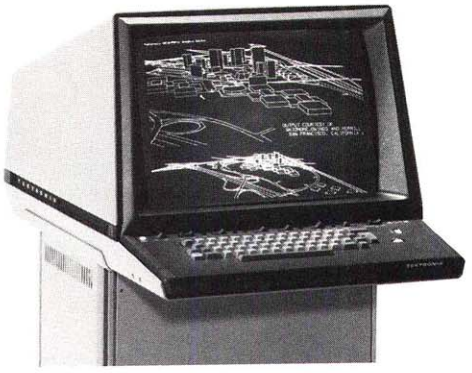
Graphics Input Mode — Thumb-wheel controlled cross-hair cursor for 3 through 1024 X, and 0 through 780 Y addressable points.

4014-1 Enhanced Graphics Module, Option 34 — With this extra-cost option, capacity is extended to 4096 X by 4096 Y addressable points, and 4096 X by 3120 Y displayable points. Dotted and dashed line vectors (five variables). Three point plotting codes allow program control of Writing Beam Brightness.

ORDERING INFORMATION

4014-1 Computer Display Terminal with Standard Data Communications Interface $11,650

Option 34, Enhanced Graphics Module (Factory Installed Only) . . . . . Add $750



4015-1

Full APL and ASCII Character Sets

4014-1 High Performance plus APL Character Set

Interactive Graphics Capability

The 4015-1 Computer Display Terminal adds the powerful problem-solving APL Language to the increased display power of the 19-inch screen, along with the full ASCII upper and lower case set and TTY subset.

The 4015-1 is compatible with the 4631 Hard Copy Unit to provide permanent copies of display information.

The Display—The 19-inch display is a direct-view storage tube with a capacity of up to 8512 characters. The 4015-1 has four different sizes of character display, two display modes, and five vector types for graphic display.

Operation Modes — The 4015-1 functions in three modes: the Alphanumeric Mode, Graphic Display Mode for computer outputs, and the interactive Graphic Input Mode. Data received may be displayed alphanumerically or graphically.

DESIGN CHARACTERISTICS

Screen Size — The screen is a direct-view storage crt 15 in wide x 11 in high.

Character Set — Includes 96 characters (Full ASCII upper and lower case), a TTY subset, and an 88 character APL set.

Vector Mode — There are 1024 X by 1024 Y addressable points, and 1024 X by 780 Y viewable points.

Graphics Input Mode — A thumb-wheel controlled cross-hair cursor for 3 through 1024 addressable points horizontally, and 0 through 780 addressable points vertically.

4015-1 Enhanced Graphics Module, Option 34 — Expands capabilities to 4096 X by 4096 Y addressable points, and 4096 X by 3120 Y displayable points. Dotted and dashed line vectors (5 variables), three point plotting modes allow program control of Writing Beam Brightness.

ORDERING INFORMATION

4015-1 Computer Display Terminal with Standard Data Communications Interface $12,700

Option 34, Enhanced Graphics Module (Factory Installed Only) . . . . . Add $750

4631

Dry Process

8½ x 11 Inch Copies

Supports up to Four Terminals

The 4631 Hard Copy Unit is compatible with the 4051, 4081, the 4006-1, 4010 family of display terminals and the 613 and 613-1 Storage Display Units. The 4631 provides permanent dry copies of any information displayed on the terminal screen. For greater flexibility it can also be multiplexed to make copies from up to four display terminals and/or display monitors. When you need to keep records, or present information a touch of the button gives you copies of any displayed data quickly and easily.

The 4631 uses 3M Brand 7770 Dry-Silver paper to give you the high-image contrast you need for complex graphics and alphanumerics.

The 4631's copy time is 18 seconds for the first copy, and 10 seconds for subsequent copies.

CHARACTERISTICS

Paper Size — 8½ x 11 in.

Copy Size — Position I and III produces an 8.85 x 6.7 in copy, oriented horizontally on an 8½ x 11 in piece of paper. Position II produces a 7.1 x 5.4 in copy, oriented vertically on an 8½ x 11 in piece of paper — not recommended for 19 in display tubes.

Exposure Time — Position I and II approx 7 s, position III approx 14 s.

Dimension — (Height, width, length) 11.6 x 16 x 25.5 in (29.5 x 40.6 x 64.8 cm).

Weight — Approx 65 lb (29.5 kg).

Standard Accessories — One 10 ft Connecting Cable (012-0547-00).

ORDERING INFORMATION

4631 Hard Copy Unit $4295

Option 01 — Copy Counter—Automatically counts the copies made by the 4631 . . . . . **Add $60**

Option 02 — Four Channel Multiplexer . . . . . **Add $575**
One 4631 can copy up to 4 separate terminal displays and/or storage display units.

4023

Low Cost Refreshed Versatility

Upper and Lower Case Capability

With Built-in Forms Ruling

The TEKTRONIX 4023 is a general-purpose alphanumeric, refreshed terminal with all the built-in features of a refreshed terminal — it is quiet, bright, and buffered, plus it has other features which are oriented toward rapid error-free data base entry and retrieval operations.

The 4023 keyboard provides selection of the full ASCII set of 96 printing characters, or the 63 character TTY upper case subset. Additional features of the keyboard include two-key roll-over and autorepeat for any keys depressed over 0.3 second.

The memory (buffer) of the 4023 allows space for 24 lines with 80 characters each, providing a total of 1920 characters.

Field and Data Formatting — Displayed data can be arranged to resemble the source document. Forms information can then be rapidly retrieved, updated, edited, and entered. Visual field formats include: inverted, blinking, blanked, and dim fields.

Interfacing — Provided by two data communication interfaces for telephone line connection. One is the Standard Data Communications Interface supplied with the 4023 if no interface option is specified. Also available is an optional Data Communications Interface with added features for full- or half-duplex data communication system operations.

The Display—A refreshed crt, 9 inches wide by 5.5 inches high, P-4 type phosphor.

Video — Composite Video compatible with standard interlaced 525 Line Monitor.

ORDERING INFORMATION

4023 Computer Display Terminal, Includes Rulings Character Set $3495

Optional Data Communications Interface . . . . . Add $350

4632

Permanent 8½ in x 11 in Gray Scale Copies from Standard Video Signals and Most Refreshed Terminals

Simple, Quiet Operation

Completely Self-Contained Dry Process Developing

The 4632 Video Hard Copy Unit provides permanent hard copies from standard composite video signals and from digital video signals of most refreshed alphanumeric/graphic terminals. The 4632 provides both high contrast (black and white) or gray scale copies. The 4632 development is a dry process and is completely self-contained, and quiet. The 4632 is easily interfaced to a video system or refreshed terminal by a single cable. As an option, it can be multiplexed to provide copying capability from one to four video sources.

DESIGN CHARACTERISTICS

Standard Copy size adjustment is 8½ in by 11 in for horizontal raster display (4:3 aspect ratio). Copy time is approx 18 s for the first copy and about 8 s for additional copies of the same display. Machine warm-up time is 20 min. The recommended ambient temperature for operation is 0°C to +35°C.

Input Requirements — Input signals may be any one of three configurations: composite video, video with horizontal and vertical drive, or video with composite sync. Input video amplitude is from 0.3 V to 5 V. Impedance is 75 ohms, loop-through. Return loss is at least 46 dB. Common-mode rejection is at least 30 dB. Max input is 10 V dc plus peak ac. Input sync amplitude is 0.3 V to 8 V p-p; impedance is 20 kΩ.

Power Requirements — The 4632 operates on 110-115 V ac, or 200-230 V ac, 50-60 Hz; these are factory wired options.

Included Accessories — One 75 ohm termination.

ORDERING INFORMATION

4632 Video Hard Copy Unit $3995

Option 01, Copy Counter . . . . . Add $60

Option 02, 4-channel Multiplexer . . . . . Add $575

Option 03, Set up for 625 Line, 50 Hz Field Operation . . . . . No charge

Option 04, Set up for 1029 Line, 60 Hz Field Operation . . . . . No charge

Option 05, Compatible with TEKTRONIX 4023 Terminal . . . . . No charge

Option 06, Enhanced Gray Scale . . . . . Add $200

Option 07, Compatible with HP 2640 Series Terminals . . . . . Add $100

Paper — One roll is included with the 4632. Refills are available from Tektronix, Inc.

For one roll, Order 006-1603-00 . . . . . $50

For one carton of four rolls, Order 006-1603-01 . . . $180

4662

Microprocessor Based

7-Character Fonts

RS-232-C and GPIB Compatible

The new TEKTRONIX 4662 Interactive Digital Plotter is microprocessor based, interactive, flexible in capabilities, and easy to use. It extends high industry standards which include:

10 in x 15 in drawing area
0.005 inch resolution ±0.0025 inch repeatability
1:1 reproduction of crt displays up to 19 in diagonal
Convenient, electrostatic positioning
16 to 22 ips

It is plug compatible with many Data Communications Systems (RS-232-C, Full Duplex) and with the TEKTRONIX 4051 and IEEE 488-1975 interface standard. It offers systems flexibility and the following pacesetting characteristics:

The Fully Resident Internal Character Generator
Excellent Quality Character Reproduction
Easy Labeling from Terminal Keyboard
Labeling of Curves without Loss of Spacing
Exact Sizing to 'Fit' Any Graph or Plot
1600 byte buffer

Its prime advantage as a digitizer (tablet) and plotter is in applications requiring reduced system cost and reduced space requirements. In many uses, the 4662 can function as a stand-alone terminal.

Specific 4662 product capabilities include:
Accommodation of Formatted Media
Easy Ratio Selection
Multiple Images
Calibration to Scale
Allowance for Up-Dating or Changes on Back of Mylar Master Plot
Improved Reliability
90 watts maximum, 60 watts typical power requirement
30 lb, 13.8 kg Approx Weight
UL Listed, CSA Approved

ORDERING INFORMATION

4662 Interactive Digital Plotter $3995

Option 01, Interactive Digital Plotter (for 4051 Graphic System) . . . . . Add $500

4931

The 4931 Modem is available as an option installed internally in 4010 Family terminals or in stand alone form as pictured above. These Bell compatible Modems are available in 300 baud full duplex, 1200 baud half duplex, and 1200 baud half duplex with supervisor channel. All are designed to work on unconditioned voice grade phone lines with a DAA (Direct Access Arrangement).

ORDERING INFORMATION*

4931 Modem (300 baud full duplex) . . . $400

4931 Option 01 (1200 baud half duplex) . . . . . Add $350
4931 Option 02 (1200/5 baud half duplex) . . . Add $450
When ordered as an integrally installed modem in a 4010 family terminal:
Option 37 (300 baud full duplex) . . . . . Add $350
Option 38 (1200 baud half duplex) . . . . . Add $700
Option 39 (1200/5 baud half duplex) . . . . . Add $800

**Communication protocalls supported by this product may not be appropriate in some areas of the world. Consult your Distributor or Representative.*

4921/4922

The Flexible Disc Memory is for users who need a convenient, user-controlled storage system for off-line or auxiliary use. The Disc Memory consists of one or two disc drive units, plug-in circuit boards, and its own interfacing board, which slides into the 4010-Series Terminal.

The Memory has its own power supply and interface electronics to make it a versatile local memory and terminal driver. The user has full control.

The Memory can store data from any of the terminal keyboards, and send data up onto any terminal screen. It can also send data to (or receive it from) a computer.

The 4922 (the two-disc drive model) can duplicate discs and store or send lengthy, continuous data streams. Either Memory can replace a paper tape device with few, if any, software changes.

The Memory has a "read-after-write" feature and a Disc/Error light for an extraordinarily safe 10^{-8} error rate.

Number of data tracks: 64

Number of sectors/track: 32

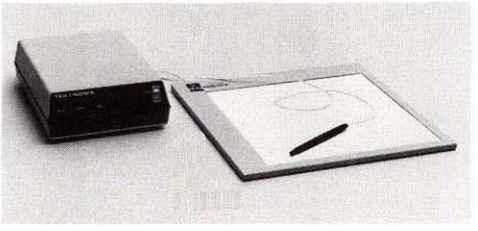
8 bit bytes per sector: 128

Total disc capacity: 262,144 bytes

ORDERING INFORMATION

4921 Flexible Disc Memory (Single Drive with Interface) $3995

4922 Dual Flexible Disc Memory (Dual Drive with Interface) $6355



4953/4954

Single Point Entry

Multiple Point Entry

Tracking (Continuous) Entry

Local Display

The Graphic Tablet comes complete with its own electronics, one of two input device options, and easy-to-follow set-up instructions.

Choice of a pen for the ultimate in convenience, or a pushbutton cursor where exacting accuracy is required. Keep pen to tablet to get instant vectors, or lift the pen between inputs for separated points. You can input points, or all of anything you put on the tablet, including maps, graphic hard copies, drawings, schematics, designs. Select options from a written "menu" placed on the Graphic Tablet. Use it for fast digitizing, freehand graphics, etc. Use it to get numbers out of any graphic display. You can store these inputs, recall them later, and make hard copies of them, just like any other graphics.

Two sizes of tablets are available: the 11 x 11 inch model 4953, or the drawing board size 40 x 30 inch model 4954.

Either Graphic Tablet is compatible with the entire family of TEKTRONIX Graphic Display Terminals. TEKTRONIX PLOT-10 Software effectively supports operation of the Graphic Tablet in the vast majority of mini- and major-computer environments.

ORDERING INFORMATION

4953 Graphics Tablet (with Interface) 11 in x 11 in $3195

4954 Graphics Tablet (with Interface) 40 in x 30 in $5295

Cursor (119-0622-00) $235

4923

RS-232-C Compatible

200,000 Characters of Storage

The 4923 Digital Cartridge Tape Recorder is the perfect step up in storage to team up with our 4010 family of terminals, or any system using an RS-232-C interface. Each tape cartridge can hold 200,000 characters in high-density storage. Each data file has a variable number of formatted records.

This is the perfect medium for local program storage, and a means to get better mileage out of your system — previewing and editing data before you go to the central processor.

Use the 4923 on audit trail to record all the data coming in from the central processor and terminal, or from our graphics terminal/tablet system. All transactions become a matter of record, so you can debug and alter later, if it's necessary.

The standard model hooks up directly to the 4010-Series terminals through the terminal bus; Option 01 uses an RS-232-C Data Communications Interface. Our standard version operates at approx 10k baud, while Option 01 lets you select the baud rate, from 110 to 9600.

SPECIFICATIONS

Tape Length — 300 usable ft.

Storage Capacity — 200,000 bytes (nominal).

Characters/Record — 128 eight-bit bytes.

Recording Density — 1600 bpi.

Data Transfer Rate —
Internal—48 kHz.
External—Standard, up to 10k baud. Option 01, 110 to 9600 baud selectable.

Data Format — 8-bit binary or 8-bit ASCII.

Data Integrity — Performs a read-after-read error check when an error is detected.

Number of Tracks — One effective data track.

Recording Format — NRZ two-track self-clocking.

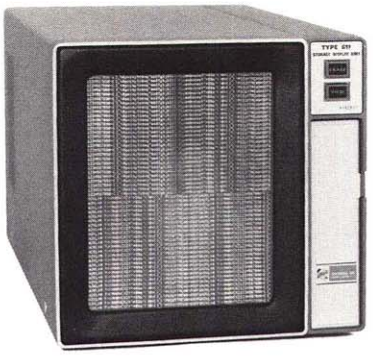
Dimension — Width: 8.75 in; depth: 17.25 in; height: 6 in; weight: 17 lb.

Standard Accessory — One data cartridge.

ORDERING INFORMATION

4923 Digital Cartridge Tape Recorder $1995

Option 01, RS-232-C Compatible . . . . . No charge



611

High-Resolution Alphanumeric and Graphic Displays

Flicker-Free Bistable Storage

Eliminates Costly Memory Devices

Hard-Copy Compatible

Remote Programming of Display Functions

The 611 Storage Display Unit provides stored displays of combined alphanumeric and graphic information from digital computers having D/A converters and from analog signal sources. The stored display eliminates the need for costly memory devices to refresh the display, and provides high information density with excellent resolution without flicker or drift. All 611 control functions (Erase, Write-Thru, Nonstore, and View) are remotely programmable.

DESIGN CHARACTERISTICS

The 611 uses an 11 in (diagonal measure) flat-faced storage tube. Resolution is 4000 characters, based on a 70 x 90 mil dot matrix; this is equivalent to 400 vertical by 300 horizontal (300 vertical by 400 horizontal for the 611-2) stored line pairs. Dot writing time is 5 μs or less; erase time is 500 ms or less. Viewing time is 15 minutes without loss of resolution but may be extended to one hour.

Vertical and Horizontal Amplifiers — The deflection factor is 1 V full scale, either axis. Any of 9 adjustable initial beam positions can be selected by internal switches. Input R and C is 100 kΩ shunted by approx 70 pF.

Z Axis Amplifier — Input turn-on level (unblanked) is + 1 V; turn-off level (blanked) is + 0.5 V or less. Input R and C is the same as the Vertical and Horizontal amplifier.

Other Features — A busy signal is provided at the rear connector to inhibit external equipment (computer, etc) during the erase cycle.

Power Requirements — The 611 operates on 110 or 220 V ac (LO, MED, HI) 48 to 66 Hz, and requires 250 W at 115 V, 60 Hz.

Included Accessories — Program connector; connector cover, and maintenance manual.

ORDERING INFORMATION

611 Storage Display Unit (Vertical Format) $3950

611-2 Storage Display Unit (Horizontal Format) $3950

613

Bright Flicker-Free Viewing

Low Cost

Storage Economy

Hard-Copy Compatibility

Remote Programming of Display Functions

The 613 Storage Display Unit is a bright large screen data storage display unit which allows satisfactory viewing under high ambient light conditions. It is ideal for storing and presenting a substantial amount of data in a single display. The 613 provides greater stored display brightness of alphanumeric and graphic information from digital computers having D/A converters and from analog signal sources.

The TEKTRONIX 4631 Hard Copy Unit will copy the 613 Display Monitor.

DESIGN CHARACTERISTICS

The 613 uses an 11 in (diagonal measure) flat-faced crt, with resolution equivalent to 200 vertical by 266 horizontal line pairs. Viewing time is 15 minutes; longer viewing may require more than one erasure to clear previously stored data. Dot writing time is 5 μs or less; erase time is 900 ms or less.

Vertical and Horizontal Amplifiers — The deflection factor is 1 V full scale, either axis. Any one of nine initial beam positions may be internally selected. Input R and C is 20 kΩ minimum, shunted by less than 60 pF.

Z Axis Amplifier — Beam turn-off (unblanked) level is + 1 V; beam turn-off (blanked) is + 0.5 V or less. Input R and C is 10 kΩ shunted by approx 50 pF. A TTL LO input circuit may be selected to turn on the crt writing beam.

Other Features — All 613 operating modes (Erase, View, Nonstore, Cursor) can be remotely controlled by applying the appropriate ground closures to the remote program connector. All control signal inputs are TTL compatible.

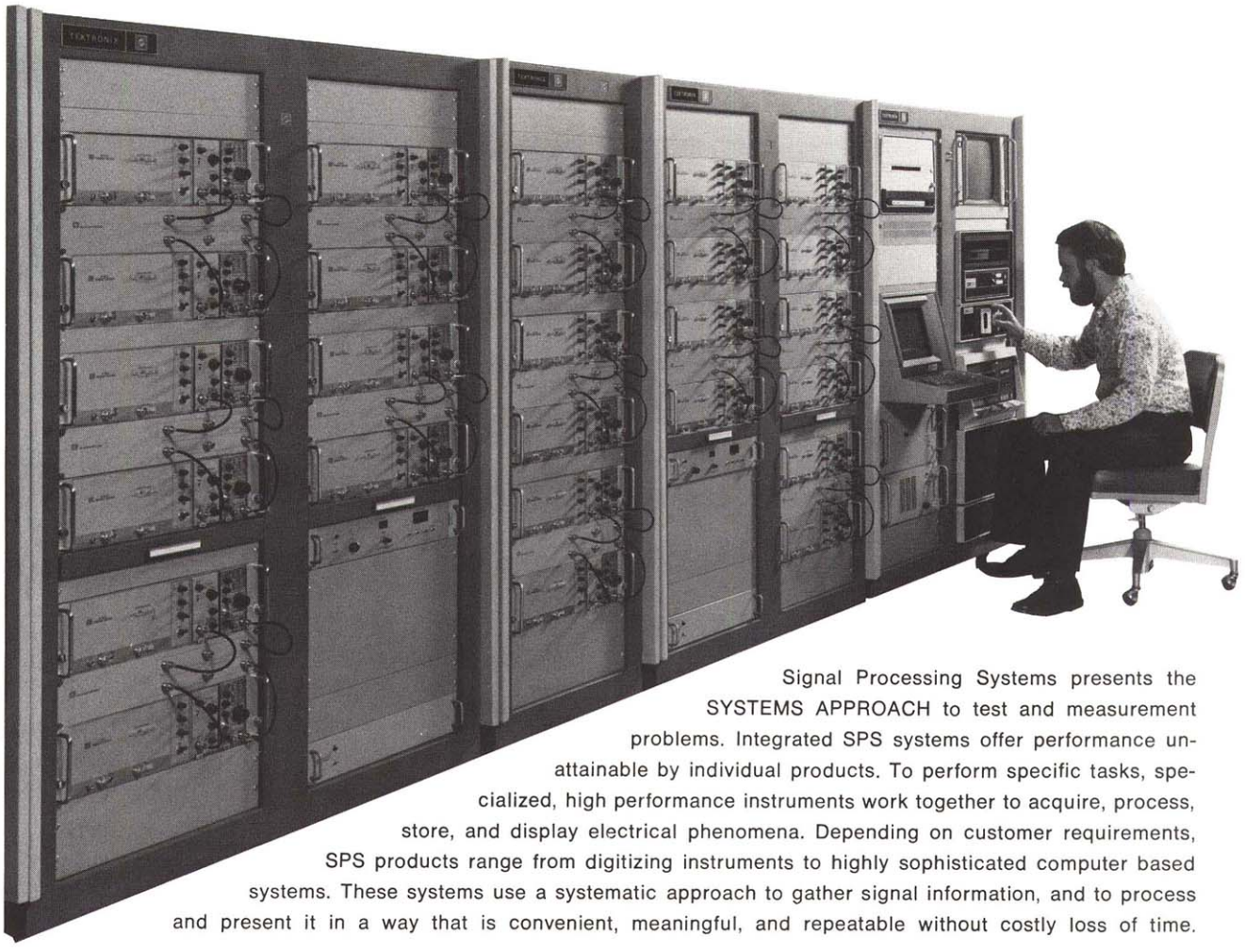
Power Requirements — The 613 operates on 110 or 220 V ac (LO, MED, HI), 48-66 Hz, and requires 180 W (max) at 115 V ac, 60 Hz.

ORDERING INFORMATION

613 Storage Display (Horizontal Format) $3195

613-1 Storage Display (Vertical Format) $3195

Signal Processing Systems
and Digitizing Instruments

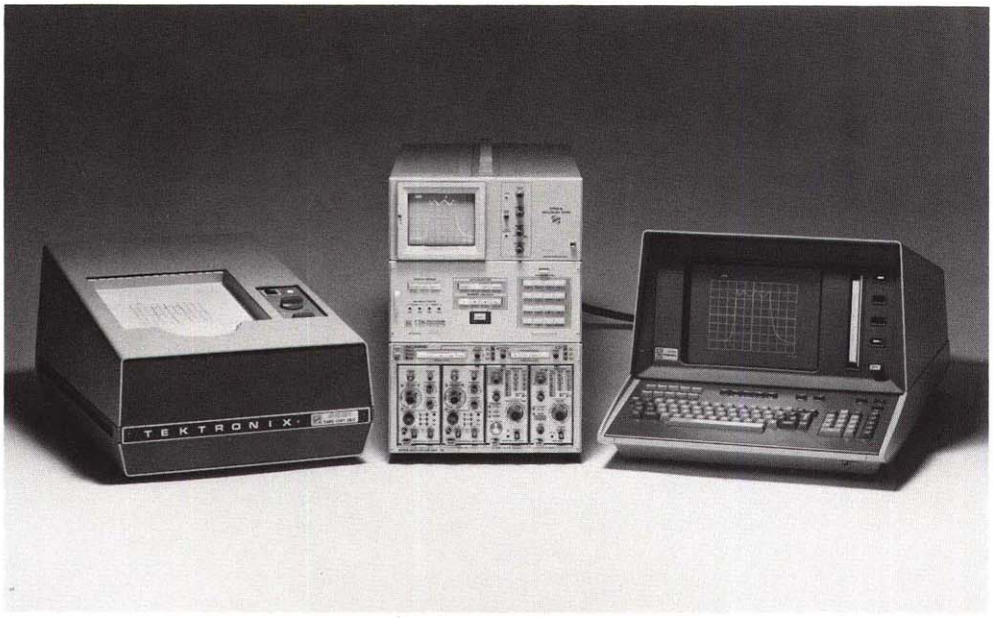


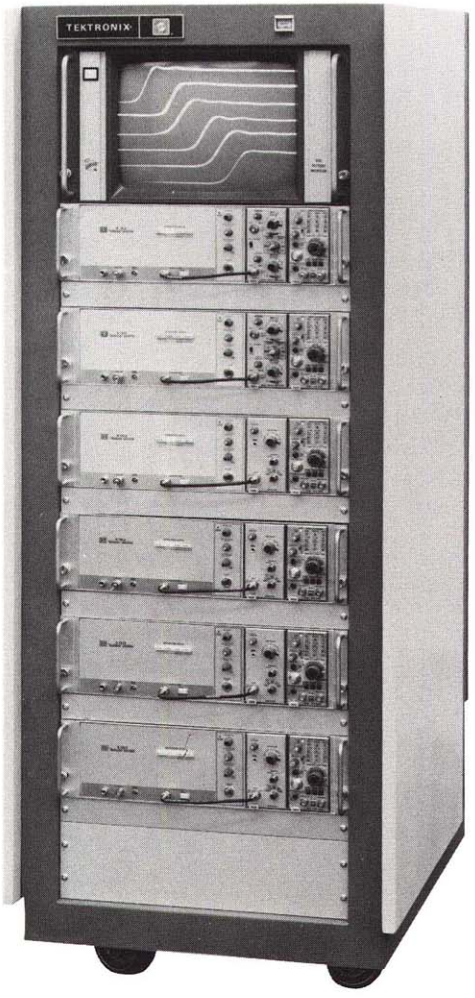
Signal Processing Systems presents the SYSTEMS APPROACH to test and measurement problems. Integrated SPS systems offer performance unattainable by individual products. To perform specific tasks, specialized, high performance instruments work together to acquire, process, store, and display electrical phenomena. Depending on customer requirements, SPS products range from digitizing instruments to highly sophisticated computer based systems. These systems use a systematic approach to gather signal information, and to process and present it in a way that is convenient, meaningful, and repeatable without costly loss of time.

Today's measurements have become so sophisticated that users and buyers of test and measurement products are now asking such questions as, how accurate is accurate? What is the trade off between speed of acquisition and quality of measurement? How much time does it really take to make a real-time analysis? How can you obtain the high accuracy provided by digital instruments while maintaining the interpretive benefit of analog systems?

The Signal Processing Systems group has addressed themselves to just such questions; and by combining analog and digital capabilities systematically, has provided the sophisticated information and performance technologists are demanding today.

To better explain the SPS approach, we begin with digitizing. Digitizing is the process of transforming analog information into a numerical format that the computer, our modern day workhorse, can quickly digest and put to work for us.





The WP2052 CAMAC Compatible WDI configuration is one of a series of SPS products designed for labs that use the CAMAC interface standard, IEEE 538.

Digitizing is not just a tool of the space scientist. We see it work for us everywhere — in our electronic instruments, our industrial machines, our home appliances, our cars. It's a big part of today's technology, a powerful answer to today's and tomorrow's measurement problems. And when you combine digitizing capability with a signal acquisition device and a controller, you have a signal processing system that can acquire, process, store, and display at speeds and levels of complexity never before possible.

Tektronix Signal Processing Systems group offers a number of different types of signal processing systems including waveform digitizing instruments (WDI) and digital processing oscilloscopes (DPO).

To advance technology in numerous disciplines such as physics, chemistry, and electronics, researchers have learned to use a variety of instruments to solve measurement problems. The acquisition of fast transient events is one problem, common to these fields, that has been extremely difficult to solve. The problem is compounded when, in addition to being observed, an event must be analyzed. WDI configurations have been designed to quickly and economically give users the information they need by capturing and processing both transients and repetitive short duration events.

Where masses of analog data must be reduced for analysis, the oscilloscope helps by acquiring and displaying signals to be photographed. Analysis requires a calculator or computer to process the data. However, the analog data must be digitized first, and the digitizing process is long and complex, especially if done by reading coordinates from a waveform photograph.

A better method is to use an oscilloscope and digitize the analog information directly, then process it, and display it in whatever format the user finds best. To accomplish this, Tektronix offers Digital Processing Oscilloscopes, intelligent instruments that provide a flexible two-way link between the analog world of the laboratory oscilloscope and the digital world of machine intelligence.

An important aspect of SPS products is the software. A complete solution of problems associated with waveform acquisition and analysis requires a commitment to both advanced hardware and comprehensive software.

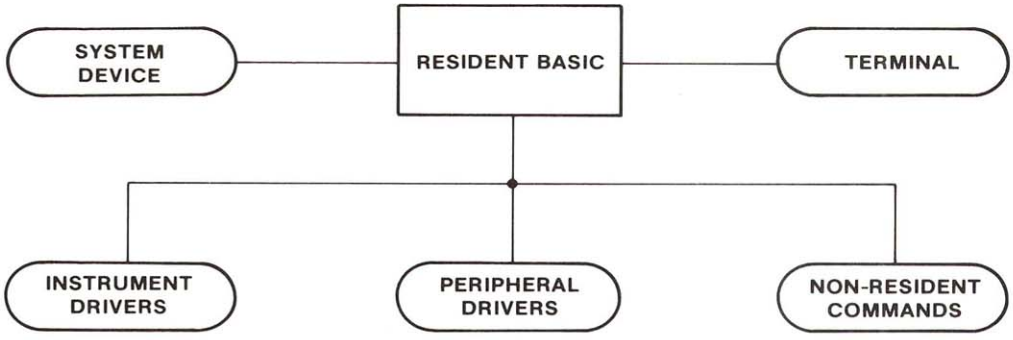
TEK™ SPS BASIC Software is a new generation of instrument control for Signal Processing Systems. It retains many of the standard features of the original Dartmouth BASIC, but includes new features and concepts to make instrument control and waveform processing fast and simple. Capabilities include array and waveform arithmetic operations and functions, character string processing, program text editing, and file manipulations.

Easy to Program

TEK SPS BASIC is interactive. Programming via the graphics terminal enables users, even those without formal computer programming experience, to quickly develop measurement and analysis routines. To assist operators, system commands are provided to edit, store, and retrieve programs easily. In addition, TEK SPS BASIC responds with an error message on the terminal when statements are entered incorrectly.

A key feature in TEK SPS BASIC is modularity. Like oscilloscope plug-ins, modularity allows you to select only those features necessary for a particular job, keeping the greatest amount of computer memory free for data. Drivers (routines that communicate with instruments and peripherals), special BASIC commands, and waveform analysis packages (like Fast Fourier Transforms, Correlations, etc.) are loaded into memory only when needed.

This ability allows you to customize your operating environment to best fit your needs.



Block diagram of TEK SPS BASIC structure. Resident BASIC, including the system device and terminal drivers, is the only software permanently resident in the computer. Everything else is modularized, reserving the maximum amount of memory for programs and data. The loadable modules are divided into three categories. Instrument drivers communicate with data gathering equipment either directly or through a General Purpose Interface Bus. The peripheral drivers handle such devices as disks, papertape, and line printers. The non-resident commands include both standard BASIC commands and special modules for routines such as Fourier transforms, graphics, and user-written routines.

Special Functions

Since waveform processing for analysis often requires a knowledge of mean, minimum, maximum, and rms values, TEK SPS BASIC contains functions for determining those values, and also contains single-word commands for *integrate (INT)* and *differentiate (DIF)*. These functions save a great deal of programming time. There is also a special function, *cross (CRS)*, that can be used for determining the point at which array values cross a specified level.

Fast Fourier Transform

Analysis of waveforms and transients often includes determining the frequency components of acquired time domain data. This can be accomplished with the fast Fourier transform. The inverse Fourier transform is also provided to reconstruct time domain information from frequency domain data. In TEK SPS BASIC, these are simple commands, *FFT* and *IFT*, that do not require tedious programming. Both can be executed by single-word commands, or incorporated easily into longer user programs.

Transfer Function Analysis

A transfer function mathematically describes the response characteristics of a circuit or a system. By measuring and analyzing both the input and output signals, one can develop the signal transfer characteristics of a circuit or system under test. When continuous wave techniques are inappropriate, the transient analysis capabilities of our WDI configurations are required. This is often the case in "real life" environments, and it is in these cases that the SPS WDI waveform analysis systems are most useful. TEK SPS BASIC allows the user to write his own transfer function algorithms. While the transfer function analysis is a complex measurement to perform, it is probably one of the most useful measurement tools available to the experimenter today.

Signals and Noise

Software techniques useful for viewing signals in the presence of noise include signal averaging and correlation. For repetitive signals, averaging can be used to remove uncorrelated noise. In other applications, such as locating an echo following a stimulus pulse (echo ranging with lidar, radar, and sonar), cross correlation can be used. Auto correlation is also provided, and can be used to detect extremely weak signals accompanied by noise, or to detect the presence of unknown periodic signals interspersed among seemingly nonperiodic signals.

Software Digital Filtering

When it is required that a signal be filtered, and it is prohibitively expensive, or not practical to build the desired filters from electronic components, digital filtering often provides a solution. The ability of TEK SPS BASIC to simulate desired circuit effects, through operations such as integration, Fourier transform, etc., enables users to synthesize the required filter.

Storage medium options include: 1) dual tape cassette drives, 2) cartridge disk drives and 3) dual floppy disk drives. (Dual floppy disk drives are components of standard systems; dual tape cassette drives and cartridge disk drives are available through special arrangement.).

Instrumentation Unmatched for Signal Acquisition and Analysis Wide-Band Digitizing Scope.

TEKTRONIX 7704A with crt readout and the P7001 Digitizer/Buffer.

Signal Acquisition Flexibility

DPO's use a wide variety of TEKTRONIX 7000-Series Oscilloscope plug-in amplifier and time bases.

Versatile Data Processing Controllers

TEKTRONIX Controllers with memory capacities of 24k or 28k.

Convenient Records

Data and programs can be easily stored on paper tape or magnetic disk and diskettes.

Easily Expandable

With various memory capacities available, and the ability to use TEKTRONIX Hard Copy Units, Dual Drive Magnetic Cassette Units, flexible disk drives, and dozens of 7000-Series signal acquisition plug-ins, DPO capabilities are almost unlimited.

The complete solution of problems associated with waveform acquisition and analysis requires a commitment to both advanced hardware and comprehensive software. At Tektronix, the WP1200-Series Digital Processing Oscilloscopes have resulted from this commitment.

Extensive signal acquisition capabilities of DPO's are made possible by use of instrumentation from the TEKTRONIX 7000-Series Oscilloscope family. The crt display and signal acquisition portions of DPO's are from the 7704A laboratory oscilloscope mainframe.

Also, the modular signal acquisition plug-in concept used in the 7000-Series has been retained. Today, acquisition capabilities are unexcelled. Users have the widest available selection of signal conditioning plug-in amplifiers, time bases, spectrum analyzers, counters, multimeters, and samplers.

In the future, as new technology increases the number and variety of 7000-Series plug-ins, users will be assured of continued DPO analysis applications.

DPO SPECIFICATIONS

Data Acquisition — Any repetitive signal that can be displayed as a waveform on the crt can be stored in the processor memory along with corresponding scale factors.

Deflection Factor — See the vertical system plug-in specifications in the TEKTRONIX 7000-Series catalog.

Data Acquisition Time — 6.5 μs per data point.

Number of Data Points — 512 per waveform (max).

Resolution — 10 bits (1 part in 1024).

DIGITIZER/BUFFER

The internal DPO memory is capable of storing four digitized waveforms, with scale factors, and twelve messages. The source of waveform information may be the plug-ins or an external device (CPU). Messages into the message area of memory originate from the external device.

Cycle Time — Less than 1.5 μs.

Allocation — The four waveforms (512 points/waveform, 2048 data points) and scale factors (80 characters/waveform, 320 characters) are allocated to memory locations A, B, C, and D.

Space is also allocated to store 12 messages (80 characters/message, 960 characters).

Message Capability — Stores up to 12 different messages* with 80 characters each, in 2 rows of 40 characters each. The messages are displayed across the top and bottom of the crt.

Character Set — Full upper case ASCII alphabet and SPACE; numerals 0 through 9; decimal point; and the following characters: +, −, <, >, /.

Four Data Handling Modes — STORE: the waveform analog information is converted to digital data and stored in memory. The process is continuous until the memory is filled or terminated. HOLD: the continuous store operation terminates and sets the P7001 in a safe mode. SEND: directs an external device (CPU) to transfer data from memory. RECEIVE: directs an external device (CPU) to transfer data into memory. Waveforms from memory provide a flicker-free display.

Program Call — Sixteen buttons provide front panel access to 13 specific software programs and an indication when the external device (CPU) is processing a program.

DISPLAY

Source — Selects one of three modes: 1) PLUG-IN, information that can be stored in memory; 2) MEMORY, information already stored in memory; or 3) BOTH, timeshares the display between memory and plug-ins.

Display Characteristics of Stored Waveforms from Processor Memory —

Resolution: 10 bits vertical, 9 bits horizontal.

Accuracy: Within 1.5% (8-div reference).

Linearity: 0.1 division or less compression or expansion of a center-screen two-division signal, when positioned anywhere within the graticule area.

Modes: Dot (display of data points) and vector (linear interpolation between adjacent points).

A front panel adjustment allows the operator to position the memory display on a graticule reference line.

Comparison of Stored Waveform to Realtime Waveform — Gain is within 1% of realtime waveform. A front panel adjustment positions the plug-in display so that it is coincident with the stored waveform display.

PROGRAMMABLE FUNCTIONS

A remote external device (CPU) can program the data handling modes, memory location, and display source of the Processor. It can also interrogate the status of the Processor data handling, memory location, and program call push buttons.

Messages are stored in the P7001 memory under control of an external device (CPU) through the I/O interface.

Sub-nanosecond Storage Oscilloscope

Bright Stored Display of a Transient or Repetitive Waveform

High Performance

- 500 MHz @ 10 mV/div
- 1 GHz @ 4 V/div
- To 0.5 ns/div sweep speeds
- 8,000 div/μs digitized writing speed
- 30,000 div/μs stored writing speed

7000-Series Compatible

Before sub-nanosecond transients can be studied in detail, they must be captured. The R7912 Transient Digitizing Instrument configurations have been designed specifically for these high speed signals. It combines efficiency, accuracy, and flexibility into an easy-to-operate system that enables you to easily view fast transients.

Researchers in many fields, including those involved in the study of laser pulses, superfast electro-chemical measurements, fluorescence decay, non-destructive device testing, EMP, and ECM, will find the WP 2000's capability to display single events with subnanosecond rise times unmatched by conventional instrumentation.

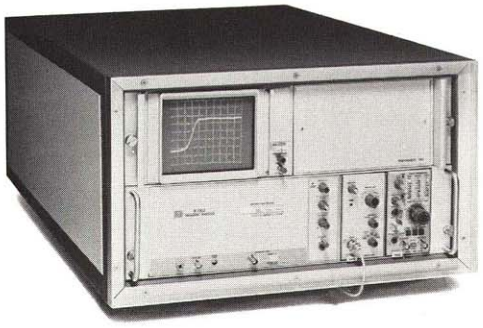
The WP 2000-Series WDI analysis configurations are designed to acquire waveforms of transient phenomena and immediately perform full analyses. Other WDI analysis configurations include from 1 to 32 R7912 acquisition units, a controller (for waveform processing), a graphics terminal, a tv video or display monitor, a disk or diskette, and TEK SPS BASIC software.

PERFORMANCE CHARACTERISTICS

OUTPUTS

Signal Outputs — Plus Gate; Output voltage: 0.5 V (±10%) into 50 Ω or 10 V (±10%) into 1 MΩ. Rise Time: 2 ns or less into 50 Ω. Output Resistance: 950 Ω ±2%.

Fast Rise Calibrator Waveshape — Positive-going square wave with baseline approximately at ground. Duty cycle: approximately 50%. Amplitude Accuracy: open circuit (4 V, 400 mV) ±0.5% from 0°C to +40°C; 50 Ω (400 mV, 40 mV) ±1.0% from 0°C to +40°C. Frequency; internally selectable, 1 MHz ±0.1%, 1 kHz ±20%. Rise Time: 1.2 ns or less at 400 mV, or 40 mV into 50 Ω.



Video Outputs — Conform to EIA RS-170 (525/60). Video Linear: 1 V into 75 Ω per full white signal. Video Binary: either low-level 0 V to ±0.3 V max, or high-level ±1.0 V ±0.1 V into 75 Ω. Video Composite: binary video plus sync, 1 V p-p nominal. Sync Out: at least 4 V into 75 Ω. Sync in (Loop Through): 2 V to 8 V, 75 Ω.

Data Outputs — 12 data lines out. All are TTL levels.

VERTICAL SYSTEM

Channels — Left-hand plug-in compartment; compatible with 7000-Series plug-ins. Bandwidth (up to 1 GHz) determined by mainframe and plug-in unit.

Chopped Mode — Chop rate determined by vertical plug-in selected.

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channels — Right-hand plug-in compartment; compatible with time bases of 7B80 and 7B90 Series.

Fastest Calibrated Sweep Speed — 500 ps/div with 7B92.

SCAN CONVERTER CRT

Type — Double-ended dual-gun crt.

Resolution — DIGITAL mode: binary, 512 point matrix; resolution elements, 320 vertically by 400 horizontally. NON-STORE mode: at least 400 tv lines per picture width at 50% response.

Writing Rate (+10°C to +40°C)* — NON-STORE mode: visual writing rate 30,000 div/μs when viewed on TEKTRONIX 632 Picture Monitor. DIGITAL mode: 8,000 div/μs digital storage writing rate.

**(0°C to +10°C) at least one half of the +10°C to +40°C values.*

MEMORY OPTION

Type — Static semiconductor memory, non-destructive readout.

Size — 4096 words by 10 bits.

Cycle Time — 1.6 μs per word or slower.

Output — Bits: parallel; word: serial; 9 data bits plus 10th-bit flag.

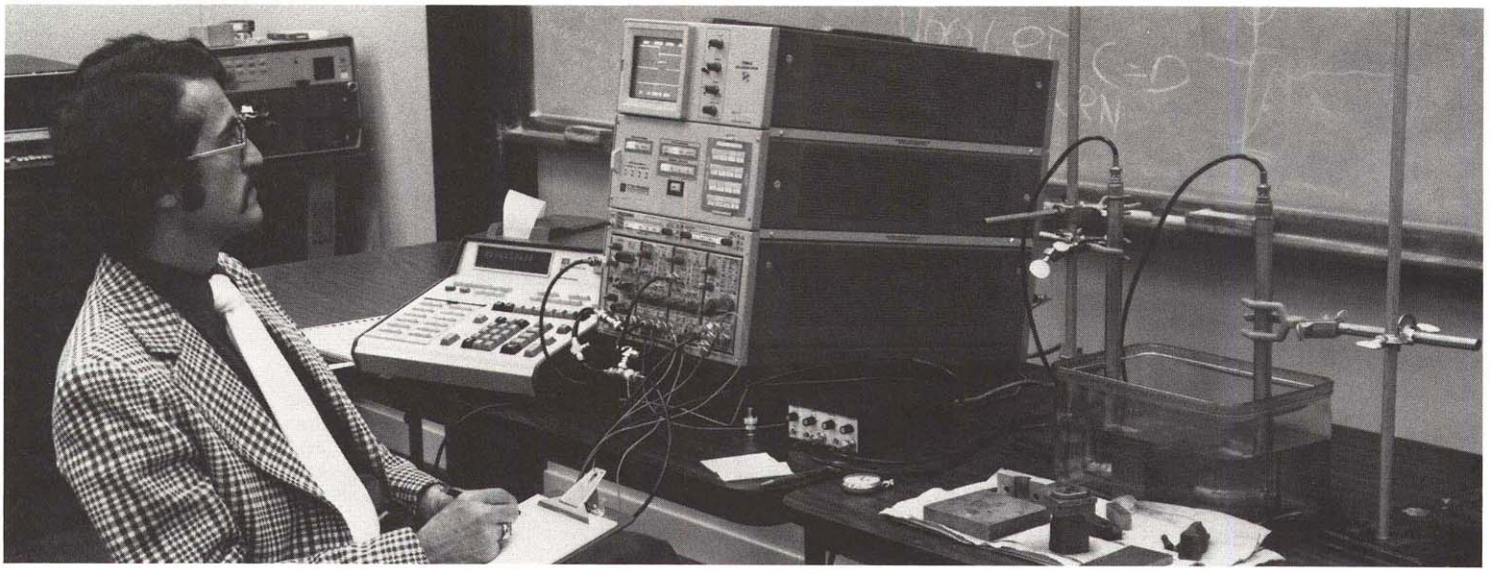
ELECTRONIC GRATICULE

Modes — Triggered at end of sweep or controlled via data-connector.

Display — 8 x 10 major divisions consisting of a dot matrix. Selectable—5 dots/div or 1 dot/div.

Intensity — Adjusted or disabled from front panel.

Stability — ±0.1% from +20°C to +30°C, ±0.5% from 0°C to +20°C and +30°C to +40°C.



Due to the truly versatile nature of TEK Signal Processing Systems, their applications are diverse. Some of these applications include the following.

Non-destructive testing of nodular iron cast components.
A digital solution that combines high-resolution ultrasonic testing with process control. It makes the measurement automatically, analyzes the data, reaches a go/no-go decision, and activates the correct assembly line controls.

Laser induced fusion research. Oscillator pulse purity may be checked by using either fiber optics and a photo diode, or a pellicle at the output of the laser to obtain pulse information for analysis. Similar techniques may be used to check the purity of pulses at several stages.

The power levels of these laser pulses may be measured by integrating each detector output waveform, with the area under the curve representing the pulse power. Other detectors that provide suitable outputs for the SPS configurations include Faraday cups, cylindrical analyzers, and secondary electron multipliers.

Dynamic laser trimming of active circuits, or devices, by applying power from the laser to do a cutting sequence that will bring the circuit closer to a specified performance level. SPS instrumentation may be used to monitor the circuit single-shot response characteristics and thus avoid circuit thermal effects.

Materials testing in industry. SPS instrumentation monitors lasers used in shock hardening materials as well as the effect of the laser energy on the material itself.

Time of flight (TOF) mass spectrometry. TOF mass spectrometry, materials are heated to cause emission of ions. These ions are accelerated, focused into an ion beam, and detected in a TOF tube. The mass-to-charge ratio (m/e) of each ion type determines its velocity in the TOF tube. Ion species identification is accomplished as a function of time, since each species in the sample travels at a different velocity and arrives at the detector at a different time. With the time data, the m/e may be calculated and each species identified.

The list of SPS applications is growing, and includes:

Aviation and Aerospace — Automatic Test Equipment.

Communications — Transfer function analysis.

Component Testing — IC parameters, pc boards, filters.

Electronic Warfare — ECM, radar signature analysis.

Laser Interferometry — Doppler shift effect of laser beams.

Meteorology — Cloud pollution content studies using radar and pulsed lasers.

Navigational Systems — Pulse code modulation (pcm), timing information.

Nuclear Magnetic Resonance — Observing flip resonance.

Optics — Determining laser related optical characteristics.

Power Lines — Transient monitoring and analysis.

Power Supply Design — Switching transient analysis.

Raman Scattering — Laser backscatter and frequency shift control and analysis.

Security Systems — Transfer function analysis.

Application Notes

A library of Application Notes is maintained to disseminate technical information about the uses of SPS instrumentation. This library contains notes on specific techniques used in operating SPS instrumentation as well as descriptions of market oriented instrument applications. A sample of notes presently available includes:

DPO Program Library Techniques
(DPO Note 45F1.0)

Mechanical Measurements Using the DPO
(DPO Note 45A1.0)

Engine Performance Measurements
(DPO Note 45A1.1)

R7912 Transient Digitizer . . . A Solution to Pulse Laser Measurement Problems
(WDI Note 47N1.0)

Pulsed Laser Measurements Using the R7912 Transient Digitizer.
(WDI Note 47N1.1)

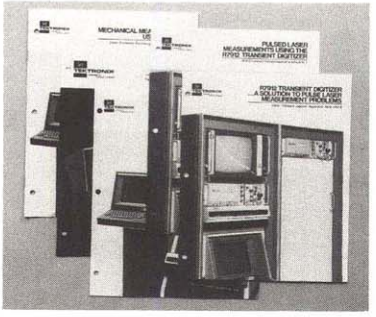
Real-Time Metals Analysis Using the DPO
(DPO Note 45N1.0)

Windowing to Control FFT Leakage
(SPS Note 47L1.0)

"Measuring Transistor Switching Times with the DPO"
(DPO App Note 45K1.1)

"TDR Difference Testing with TEK Signal Processing Systems"
(Signal Processing Systems App Note 47I1.1)

"Automatic Measurement of Nodular Iron Cast Parts"
(DPO App Note 45C1.1)



7000-Series Instruments

Pick a Plug-in Oscilloscope for:

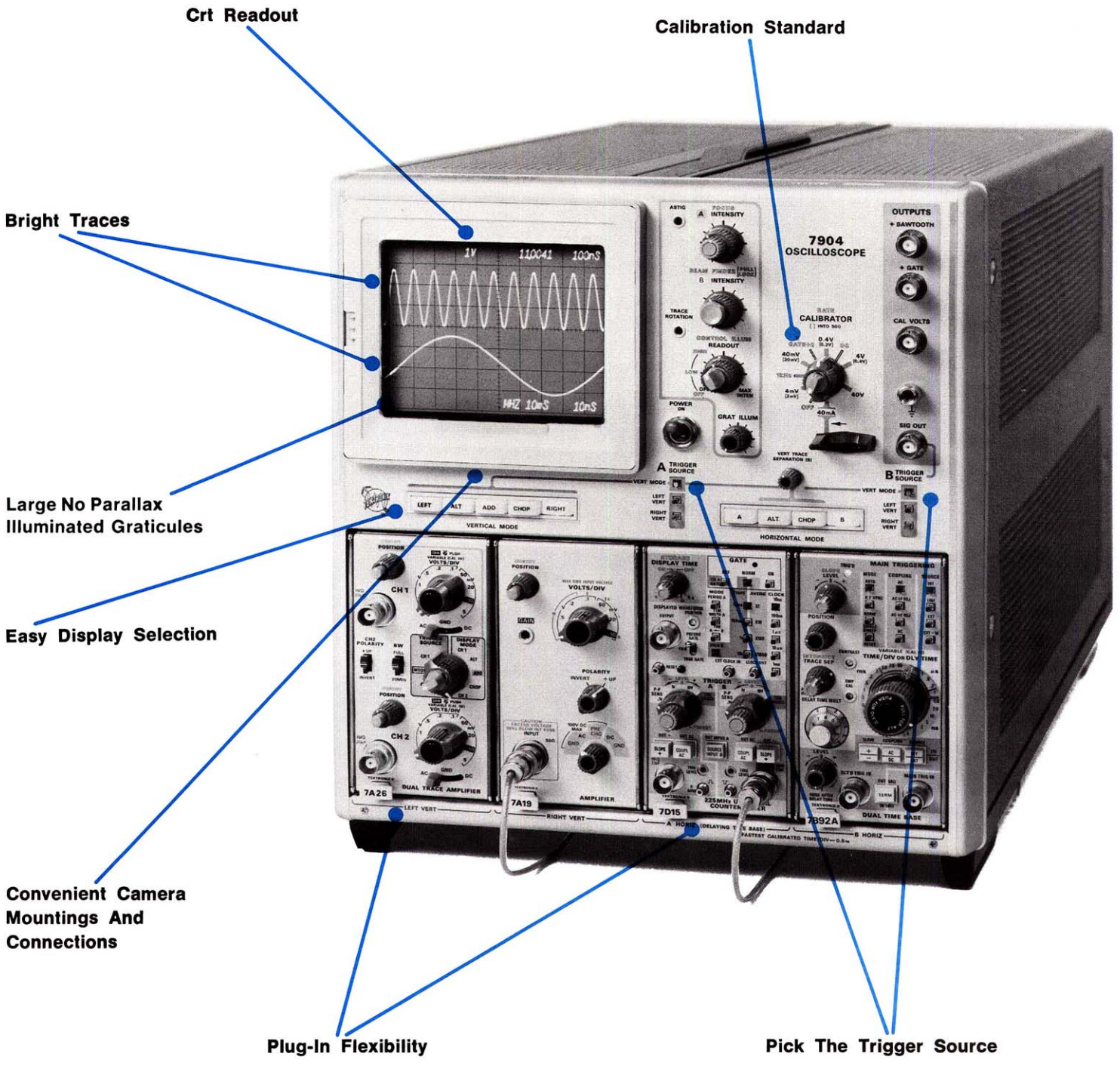
Superior Performance. The 7000 Series of plug-in laboratory instruments embodies more state-of-the-art performance features than any other oscilloscope-based measurement system.

Flexibility. The 7000 Series offers a choice in measurement parameters, ranges, and techniques which allow you to tailor the optimum system for your specific needs.

Expandability. The 7000 Series is a growing family of mainframes and plug-ins which continues to develop new capabilities and techniques, thereby reducing the likelihood that your instruments will become obsolete.

The 7000 Series...more than an oscilloscope.

7000 Series...more than an oscilloscope

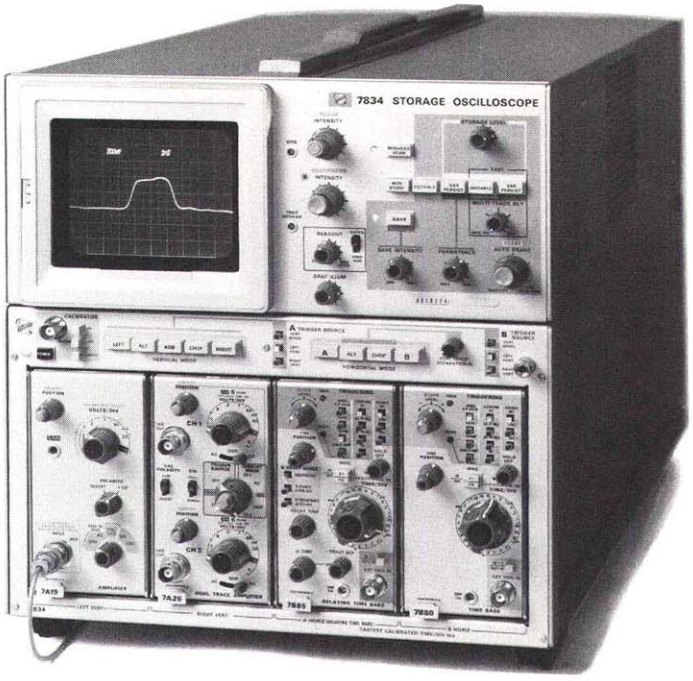


The 7000 Series is a unique family of instrumentation components, a continuation of the Tektronix heritage of bringing to the laboratory the ultimate in measurement technology.

Numerous measurement concepts—oscilloscopy, synergistic analog-digital measurements, spectrum analysis, sampling, time domain reflectometry, curve tracing—are fused into a family of interdependent cathode-ray-tube mainframes and instrumentation plug-ins.

A system can be tailored for your exact measurement needs. Mainframes in the family offer a choice of popular bandwidth ranges and a wide selection of additional features. Plug-ins—including oscilloscope vertical amplifiers and time bases as well as instruments for a variety of applications—can be selected to round out your tailored system.

In opposition to an industrial world that is frequently faulted for planning obsolescence, this instrument family strategically defers obsolescence. Each mainframe and each plug-in reflect the latest technology at their inceptions, yet each fits a well planned niche in this interdependent family. The result is an array of instrumentation components that can adapt to and adopt new developments while protecting your initial investment. Today's system may be expanded to meet future needs at a relatively low cost by the addition of a plug-in or two. When the time comes to add a more powerful mainframe, your older model continues to be useful for a host of applications.



Crt Readout

All significant parameters are displayed in alphanumeric characters right on the crt. They are readily visible when you need them for quick oscilloscope measurements, and they are permanently recorded on your waveform photographs for future analysis. When your 7000-Series measurement system includes a digital instrument plug-in, the measurement is presented in clear, accurate digital terms, along with a corresponding analog waveform.

Bright Traces

All 7000-Series crts have bright displays and excellent photographic writing speeds. For applications requiring maximum photographic writing speeds, several mainframes feature a condensed scan on a reduced area in the center of the crt.

Large Illuminated Graticules Eliminate Parallax

The display area is 8 by 10 divisions (0.9, 0.98, 1.0, or 1.22 cm/div depending upon mainframe) with a parallax-free graticule. All graticules are illuminated except the 7313.

Convenient Camera Mountings and Connections

A standard bezel connector matches all TEKTRONIX Oscilloscope Cameras to 7000-Series Mainframes.

Independent Intensity Controls

Separate intensity controls allow for independent adjustment of A sweep, B sweep, and character readout brightness. The intensity of each sweep may be adjusted to a level that suits your application.

Autofocus

The trace stays in focus with changes in intensity. After the focus is initially set, an autofocus circuit reduces the need for additional adjustments.

Adjustable Graticule Illumination

This gives you easier viewing and sharper photos. Not available on the 7313.

Plug-ins

Flexible Measurement Systems

More than thirty plug-ins provide you with flexibility to choose just the measurement capability you require.

Analog/Digital Synergism

Digital instrumentation plug-ins create unsurpassed measurement capabilities. Highly accurate digital measurements may be made at selectable points on complex waveforms by visually superimposing gate waveforms over signal waveforms.

Mainframes

Calibration Standard

All the 7000-Series calibrators serve as a voltage standard for calibrating vertical plug-ins, a 1 kHz square wave for adjusting probe compensation, or a 1 kHz frequency standard in the 7800- and 7900-Series Mainframes. The output is available in several dc or 1 kHz square-wave voltages.

Trigger Source Flexibility

The left and right trigger selector mainframe pushbuttons route the desired trigger source to the appropriate time base. A VERT mode position automatically routes whichever source has been chosen for vertical inputs.

Easy Display Selection

Vertical mode switches allow you to easily select the desired vertical amplifier or interaction of amplifiers (e.g., alternate, chopped, or added modes). Four-compartment mainframes provide equivalent flexibility for time bases as well.

Mainframe Flexibility

Numerous options add even more flexibility in creating the oscilloscope system that most closely meets your measurement requirements.

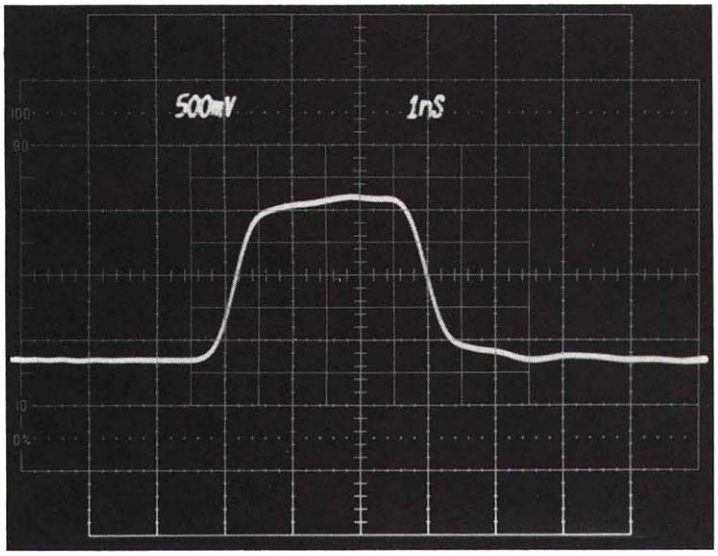
STORAGE

Readout Stored with the Waveform

Fast Stored Writing Speeds

Multimode 7834/7633/7623A

Variable Persistence 7613
or
Split Screen Bistable 7313

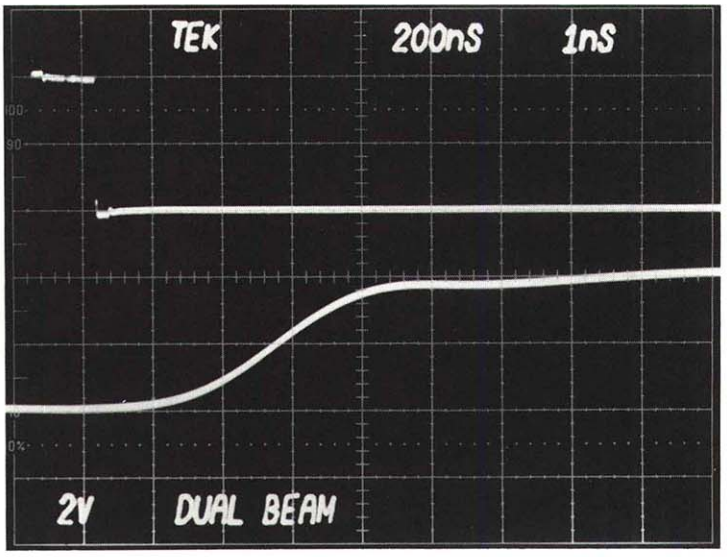


DUAL BEAM

400 MHz Bandwidth

Full Vertical and Horizontal
Cross-over Switching (one input shown at two sweep speeds)

Full Overlap on 8 x 10 cm Display



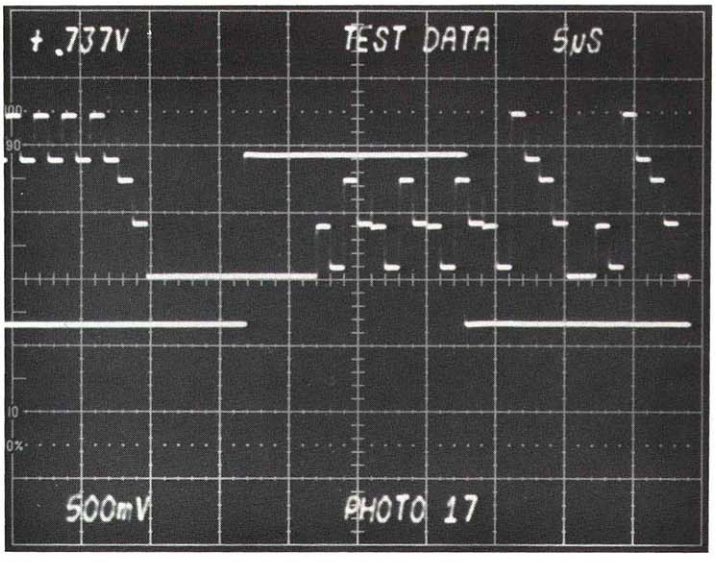
DIGITAL

Sample and Hold Dvm Measures Difference Voltage between Two Points on Complex Waveform (gate waveform indicates two points—leading and trailing edges—where voltage difference is made—+0.737 V)

Readout Unit Identifies this Waveform as TEST DATA-PHOTO 17

Counter/Timer Measurement with Analog Display

Compare Digital Measurement with Analog Display



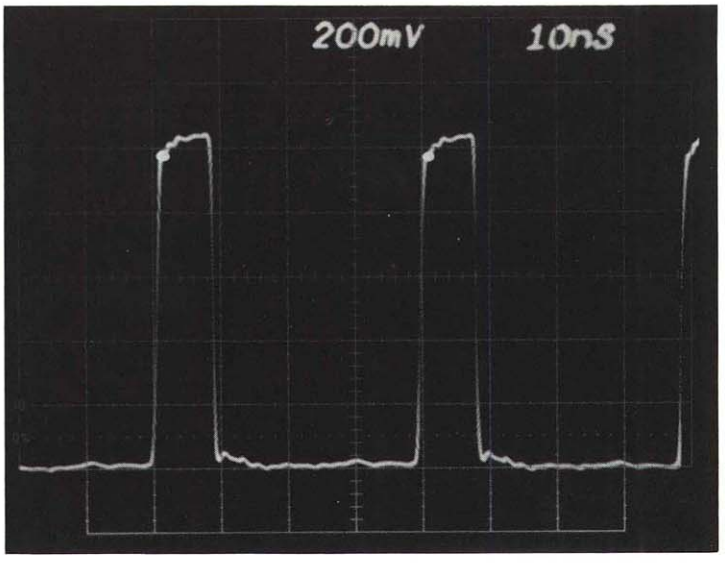
SAMPLING

Two-Dot Time Measurement

Calibrated Delayed Sweep

Simultaneous Sampling & Conventional Displays

Operational Ease of a Conventional Oscilloscope



7000-Series Storage Oscilloscopes

Storage, as it applies to most instruments in the TEKTRONIX 7000 Series, involves techniques for capturing and retaining signals within the cathode-ray tube itself. (Systems for digitally reconstructing signals, sometimes included under the broad umbrella of storage, are discussed on pages 61 through 68).

Why Store?

Capturing an event for detailed analysis is perhaps the most obvious application for a storage crt, but many other situations also call for its unique advantages. Some examples include capturing the entire display of a slowly occurring signal . . . observing signal changes during circuit adjustment . . . comparing incoming signals with a standard . . . increasing the brightness of a repetitive signal for viewing in normal ambient light . . . reducing flicker or noise . . . baby-sitting, or unattended monitoring for a transient event . . . and enhancing other recording techniques such as photography.

Storage Features

Since 1962, when Tektronix introduced phosphor target bistable storage in the 564, techniques for capturing and retaining waveforms have grown at an explosive rate in order to keep pace with measurement demands.

However, the language of storage—such terms as bistable, variable persistence, and mesh transfer—frequently presents as much confusion as the measurement that must be made.

Characteristics of individual 7000-Series Mainframes employing storage techniques are listed on pages 43 through 46. A review, though, of storage concepts should prepare the reader to evaluate the various alternatives more knowledgeably.

Bistable

Phosphor target bistable, available on the 7313 Mainframe, offers a low-cost alternative with relatively long view times. Waveform storage takes place directly on the crt phosphor. This easy-to-use technique offers the flexibility of split-screen storage. Upper and lower halves of the screen may be stored independently. Thus, a reference signal may be stored on one half for comparison against signals on the other half.

Phosphor target bistable has a relatively slow writing speed and a dim contrast between the trace and the background brightness.

Bright Bistable

Bright bistable storage, available as one storage mode on the 7834, 7633 and 7623A Mainframes, employs a mesh between the electron gun and the crt phosphor. It features bright, long-lasting displays with reduced contrast.

Variable Persistence

Variable persistence storage is available in the 7613, 7623A, 7633 and 7834 Mainframes. It features bright, high-contrast displays and controlled persistence.

A front-panel persistence knob provides control of the decay (fade-away) rate of the stored image. The rate can be varied from almost instantaneous disappearance to a view time of greater than 15 s in the 7613 (30 s in the 7623A, 7633, and 7834).

Fast Multimode

Fast multimode storage, available in the 7623A, 7633, and 7834, provides four storage modes. The four modes combine the previously discussed bright bistable and variable persistence storage modes with fast bistable and fast variable presistence.

The display characteristics of fast bistable and fast variable persistence are the same as bistable and variable persistence respectively. In either fast storage mode the trace image is first written on a fast mesh, then transferred to a long retention mesh for viewing.

As the name implies, fast provides increased storage writing speed. For example, in the reduced scan display mode, the variable persistence writing speed of 5.4 cm/μs is increased to 2500 cm/μs by selecting fast variable persistence. The 2500 cm/μs writing speed is fast enough to capture a single event equivalent to the 7834's 400-MHz bandwidth or a 900 ps rise time.

400 MHz Dual-Beam

Dual-beam oscilloscopes are essentially two oscilloscopes in one. Each beam operates separately and independently of the other. They are required for many applications where two transient events must be compared simultaneously. These application areas include stimulation and reaction events in such fields as medicine, biology, chemistry, engineering mechanics, to name just a few.

Depending on the plug-ins selected, up to eight traces can be displayed at a time.

Digitals

The 7000-Series Digital Plug-ins include: a universal counter/timer, 525 MHz direct frequency counter, digital multimeter with temperature mode, digital delay by time or events, a versatile 0.01% A/D converter with vertical amplifier, and a special readout unit to label each test for future reference. Together with a 7000-Series Mainframe, these give you the advantage of seeing what you're measuring, plus accuracy of digital techniques.

This combination offers many advantages over separate test units. You get: scope-controlled digital measurements, measuring convenience and confidence, increased accuracy, easier and faster solution to complex problems, a lower dollar investment, more bench space and signal conditioning.

Sampling

The 7000-Series Sampling Plug-ins provide some unique measurement capabilities not available in other sampling oscilloscopes. You get: a low-cost storage crt for slow scans, a random mode lets you see leading edges with pretrigger or bandwidth-limiting delay line, you have a wide choice of sampling heads at minimal cost, and you get the convenience of sampling and conventional displays at the same time on the crt.

The sampling waveform on the preceding page was displayed using the 7S14. You can position the two bright dots to any two points in a waveform which is displayed at 10 ns/div or faster. The separation between dots is controlled by a calibrated 10-turn DTM dial. Repeated time measurements on similar waveforms may be made more rapidly and accurately and with less fatigue using this unique two-dot method.

7000-SERIES VERTICAL SYSTEM SPECIFICATIONS

PLUG-IN AMPLIFIER			7A11	7A13	7A15A 7A15AN	7A16A	7A17	7A18 7A18N	7A19	7A21N	7A22	7A24	7A26
PAGE			70	71	70	70	70	72	71	71	71	72	72
PERFORMANCE FEATURE			Low-capacitance FET probe amplifier	Differential dc offset, high-freq cmrr amplifier	Low-cost conventional input amplifier	Wide-bandwidth conventional input amplifier	Low-cost, easy to customize amplifier	Dual-channel amplifier	Wide-bandwidth 50-Ω input amplifier	Direct crt access	Dc-coupled, high-gain differential amplifier	Dual-channel 50-Ω amplifier	Dual-channel amplifier
MIN DEFL FACTOR			5 mV/div	1 mV/div	5 mV/div (0.5 mV/div)[2]	5 mV/div	50 mV/div	5 mV/div	10 mV/div	<4 V/div	10 μV/div	5 mV/div	5 mV/div
ACCURACY[1] WITHOUT PROBE			2% (integral)	1.5%	2%	2%	—	2%	3%	—	2%	2%	2%
7900 FAMILY (0°C to 30°C)	7904 R7903 R7912[6]	BW	250 MHz	105 MHz P6053B 65 MHz P6055	80 MHz	225 MHz	150 MHz	75 MHz	500 MHz	1 GHz	1 MHz ± 10%	350 MHz	200 MHz
		Tr	1.4 ns	3.4 ns P6053B 5.4 ns P6055	4.4 ns	1.6 ns	2.4 ns	4.7 ns	0.8 ns	350 ps	350 ns ± 9%	1.0 ns	1.8 ns
		SIG OUT BW	140 MHz	100 MHz P6053B 65 MHz P6055	70 MHz	140 MHz	15 MHz	70 MHz	300 MHz	—	1 MHz ± 10%	140 MHz	140 MHz
7800 FAMILY (0°C to 35°C)	7844/R	BW	200 MHz	100 MHz P6053B 65 MHz P6055	80 MHz	200 MHz	150 MHz	75 MHz	400 MHz[3]	1 GHz	1 MHz ± 10%	300 MHz	180 MHz
		Tr	1.8 ns	3.5 ns P6053B 5.4 ns P6055	4.4 ns	1.8 ns	2.4 ns	4.7 ns	0.9 ns	350 ps	350 ns ± 9%	1.2 ns	1.9 ns
	7834	BW	200 MHz	95 MHz P6053B 65 MHz P6055	80 MHz	200 MHz	150 MHz	75 MHz	400 MHz	—	1 MHz ± 10%	300 MHz	180 MHz
		Tr	1.8 ns	3.7 ns P6053B 5.4 ns P6055	4.4 ns	1.8 ns	2.4 ns	4.7 ns	0.9 ns	—	350 ns ± 9%	1.2 ns	1.9 ns
7700 FAMILY	7704A Opt 9 (0°C to 30°C)	BW	170 MHz	100 MHz P6053B 65 MHz P6055	75 MHz	170 MHz	150 MHz	75 MHz	250 MHz[4]	—	1 MHz ± 10%	200 MHz	170 MHz
		Tr	2.1 ns	3.5 ns P6053B 5.4 ns P6055	4.7 ns	2.1 ns	2.4 ns	4.7 ns	1.5 ns	—	350 ns ± 9%	1.8 ns	2.1 ns
		SIG OUT BW	70 MHz	60 MHz P6053B 50 MHz P6055	55 MHz	70 MHz	15 MHz	55 MHz	80 MHz	—	1 MHz ± 10%	70 MHz	70 MHz
	7704A	BW	170 MHz	100 MHz P6053B 65 MHz P6055	75 MHz	160 MHz	150 MHz	75 MHz	200 MHz	—	1 MHz ± 10%	200 MHz	150 MHz
		Tr	2.1 ns	3.5 ns P6053B 5.4 ns P6055	4.7 ns	2.2 ns	2.4 ns	4.7 ns	1.8 ns	—	350 ns ± 9%	1.8 ns	2.4 ns
		SIG OUT BW	70 MHz	60 MHz P6053B 50 MHz P6055	55 MHz	70 MHz	15 MHz	55 MHz	80 MHz	—	1 MHz ± 10%	70 MHz	70 MHz
	R7704	BW	150 MHz	100 MHz P6053B 65 MHz P6055	75 MHz	150 MHz	150 MHz	75 MHz	175 MHz	—	1 MHz ± 10%	160 MHz	140 MHz
		Tr	2.4 ns	3.5 ns P6053B 5.4 ns P6055	4.7 ns	2.4 ns	2.4 ns	4.7 ns	2.0 ns	—	350 ns ± 9%	2.2 ns	2.5 ns
		SIG OUT BW	60 MHz	55 MHz P6053B 45 MHz P6055	50 MHz	60 MHz	15 MHz	50 MHz	65 MHz	—	1 MHz ± 10%	60 MHz	60 MHz
7600 FAMILY and STORAGE FAMILY	7603/R 7633/R	BW	100 MHz	75 MHz P6065A 55 MHz P6055	65 MHz	100 MHz	100 MHz	75 MHz	100 MHz	—	1 MHz ± 10%	100 MHz	100 MHz
	7623A/R 7613/R	Tr	3.5 ns	5.0 ns P6065A 6.4 ns P6055	5.4 ns	3.5 ns	3.5 ns	4.7 ns	3.5 ns	—	350 ns ± 9%	3.5 ns	3.5 ns
	7603N Opt 11[5]	SIG OUT BW	60 MHz	55 MHz P6065A 45 MHz P6055	50 MHz	60 MHz	15 MHz	50 MHz	65 MHz	—	1 MHz ± 10%	60 MHz	60 MHz
	7313 R7313	BW	25 MHz	25 MHz P6062A 24 MHz P6055	25 MHz	25 MHz	25 MHz	25 MHz	25 MHz	—	1 MHz ± 10%	25 MHz	25 MHz
		Tr	14 ns	14 ns P6062A 15 ns P6055	14 ns	14 ns	14 ns	14 ns	14 ns	—	350 ns ± 9%	14 ns	14 ns
		SIG OUT BW	60 MHz	55 MHz P6062A 45 MHz P6055	50 MHz	60 MHz	15 MHz	50 MHz	65 MHz	—	1 MHz ± 10%	60 MHz	60 MHz

System Environmental Specification (apply to all instruments except where noted)—Operating temperature range is from 0°C to +50°C. Operating altitude to 15,000 feet. Nonoperating to 50,000 feet.

[1]Accuracy percentages apply to all deflection factors. Plug-in gain must be set at the deflection factor designated on each plug-in. When a probe is used, the gain must be set with the calibration signal applied to the probe tip. The calibration signal is supplied by an external calibrator whose accuracy is within 0.25%.

[2]Obtained with X10 gain at reduced bandwidth of 10 MHz.

[3]Bandwidth is 325 MHz to 10 mV/div.

[4]Bandwidth is 200 MHz at 10 mV/div.

[5]All 7000-Series Plug-ins are compatible with the 7603N Opt 11. However, they do not meet the rigid environmental specifications required by the military.

[6]Refer to Transient Digitizer, R7912 not available with signal outputs.

RECOMMENDED COMBINATIONS 7000-SERIES MAINFRAMES AND TIME BASES

MAINFRAME		7904 R7903	7834	7844/R	7704A R7704	7603/R	7603N Opt 11	7633/R 7623A/R	7613/R	7313/R
Time Base	PERFORMANCE FEATURE	● INDICATES RECOMMENDED COMBINATION								
7B50A	Single time base					●		●	●	●
7B53A	Dual time base with mixed sweep				●	●	● *	●	●	●
7B53A Opt 05	7B53A with tv sync triggering				●	●		●	●	●
7B80	Single time base (used also as delayed time base)	●	●	●	●					
7B85	Single time base with delaying and Δ delay sweep function	●	●	●	●(1)					
7B92A	Dual time base with display switching	●	●	●	●(1)					

*7B53AN Opt 11 is recommended; one is supplied with 7603N Opt 11S system.

(1)No trace separation.

7000-SERIES
OSCILLOSCOPE SYSTEMS/PROBE SELECTION CHART*

		PASSIVE VOLTAGE 1-MΩ INPUT COMPATIBLE							PASSIVE VOLTAGE 50-Ω INPUT COMP		FET PROBES 50 Ω/1 MΩ INPUT COMPATIBLE			CURRENT PROBES		
PROBE		P6101 1 Meter	P6106 3.5'	P6055 3.5'	P6009 9'	P6015 10'	P6062B 6'	P6105 P6108 2 Meter	P6056 6'	P6057 6'	P6202 2 Meter	P6046 6'	P6201 6'	w/passive term P6021 5' 10 mV/mA	w/passive term P6022 5' 10 mV/mA	P6302/ AM 503 6'
FEATURES		Minature Probe	Fastest Probes Compatible with 1-MΩ Input	Adj Attenuation for Differential Use	1.5 kV Compatibility	40 kV Pk Pulse Compatibility	Selectable Attenuation	Miniature Probe	Fastest 10X Passive Probe Low C	Fastest 100X Passive Probe Low C	10-MΩ Input Impedance Dc, Offset	Differential Probe High Cmrr	Low Capacitive Loading Ac Coupling Dc Offset	Ac High Current	Ac High Frequency	Dc High Current
ATTENUATION		1X	10X	10X	100X	1000X	Selectable	10X	10X	100X	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
7900 FAMILY	7A11*	Nc	Nc	Nc	Nc	Nc		Nc						55 MHz	150 MHz	45 MHz
	7A13	34 MHz	105 MHz	65 MHz	85 MHz	65 MHz		75 MHz		105 MHz	105 MHz	70 MHz	105 MHz	50 MHz	90 MHz	45 MHz
	7A15A	34 MHz	75 MHz		70 MHz	60 MHz	75 MHz	75 MHz		80 MHz	80 MHz	60 MHz	75 MHz	45 MHz	70 MHz	40 MHz
	7A16A	34 MHz	200 MHz		130 MHz	80 MHz				205 MHz	205 MHz	90 MHz	215 MHz	55 MHz	150 MHz	45 MHz
	7A18	34 MHz	75 MHz		70 MHz	60 MHz	75 MHz	75 MHz		75 MHz	75 MHz	60 MHz	75 MHz	45 MHz	70 MHz	40 MHz
	7A19	Nc	Nc	Nc	Nc	Nc	Nc	Nc	500 MHz	480 MHz	300 MHz	95 MHz	430 MHz	Nc	Nc	50 MHz
	7A22	1 MHz	Nc	1 MHz			1 MHz							1 MHz	1 MHz	1 MHz
	7A24	Nc	Nc		Nc	Nc	Nc	Nc	350 MHz	350 MHz	290 MHz	90 MHz	310 MHz	Nc	Nc	45 MHz
	7A26	34 MHz	175 MHz		125 MHz	75 MHz					185 MHz	85 MHz	180 MHz	55 MHz	140 MHz	45 MHz
7800 FAMILY	7A11	Nc	Nc	Nc	Nc	Nc	Nc	Nc						55 MHz	130 MHz	45 MHz
	7A13	34 MHz	95 MHz	65 MHz	85 MHz	60 MHz		100 MHz			100 MHz	70 MHz	100 MHz	50 MHz	85 MHz	45 MHz
	7A15A	34 MHz	75 MHz		70 MHz	55 MHz	75 MHz	75 MHz			80 MHz	60 MHz	80 MHz	45 MHz	70 MHz	40 MHz
	7A16A	34 MHz	160 MHz		110 MHz	75 MHz		100 MHz			170 MHz	85 MHz	165 MHz	55 MHz	130 MHz	45 MHz
	7A18	34 MHz	85 MHz		80 MHz	60 MHz	85 MHz	85 MHz			75 MHz	65 MHz	90 MHz	45 MHz	70 MHz	40 MHz
	7A19	Nc	Nc	Nc	Nc	Nc	Nc	Nc	400 MHz	400 MHz	320 MHz	95 MHz	360 MHz	Nc	Nc	50 MHz
	7A22	1 MHz	Nc	1 MHz	1 MHz	1 MHz	1 MHz	Nc						1 MHz	1 MHz	1 MHz
	7A24	Nc	Nc	Nc	Nc	Nc	Nc	Nc	300 MHz	300 MHz	270 MHz	90 MHz	280 MHz	Nc	Nc	45 MHz
	7A26	34 MHz	145 MHz		105 MHz	75 MHz		100 MHz			150 MHz	85 MHz	155 MHz	55 MHz	125 MHz	45 MHz
7704A	7A11	Nc	Nc	Nc	Nc	Nc	Nc	Nc						55 MHz	125 MHz	45 MHz
	7A13	34 MHz	100 MHz	65 MHz	85 MHz	65 MHz		70 MHz			100 MHz	70 MHz	100 MHz	50 MHz	85 MHz	40 MHz
	7A15A	34 MHz	70 MHz		65 MHz	55 MHz	70 MHz	70 MHz			75 MHz	55 MHz	70 MHz	45 MHz	70 MHz	40 MHz
	7A16A	34 MHz	145 MHz		115 MHz	75 MHz		100 MHz			160 MHz	80 MHz	150 MHz	55 MHz	125 MHz	45 MHz
	7A18	34 MHz	75 MHz		70 MHz	60 MHz	75 MHz	75 MHz			75 MHz	60 MHz	75 MHz	45 MHz	70 MHz	40 MHz
	7A19**	Nc	Nc	Nc	Nc	Nc	Nc	Nc	250 MHz	250 MHz	220 MHz	85 MHz	215 MHz	Nc	Nc	45 MHz
	7A22	1 MHz	Nc	1 MHz			1 MHz							1 MHz	1 MHz	1 MHz
	7A24	Nc	Nc		Nc	Nc	Nc	Nc	200 MHz	200 MHz	185 MHz	80 MHz	180 MHz	Nc	Nc	45 MHz
	7A26	34 MHz	140 MHz		105 MHz	75 MHz		100 MHz			160 MHz	80 MHz	140 MHz	55 MHz	115 MHz	45 MHz
7600 FAMILY	7A11	Nc	Nc	Nc	Nc	Nc	Nc	Nc						50 MHz	85 MHz	40 MHz
	7A13	34 MHz	75 MHz	55 MHz	60 MHz	55 MHz	70 MHz	70 MHz			75 MHz	55 MHz		45 MHz	70 MHz	40 MHz
	7A15A	34 MHz	60 MHz		55 MHz	50 MHz	60 MHz	60 MHz			65 MHz	50 MHz		40 MHz	60 MHz	35 MHz
	7A16A	34 MHz	95 MHz		85 MHz	65 MHz	95 MHz	95 MHz			100 MHz	70 MHz		50 MHz	85 MHz	40 MHz
	7A18	34 MHz	70 MHz		65 MHz	55 MHz	70 MHz	70 MHz			75 MHz	55 MHz		45 MHz	70 MHz	40 MHz
	7A22	1 MHz	Nc	1 MHz			1 MHz							1 MHz	1 MHz	1 MHz
	7A26	34 MHz	95 MHz		85 MHz	65 MHz	95 MHz	95 MHz			100 MHz	70 MHz		50 MHz	85 MHz	40 MHz
7313	7A11	20 MHz	25 MHz	23 MHz	25 MHz	24 MHz	25 MHz	25 MHz	Nc	Nc	25 MHz	25 MHz	25 MHz	24 MHz	22 MHz	22 MHz
	7A13A	20 MHz	25 MHz	23 MHz	25 MHz	24 MHz	25 MHz	25 MHz	Nc	Nc	25 MHz	25 MHz	25 MHz	24 MHz	22 MHz	22 MHz
	7A15A	20 MHz	25 MHz	23 MHz	25 MHz	24 MHz	25 MHz	25 MHz	Nc	Nc	25 MHz	25 MHz	25 MHz	24 MHz	22 MHz	22 MHz
	7A18	20 MHz	25 MHz	23 MHz	25 MHz	24 MHz	25 MHz	25 MHz	Nc	Nc	25 MHz	25 MHz	25 MHz	24 MHz	22 MHz	22 MHz
	7A22	1 MHz	1 MHz	1 MHz	1 MHz	1 MHz	1 MHz	1 MHz	Nc	Nc	1 MHz	1 MHz	1 MHz	1 MHz	1 MHz	1 MHz

*NOTE: The values in the above table represent the approximate useful frequency response for the measurement systems at the probe tip. If there is no bandpass specified the probe/plug-in combination is compatible but not recommended.

** = Option 09 Mainframe

Nc = Not compatible

DIMENSIONS AND WEIGHTS 7000-SERIES MAINFRAMES AND PLUG-INS

Dimensions		7904	R7903	7844	R7844	7834	7704A	R7704	7603	R7603	7603N OPT 11S	7603N OPT 11	7633, 7623A, 7613, 7313	R7633, R7623A, R7613, R7313	PLUG-INS SINGLE	PLUG-INS DOUBLE
Height	in	13.5	5.3	12.9	7.0	13.6	13.6	7.0	11.4	5.25	11.5	11.5	12.0	5.25	5.0	5.0
	cm	34.3	13.5	32.8	17.8	34.5	34.5	17.8	29.0	13.3	29.2	29.2	30.5	13.3	12.7	12.7
Width	in	12.0	19.0	12.0	19.0	12.0	12.0	19.0	8.7	19.0	9.7	9.7	8.7	19.0	2.8	5.5
	cm	30.5	48.3	30.5	48.3	30.5	30.5	48.3	22.1	48.3	24.6	24.6	21.2	48.3	7.1	14.0
Length	in	23.3	22.8	23.8	24.8	23.2	22.7	22.4	24.0	24.7	25.2	23.5	23.5	22.3	14.5	14.5
	cm	59.2	57.9	60.5	63.0	58.9	57.7	56.9	61.0	62.7	64.0	59.7	59.7	56.6	36.8	36.8
Weights (approx)																
Net	lb	32	27	36	33	35.5	30	44	30	30	45	36	30	32	2	9
	kg	14.5	12.2	16.3	15.0	16.1	13.6	20.0	13.6	13.6	20.4	16.3	13.6	14.5	0.9	4.1
Shipping	lb	44	52	47	63	47	43	77	46	62	72	42	42	62	5	12
	kg	20	23.6	21.3	28.5	21.3	19.5	35.0	20.8	28.2	32.7	19.0	19.0	28.2	2.3	5.4

SUMMARIZED CAMERA CHARACTERISTICS

			LENS				FILM BACKS		
CAMERA	**RECOMMENDED FOR**	**PERFORMANCE FEATURES AND BENEFITS**	MAXIMUM RELATIVE APERTURE	MAG	RELATIVE SPEED*	FIELD OF VIEW (with 3.25 x 4.25 in Polaroid Film except where noted)	ORDI-NARILY USED	OPTIONAL AND INTER-CHANGEABLE	**PRICE with back ordi-narily used**
C-51	7904, R7903, 7844, 7704A	Fastest writing speed with 0.5 mag lens.	f/1.2	0.5	3.0	8 x 10 cm/ 3.15 x 3.93 in	Polaroid Roll	Polaroid Pack and 4 x 5 in Graflok	$1370
C-53	All except 7603 7603N11S	General-purpose with 0.85 mag lens.	f/1.9	0.85	1.0	8 x 10 cm/ 3.15 x 3.93 in	Polaroid Pack	Polaroid Roll and 4 x 5 in Graflok	$1100
C-59	7603 7603N11S	General-purpose at low price.	f/2.8	0.67	0.65	10.2 x 12.7 cm/ 4 x 5 in	Polaroid Pack	Polaroid Roll and 4 x 5 in Graflok	$660
C-5A	All	Low cost.	f/16	0.67 or 0.85 select-able	0.02	9.76 x 12.2 cm	Polaroid Pack	None	$250

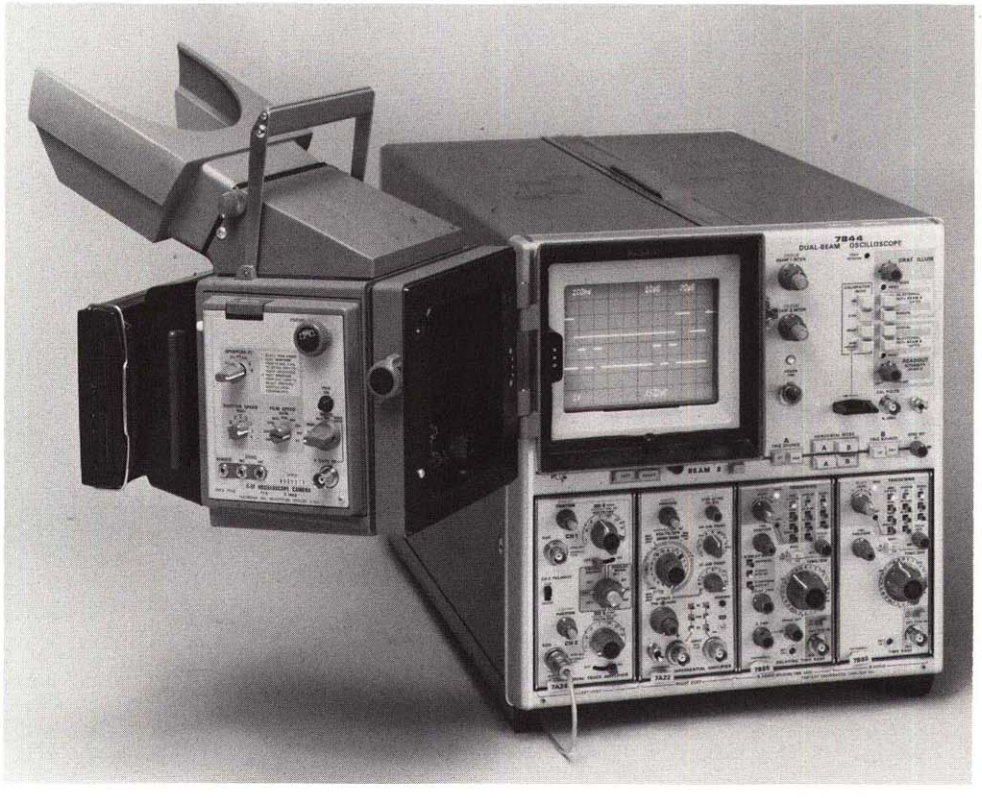
*Relative light-gathering power.

Recommended Cameras and Adapters

OSCILLOSCOPE	**RECOMMENDED CAMERA**
7904, R7903, 7844, 7704A	C-53 or C-51
7633, 7623A, 7613, 7834	C-53
7603, 7603N Opt 11S	C-59

C-50 Series Camera Adapter, Part Number 016-0249-03, included with camera.

For full details see camera section, page 225.

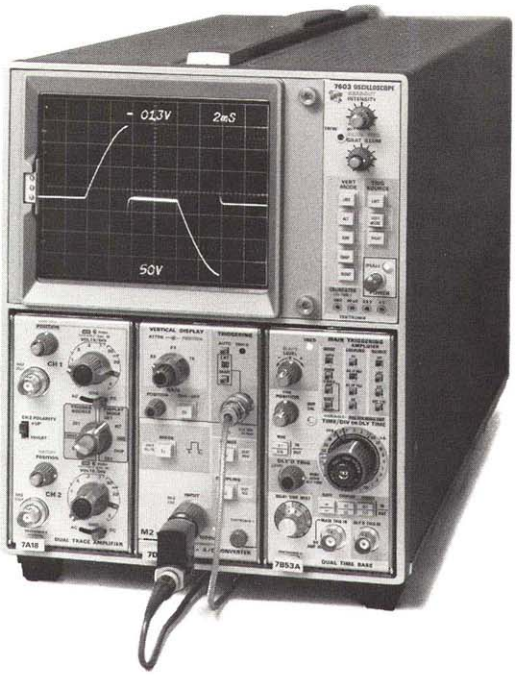


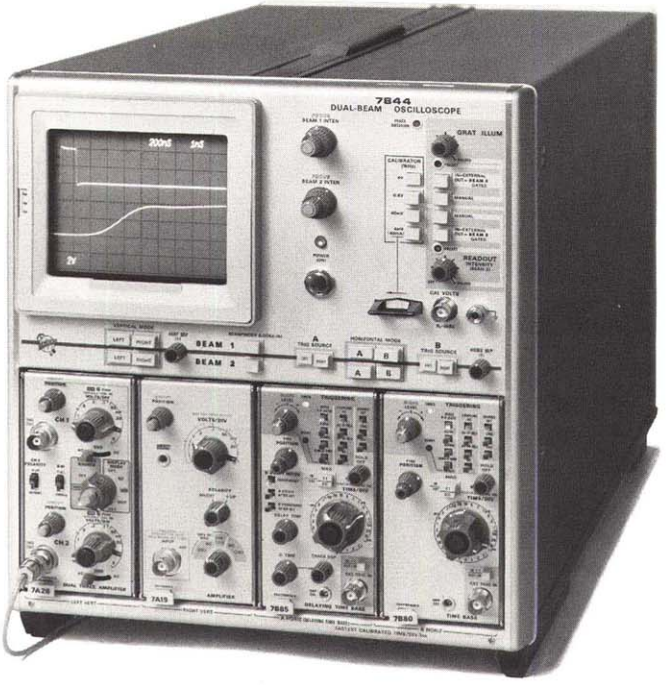
TEK Lab Cart Model 3

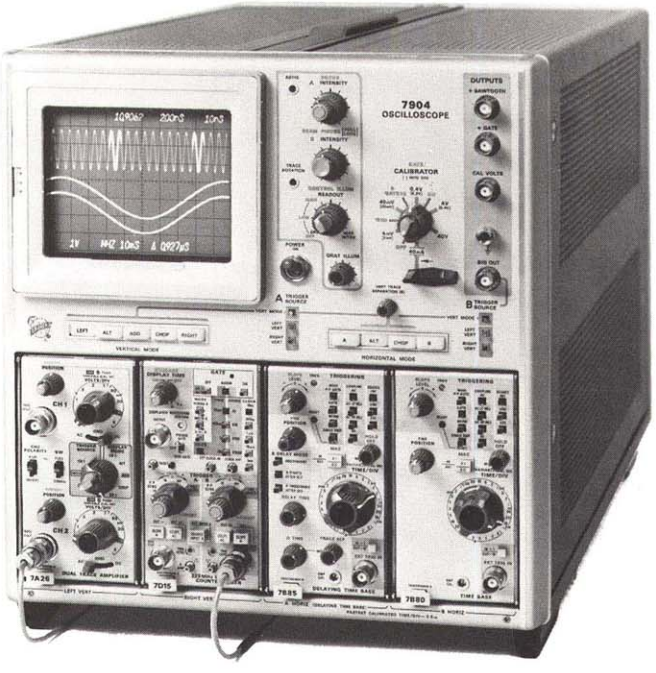
Model 3 Lab Cart accepts all 7000-Series Oscilloscopes. A lockable drawer for storage and a movable shelf for additional instrumentation are included. The shelf accepts TM 500 Test and Measurement instruments, 5000-Series Oscilloscopes, or 400-Series Oscilloscopes.

For full details see SCOPE-MOBILE® section, page 254.

7000-Series Nonstorage Mainframes





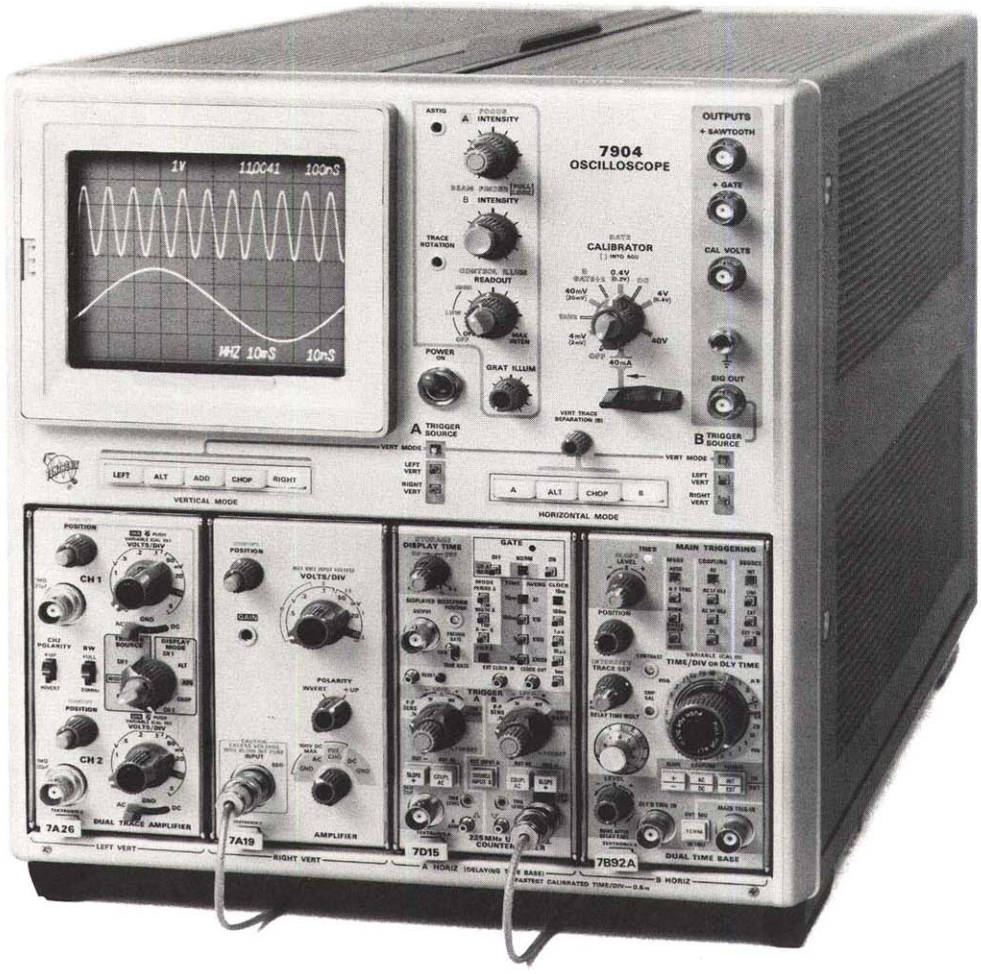


A high performance instrument system begins with the basic oscilloscope building block — the 7000-Series Mainframe. Each mainframe consists of a cathode-ray tube, a power supply, electron beam deflection systems, and the switching circuitry necessary to integrate a versatile and complete measurement system.

Choose from a variety of features, including bandwidth, dual-beam, alphanumeric displays, rack-mounting, and three- or four-plug-in flexibility:

the 7000 Series . . . more than an oscilloscope

7000-Series 500-MHz General-Purpose Oscilloscopes



500 MHz at 10 mV/div

1-GHz Direct-access Unit (less than 4 V/div)

500 ps/div Fastest Calibrated Sweep Rate

Greater than 15 cm/ns Enhanced Writing Speed

Crt Readout

Over 30 Compatible Plug-ins

900-MHz FET Probe Available

The 7904 and 5¼ in rackmount R7903 are the widest real-time-bandwidth, general-purpose oscilloscopes available today. The 7A19 Amplifier/7904 Mainframe attains 500 MHz at 10 mV. A 7A19 variable delay option allows for the matching of signal transit times of two plug-ins and their probes to better than 50 ps.

The P6201 1X FET probe gives you high impedance and wide bandwidth. It has a 900-MHz bandwidth by itself, and in combination with the 7A19/7904, it provides a system bandwidth of 450 MHz at 10 mV.

The crt, the major contributor to the performance of the 7904 and R7903, has excellent visual brightness and an 8 x 10 cm display area. The C-51R Camera, Writing Speed Enhancer, 10,000 ASA film and P11 phosphor can produce writing speeds of at least 9 cm/ns. Speeds up to 15 cm/ns are possible when an optional max-brightness crt with a 4 x 5 cm display area is used.

7904 and R7903 — VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — Repetition rate is approx 1 MHz.

Trace Separation Range (Dual-sweep Modes) — The B trace can be positioned 4 divisions above or below the A trace (7904 only).

Delay Line — Permits viewing leading edge of displayed waveform when using 7B80 and 7B90 Series Time Bases. 7B50 Series not recommended.

7904 — HORIZONTAL SYSTEM

Channels — Two right-hand plug-in compartments; compatible with time bases of the 7B80 and 7B90 Series. 7000-Series vertical amplifiers and specialized plug-ins may also be used.

Fastest Calibrated Sweep Rate — 500 ps/div with the 7B92A.

Chopped Mode — Repetition rate is approx 200 kHz.

X-Y Mode — Phase shift is within 2° from dc to 35 kHz without phase correction (dc to 1 MHz with phase correction, Option 02) between vertical and horizontal channels. Bandwidth is dc to at least 1 MHz.

R7903 — HORIZONTAL SYSTEM

Single Channel — Right-hand plug-in compartment compatible with time bases of 7B80 and 7B90 Series. 7000-Series vertical amplifiers and specialized plug-ins may also be used.

Fastest Calibrated Sweep Rate — 500 ps/div with the 7B92A.

7904 and R7903 CRT AND DISPLAY FEATURES

Standard — Internal 8 x 10 cm graticule with variable illumination. Accelerating potential is 24 kV with P31 phosphor standard.

Option 01, without Crt Readout — No crt readout.

Option 04, Max Brightness Crt — Internal 4 x 5 cm graticule with variable illumination. Accelerating potential is 24 kV. P11 phosphor provides max writing rate. This provides extremely high photographic and information writing speed and increases the visibility of low-rep-rate, high-speed signals.

Option 78, P11 Phosphor — No charge.

Option 10, Pulsed Graticule (R7903 Only) — Provides a means of pulsing the graticule lights at a preset level coincident with a single-shot event in one exposure. The graticule lights may be pulsed by the event, an external ground closure, or a front panel pushbutton. If the mainframe is equipped with crt readout, Option 10 provides additional controls and inputs for crt readout pulsed operation.

The R7903 requires only 5¼ in of rack height in a standard 19 in rack. It is fan-cooled and comes complete with slide-out chassis tracks.

Min Photographic Writing Speed (Using Polaroid Film without Film Fogging) — Can be increased by using the TEKTRONIX Writing Speed Enhancer. In typical applications P31 phosphor has approx one-half the writing speed of P11 phosphor.

Crt	Writing Speed cm/ns P11		Camera	Lens
	Type 410	Type 47		
Standard 8 x 10 cm	6.1	3.1	C-51R	f/1.2 1:0.5
Option 04 4 x 5 cm	10.0	5.0	C-51R	f/1.2 1:0.5

The following table lists the approx relative writing speed of three types of Polaroid film and the gains that can be achieved by controlled fogging with the Writing Speed Enhancer. See chart on page 55 for further information.

Polaroid Film		Approx Relative Writing Speed		
Type	ASA Equivalent Speed	Unfogged		Fogged
		Print viewed with front illumination	Print viewed with back illumination	Print viewed with front illumination*
107	3000	1 (Reference)	Print base is opaque	3
47	3000	1	1.2	3
410	10,000	2	2.2—2.4	4

*Viewing a fogged print with back illumination does not increase the apparent writing speed.

Autofocus — Reduces the need for additional manual focusing with changes in intensity after focus control has been set.

Beam Finder — Limits display within graticule area.

External Z-Axis Input — 2 V p-p for full intensity range. A positive signal blanks the trace. Max input voltage is 15 V (dc + peak ac) and p-p ac. Input is dc coupled.

7904 — CALIBRATOR

Output Waveshape — Rectangular positive-going from ground, 1 kHz (±0.25%), dc or B Gate ÷ 2.

Voltage Ranges — 4 mV, 40 mV, 0.4 V, 4 V, 40 V into an open circuit; 2 mV, 20 mV, 0.2 V, 0.4 V into 50 Ω (±1%).

Current Output — 40 mA dc or 1 kHz.

R7903 — CALIBRATOR
(Not Available with Option 10)

Output Waveshape — Rectangular positive-going from ground, 1 kHz (±0.25%).

Voltage Ranges — 4 mV, 40 mV, 0.4 V, 4 V into an open circuit; 4 mV, 40 mV, 0.4 V into 50 Ω (±1%).

Current Output — 40 mA rectangular waveshape with optional current-loop accessory (012-0341-00) connected to calibrator output. Output R is 450 Ω.

7904 — OUTPUTS/INPUTS

+Sawtooth — Sawtooth starts 1 V or less from ground (into 1 MΩ). Internally selectable from A or B horizontal. Output voltage is 50 mV/div (±5%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is approx 950 Ω.

+GATE — Positive-going rectangular waveform derived from A, B, or Delayed Gate, internally selectable. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%) into 1 MΩ. Rise time is 5 ns or less into 50 Ω; output R is approx 950 Ω.

Sig Out — Selected by B TRIGGER SOURCE switch. Output voltage is 25 mV/div (±10%) into 50 Ω, 0.5 V/div (±10%) into 1 MΩ. Bandwidth depends upon vertical plug-in. See the Vertical System Specifications Chart. Output R is approx 950 Ω.

Camera Power — Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for C-50-Series Cameras.

Probe Power — Two rear-panel connectors provide correct operating voltages for two active probes.

R7903 — OUTPUTS/INPUTS
(Standard)

+Sawtooth — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is approx 950 Ω.

+Gate — Positive-going rectangular waveform derived from Main or Auxiliary Gate. Output voltage 0.5 V (±10%) into 50 Ω. 10 V (±10%) into 1 MΩ. Rise time is 7 ns or less into 50 Ω. Output R is approx 950 Ω.

Sig Out — Selected by TRIGGER SOURCE switches. Output voltage is 25 mV/div (±10%) into 50 Ω, 0.5 V/div (±10%) into 1 MΩ. Bandwidth depends on the vertical plug-in. See the Vertical System Specifications Chart. Output R is approx 950 Ω.

Single-sweep Ready Indicator — +5 V, rear panel BNC output, for single-sweep ready indication.

External Single-sweep Reset — Ground closure, rear panel BNC, provides input to reset sweep.

Crt Readout, Inhibit — Ground closure, rear panel BNC input locks out crt readout. Not available with Option 10.

Crt Readout, Single-shot — Ground closure, rear panel BNC input initiates one frame of crt readout. Not available with Option 10 separately, but in combination with the pulsed graticule input.

Camera Power — Three-prong connector to the left of the crt provides power, ground, and remote single sweep reset access for C-50-Series Cameras.

Probe Power — Two front-panel connectors provide correct operating voltages for two active probes. Not available for R7903 Option 10.

R7903 — OUTPUTS/INPUTS OPTIONS

Option 10, Pulsed Graticule — No crt readout single-shot input, crt readout inhibit input, calibrator, and probe power. Single-shot graticule and crt readout (ground closure) rear-panel BNC input is added. Initiates one frame of crt readout and pulses graticule. Crt readout inputs are not functional with Option 01.

POWER REQUIREMENTS

7904 Power Requirements — Line voltage ranges, 90 to 132 V ac and 180 to 264 V ac. Line frequency, 48 to 440 Hz. Max power consumption, 190 W, 2.5 A at 115 V line, 60 Hz.

R7903 Power Requirements — Line voltage ranges, 90 to 132 V ac and 180 to 264 V ac. Line frequency, 48 to 440 Hz. Max power consumption, 160 W, 2 A at 115 V line, 60 Hz.

7904 Included Accessories — Test adapter (012-0092-00); two 18 in test leads (012-0087-00); 9-pin cable-mount plug (134-0049-00).

R7903 Included Accessories — Test adapter (012-0092-00); two 18 in test leads (012-0087-00); rack-mounting hardware.

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

7904 ORDERING INFORMATION
(Plug-ins not Included)

7904 Oscilloscope $4500

7904 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 02	X-Y Horiz Comp	Add $100
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $350
Option 78	P11 Phosphor	No charge

7904 CONVERSION KITS

040-0605-03	Crt Readout	$600
040-0606-00	X-Y Horiz Comp	$125
040-0570-00	Emi Modification	$200

R7903 ORDERING INFORMATION
(Plug-ins not Included)

R7903 Oscilloscope $4150

R7903 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $350
Option 10	Pulsed Graticule	Add $100
Option 78	P11 Phosphor	No charge

R7903 CONVERSION KITS

040-0605-03	Crt Readout	$600
040-0647-00	Emi Modification	$170

7000-Series 400-MHz Dual-Beam Oscilloscopes

400-MHz Bandwidth

Dual Beam

Full Vertical Crossover Switching

8 x 10 cm Full Scan Overlap Crt

Crt Readout

1 ns/div Max Calibrated Sweep

1-GHz Direct-access Unit (less than 4 V/div)

The 7844 and 7 inch rackmount R7844 are wide bandwidth, dual-beam oscilloscopes designed primarily for fast, single-shot events. Unique features such as pulsed graticule and pulsed crt readout allow you to photograph vertical and horizontal scale factors, test date, test number, and other pertinent data before or after an event. Vertical signal crossover switching permits you to view a single event from a single probe at two sweep speeds.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit.

Display Logic —

	Beam 1	Beam 2
Vertical Compartment Controlling Beam	Left	Left
	Left	Right
	Right	Left
	Right	Right

Vertical Crossover — Permits viewing the same signal on two time bases.

Vertical Trace Separation — Beam 1 can be positioned ±4 cm with respect to Beam 2.

Delay Line — Permits viewing leading edge of displayed waveform when using 7B70, 7B80, and 7B90 Series Time Bases; not compatible with 7B50 Series.

HORIZONTAL SYSTEM

Channels — Two right-hand plug-in compartments; compatible with time bases of the 7B80 and 7B90 Series. 7000-Series vertical amplifiers and specialized plug-ins may also be used. 7B53AN11 requires modification for use in the 7844.

Fastest Calibrated Sweep Rate — 1 ns/div.

X-Y Mode — Phase shift is within 2° from dc to 50 kHz.

Bandwidth — Dc to at least 1 MHz.

Horizontal Separation — Beam 1 can be positioned at least 0.25 cm to the right and at least 0.25 cm to the left of Beam 2 with a total 2 cm range.

Display Logic —

Beam 1	Beam 2
A Horizontal	A Horizontal
A Horizontal	B Horizontal
B Horizontal	A Horizontal
B Horizontal	B Horizontal

CRT AND DISPLAY FEATURES

Crt — Dual beam, full overlap. 8 x 10 cm graticule with variable illumination. Crt readout intensity is adjustable with front-panel control. Accelerating potential is 24 kV with P31 phosphor standard.

Option 78, P11 Phosphor — No charge.

Autofocus — Reduces the need for additional manual focusing with changes in intensity after focus control has been set.

Beam Finder (Beam 1 and Beam 2, Independent Controls) — Limits display within graticule area and intensifies beam.

External Z-Axis Input (Beam 1 and Beam 2) — 2 V p-p for full intensity range. A positive signal blanks the trace. Max input voltage is 15 V (dc + peak ac) and p-p ac. Input is dc coupled.

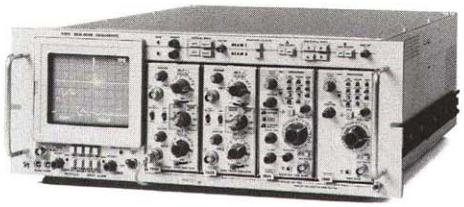
Minimum Photographic Writing Speed — 1.7 cm/ns using Polaroid type 47 film, C-51R and optional P11 phosphor. In typical camera applications, P31 phosphor has about one-half the writing speed of P11 phosphor. Writing speed can be increased by using the TEKTRONIX Writing Speed Enhancer or Polaroid type 410 film or both.

The following table lists the approx relative writing speed of three types of Polaroid film and the gains that can be achieved by controlled fogging with the Writing Speed Enhancer.

Polaroid Film		Actual Relative Film Writing Speed		
Type	ASA Equivalent Speed	Unfogged		Fogged
		Print viewed with front illumination	Print viewed with back illumination	Print viewed with front illumination*
107	3000	1 (Reference)	Print base is opaque	3
47	3000	1	1.2	3
410	10,000	2	2.2—2.4	4

*Viewing a fogged print with back illumination does not increase the apparent writing speed.

The Photographic Writing Speed Enhancer (Opt 22) provides a preset automatic method of photographic writing speed enhancement. Opt 22 is recommended for writing speed enhancement when a camera with a writing speed enhancer is not available. With Opt 22, photographic writing speed can be increased approx 2 times.



PULSED READOUT AND GRATICULE ILLUMINATION

Provides a means of pulsing the graticule lights or crt readout at a preset level, coincident with a single-shot event in one exposure. The graticule lights or crt readout can be pulsed by the event, an external ground closure, or front-panel pushbutton.

CALIBRATOR

Calibrator — Rectangular positive-going waveform from ground, 1 kHz (±0.25%).

Voltage Ranges — 4 mV, 40 mV, 0.4 V, 4 V (±1%) into an open circuit; 0.4 mV, 4 mV, 40 mV, 0.4 V (±1%) into 50 Ω.

Current Output — 40-mA (±1%) rectangular waveshape, front panel current loop 7844, optional current loop adapter (012-0341-00) required for R7844.

OUTPUTS/INPUTS

A and B + Sawtooth — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is approx 950 Ω.

A and B + Gate — Positive-going rectangular waveform derived from Main or Delayed Gate. Output voltage 0.5 V (±10%) into 50 Ω. 10 V (±10%) into 1 MΩ. Rise time is 5 ns or less into 50 Ω. Output R is approx 950 Ω.

Single-sweep Ready Indicator — +5 V, rear panel BNC output, for single-sweep ready indication.

External Single-sweep Reset — Ground closure, rear panel BNC, provides input to reset sweeps.

Camera Power — Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for C-50-Series Cameras.

Probe Power — Two connectors provide correct operating voltages for two active probes.

POWER REQUIREMENTS

Line Voltage Ranges — Selectable 115 V nominal (90-132 V), 230 V nominal (180-264 V).

Line Frequency — 48 to 440 Hz.

Max Power Consumption — 235 W, 2.9 A at 60 Hz 115 V line.

INCLUDED ACCESSORIES

R7844 — 1 rackmount hardware kit, 1 rackmount slide guide (351-0314-00).

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION

(Plug-ins not Included)

7844 Oscilloscope **$6800**

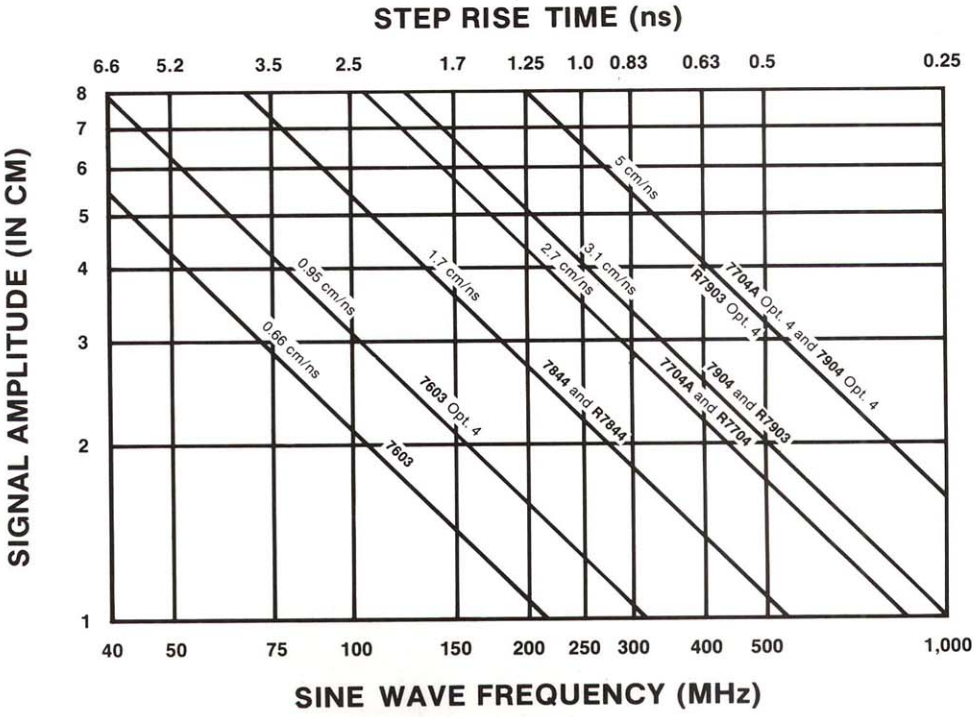
R7844 Oscilloscope **$7000**

OPTIONS

Option 03 Emi Modification ..... **Add $100**

Option 22 Writing Speed Enhancer Modification ..... **Add $275**

Option 78 P11 Phosphor ..... **No charge**



The above graph shows the relationship of writing speed to practical measurement parameters of signal amplitude and frequency or rise time.

The vertical scale is the maximum peak-to-peak signal amplitude. The horizontal scale below the graph is maximum sine-wave frequency. Above the graph, the horizontal scale is the equivalent signal rise time for nonsinusoidal signals. These speeds assume a horizontal spot velocity that is small compared to the maximum vertical velocity. The step rise time is assumed to be a linear ramp measured between 10% and 90% points. The diagonal lines represent the minimum photographic writing speeds for 7000-Series Mainframes and are all measured under the following conditions: Camera, TEKTRONIX type C-51R, f 1.2, with the shutter opened before the sweep and closed 5 seconds after the sweep. Phosphor, P11 (optional). Film, Polaroid type 47 (ASA 3,000), no fogging for film speed enhancement, developed for 20 seconds at 25°C and viewed with back illumination.

7704A
R7704

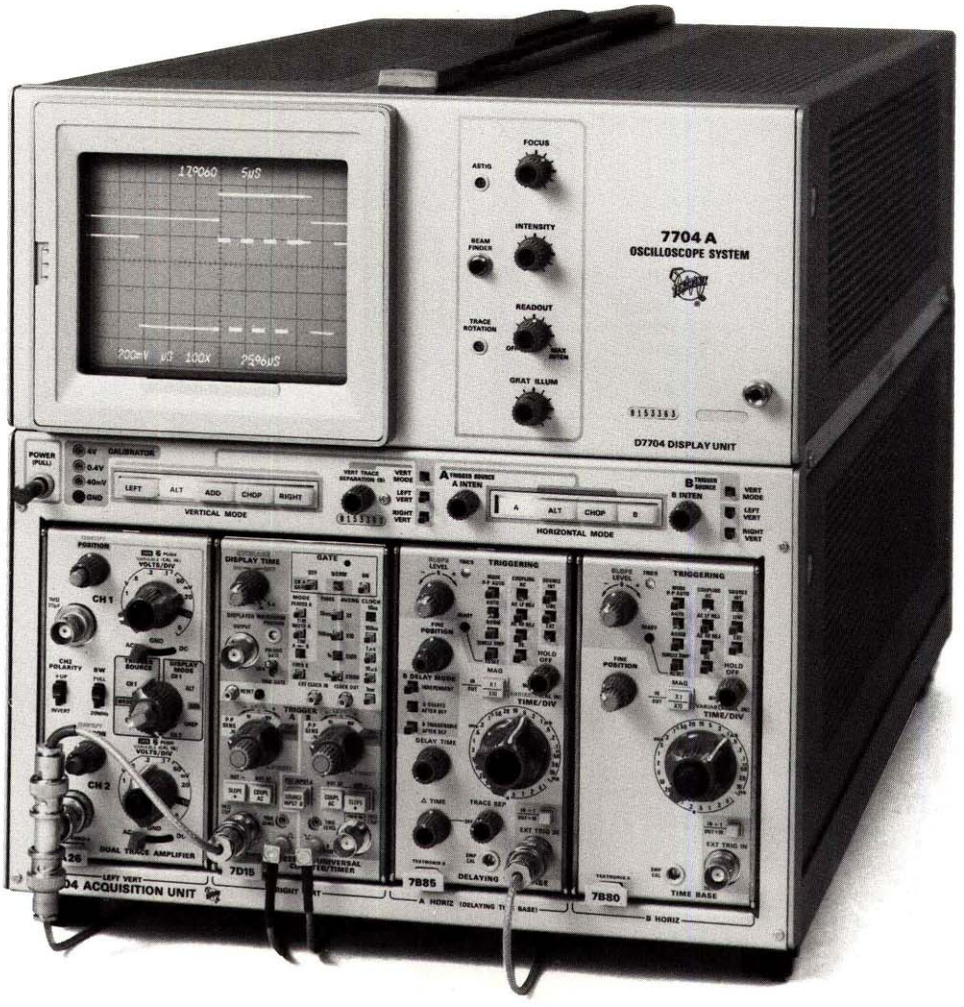
7000-Series 250-MHz General-Purpose Oscilloscope System

Dc to 200 MHz with Optimum Pulse Response

Dc-to-250 MHz Bandwidth Option

Greater than 15 cm/ns Enhanced Writing Speed with Optional Crt and WSEN

Crt Readout



The 7704 family is a wide bandwidth general-purpose oscilloscope measurement system.

The 7704A Oscilloscope offers you the capability to optimize the oscilloscope's response for your type of work. For pulse analysis, aberrations are reduced below the normal level in the optimized transient response version while still giving you a bandwidth of 200 MHz. The 250 MHz option is optimized for bandwidth performance for high-frequency applications. The R7704 offers a 175 MHz bandwidth.

The 7704A modularity permits the addition of a processing module. With this addition and a Controller, the 7704A is converted into a Digital Processing Oscilloscope. This modularity also provides for easy maintenance.

Quite often the need arises to photograph the waveforms that are produced. The 7704A gives you a choice of two designs available for this purpose: the standard 8 x 10 cm crt and an optional 4 x 5 cm reduced-scan crt for high writing-speed applications. The standard crt affords 5.3 cm/ns writing speed (C-51R Camera, P11 phosphor, and 10,000 ASA film), without enhancement, and 8 cm/ns with the TEKTRONIX Writing Speed Enhancer. With the optional crt and film fogging technique, writing speed can be increased to at least 15 cm/ns. This writing speed reserve means reduced intensity setting for improved trace definition. See chart on page 55 for additional information.

Characteristics are common to all mainframes unless noted.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit; see Vertical System Specifications Chart.

Option 09 Bandwidth Change (250 MHz) — 7704A vertical circuit performance is adjusted to extend frequency response to 250 MHz at 20 mV/div (upper —3 dB) when 7A19 is used. Provides additional performance for those working in this frequency domain.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — 7704A, repetition rate is internally selectable, approx 100 kHz or 1 MHz; R7704, fixed at approx 1 MHz.

Trace Separation Range (Dual-sweep Modes) — The B trace can be positioned above or below the A trace.

Delay Line — Permits viewing leading edge of waveform.

HORIZONTAL SYSTEM

Channels — Two right-hand plug-in compartments; compatible with all 7000-Series Plug-ins.

Fastest Calibrated Sweep Rate — 2 ns/div with 7B80 or 7B90 Series.

Chopped Mode (between Horizontal Plug-ins) — 7704A, repetition rate is internally selectable, approx 20 kHz or 200 kHz; R7704, fixed at approx 200 kHz.

X-Y Mode — Phase shift is within 2° from dc to 50 kHz (7704A), from dc to 35 kHz (R7704) between vertical and horizontal channels. Frequency response at 10% down is dc to at least 3 MHz.

Option 02, X-Y Horizontal Compensation (R7704 only) — Provides phase shift compensation to less than 2° from dc-to-2 MHz.

CRT

Standard — Internal 8 x 10 cm graticule with variable illumination. Accelerating potential is 24 kV with P31 phosphor standard.

Option 01, without Crt Readout — No crt readout.

Option 04, Max Brightness Crt (7704A Only) — Internal 4 x 5 cm graticule with variable illumination. Accelerating potential is 24 kV with P31 phosphor standard, P11 optional. This provides extremely high photographic and information writing speed and increases the visibility of low-rep-rate, high-speed signals.

Option 78, P11 Phosphor — No charge.

Minimum Photographic Writing Speed (Using Polaroid Film without Film Fogging) — Can be increased by using the TEKTRONIX Writing Speed Enhancer. In typical application, P31 phosphor has approx one-half the writing speed of P11 phosphor. See chart on page 55 for further information.

Mainframe	P11 Writing Speed cm/ns		Camera	Lens
	Type 410	Type 47		
7704A R7704 8 x 10 cm	5.3	2.7	C-51R	f/1.2 1:0.5
7704A Option 04 4 x 5 cm	10.0	5.0		

Autofocus — Reduces the need for additional manual focusing with changes in intensity after focus control has been set.

Beam Finder — Limits display within graticule area.

External Z-Axis Input (7704A only) — 2 V p-p for full intensity range. A positive signal blanks the trace. Max input voltage is 15 V (dc + peak ac) and p-p ac. Input is dc-coupled.

External Z-Axis Inputs (R7704 only) — High sensitivity input: minimum pulse width to blank trace is 30 ns at 2 V; 2 V p-p for full intensity range from dc to 2 MHz; intensity range diminishes to 20% of full range at 10 MHz. A positive signal blanks the trace; input R is 500 Ω within 10%. Max input voltage is 15 V (dc + peak ac) and p-p ac.

High Speed Input — Minimum pulse width to blank trace is 3.5 ns at 60 V; 60 V p-p for fully intensity range from dc to 100 MHz. A positive signal blanks the trace; input R is 18 kΩ within 20%. Max input voltage is 60 V (dc + peak ac) and p-p ac.

OUTPUTS/INPUTS

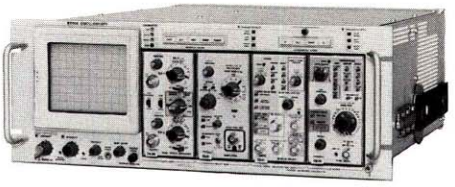
+ Sawtooth — Sawtooth starts 1 V or less from ground (into 1 MΩ). Internally selectable from A or B horizontal. Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is 950 Ω nominal.

+ Gate — Positive-going rectangular waveform derived from A, B, or Delayed Gate, internally selectable. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%) into 1 MΩ. Rise time is 20 ns or less into 50 Ω; output R is 950 Ω nominal.

Sig Out — Selected by B TRIGGER SOURCE switch. Output voltage is 25 mV/div (±10%) into 50 Ω, 0.5 V/div (±10%) into 1 MΩ. The bandwidth depends upon vertical plug-in; see Vertical System Specifications Chart. Output R is 950 Ω nominal.

External Single-sweep Reset — Ground closure, rear-panel input to reset sweep.

Option 07, without Signal Outputs/Inputs (7704A only) — Without previously described outputs/inputs and External Z-Axis input.



The R7704 requires 7 inches of rack height and offers 175 MHz bandwidth.

Camera Power — Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

Probe Power — Two rear-panel connectors provide correct operating voltages for two active probes. R7704 connectors are located on both the front and rear panels. Probe power is deleted on Option 01 of 7704A.

CALIBRATOR

Voltage Output — Rectangular waveshape, positive-going from ground (40 V and 4 mV available when selected by internal jumper). Ranges are 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15°C to +35°C); within 2% (0°C to +50°C). Repetition rate is approx 1 kHz.

Current Output — 40 mA rectangular waveshape with optional current-loop accessory (012-0259-00) connected between 4 V and gnd pin jacks.

POWER REQUIREMENTS

Line Voltage Ranges — 90 to 132 V ac and 180 to 264 V ac.

Line Frequency — 48 to 440 Hz (7704A), 48 to 66 Hz (R7704).

Option 05, Line Frequency Change (50-400 Hz) — Converts the R7704 to 50-400 Hz operation (not required for 7704A).

Max Power Consumption — 180 W, 2.5 A at 115 V line 60 Hz (7704A); 225 W, 2.8 A at 115 V line, 60 Hz (R7704).

Included Accessories — For 7704A: 20 in cable, two-pin-to-BNC, (175-1178-00). For R7704: 42 in BNC 50-Ω cable (012-0057-01); 20 in cable, two-pin-to-BNC (175-1178-00); rackmounting hardware.

Weights and Dimensions — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION
(Plug-ins not Included)

7704A Oscilloscope $2900

R7704 Oscilloscope $3900

7704A OPTIONS

Option 01	without Crt Readout and Probe Power	Sub $400
Option 03	Emi Modification	Add $100
Option 04 (Specify Phosphor)	Max Brightness Crt	Add $350
Option 09	Bandwidth Change (250 MHz)	No charge
Option 78	P11 Phosphor	No charge

R7704 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 02	X-Y Horiz Comp	Add $100
Option 03	Emi Modification	Add $100
Option 05 (50-400 Hz) (not required for 7704A)	Line Freq Change	Add $125
Option 78	P11 Phosphor	No charge

7704A CONVERSION KITS

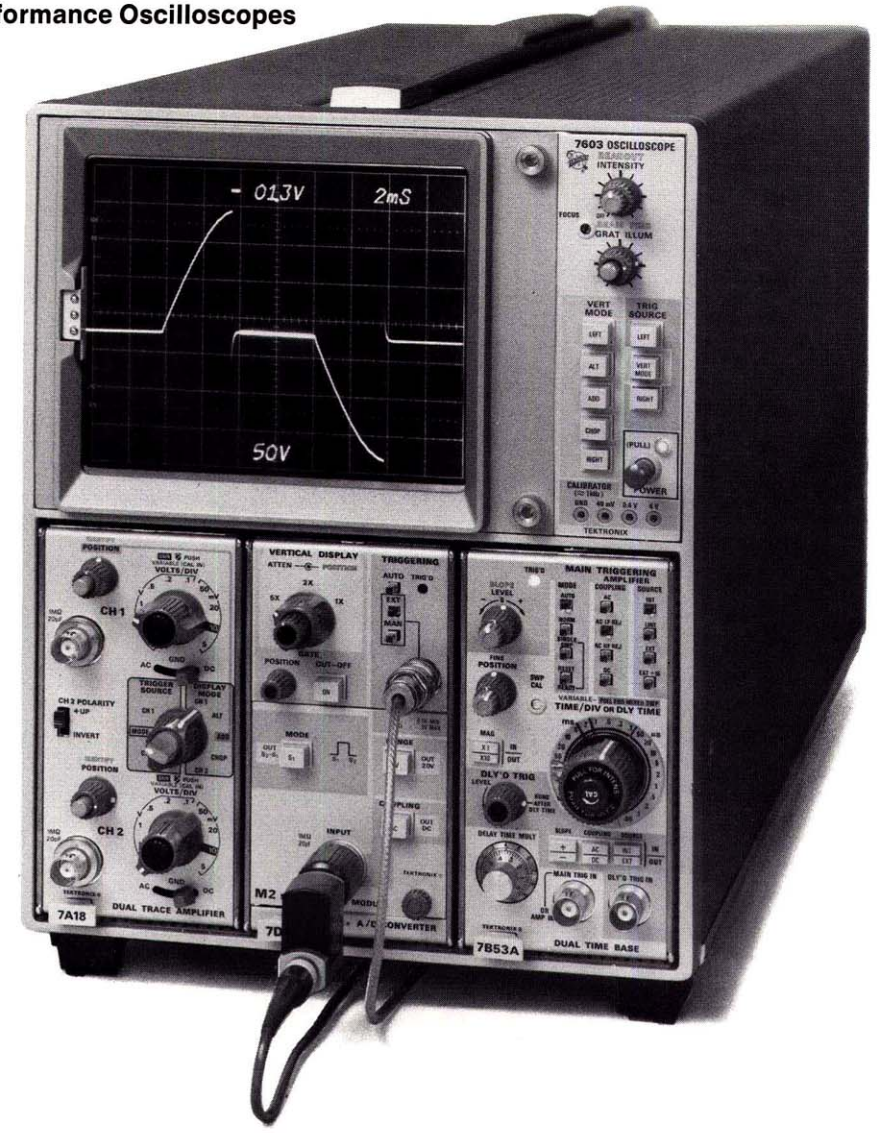
040-0613-00	Crt Readout and Probe Power	$600
040-0612-00	Emi Modification	$180
040-0619-00	Sig Out/In	$125

R7704 CONVERSION KITS

040-0533-01	Crt Readout	$600
040-0529-00	X-Y Horiz Comp	$110
040-0562-00	Emi Modification	$155

7603
R7603

7000-Series 100-MHz Wide Performance Oscilloscopes



Dc-to-100 MHz Bandwidth

6½ in Crt

Crt Readout

5¼ in Rackmount

The TEKTRONIX 7603 and R7603 Oscilloscopes represent the best price/performance ratio available in the 100-MHz plug-in oscilloscope market today.

The crt is large, 8 x 10 div (1.22 cm/div), and features an internal graticule with variable illumination and 15 kV accelerating potential. An optional maximum brightness crt with a smaller 8 x 10 cm display and 18 kV potential gives you greater visual brightness and higher photographic writing speed.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit; see Vertical System Specifications Chart.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — Repetition rate is approx 1 MHz.

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channels — One right-hand plug-in compartment; compatible with all 7000-Series Plug-ins.

Fastest Calibrated Sweep Rate — 5 ns/div.

X-Y Mode — The phase shift between vertical and horizontal channels is within 2° from dc to 35 kHz. Bandwidth is dc to at least 2 MHz.

CRT AND DISPLAY FEATURES

Standard — Internal 8 x 10-div (1.22 cm/div) graticule with variable illumination. Accelerating potential is 15 kV with P31 phosphor.

Option 01, without Crt Readout — No crt readout.

Option 04, Max Brightness Crt — Internal 8 x 10 cm graticule with variable illumination. Accelerating potential is 18 kV with P31 phosphor standard.

Option 06, Spectrum Analyzer Graticule.

Optional Phosphors (Specify) — P7, P11, or P7/SA. (Phosphor/Spectrum Analyzer graticule combination.)

Minimum Photographic Writing Speed — Using Polaroid film without film fogging. Can be increased by using the TEKTRONIX Writing Speed Enhancer.

Crt	Writing Speed div/μs				Camera	Lens
	Type 107/47		Type 410			
	P31	P11	P31	P11		
Standard 8 x 10 div (1.22 cm/div)	100	150	200	300	C-50	f/1.9 1:0.7
Option 04 8 x 10 div (1 cm/div)	200	300	400	600		

External Z-Axis Input — 2 V p-p for full intensity range from dc to 2 MHz; intensity range diminishes to 20% of full range at 10 MHz. A positive signal blanks the trace. Max input voltage is 10 V (dc + peak ac) and p-p ac.

Autofocus — Reduces the need for additional manual focusing with changes in intensity after focus control has been adjusted.

Beam Finder — Limits display within graticule area.

OUTPUTS/INPUTS

+SAWTOOTH — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output R is 950 Ω. Output voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω.

+Gate — Positive pulse of the same duration and coincident with sweep. Output R is 950 Ω. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Rise time is 20 ns or less into 50 Ω. Source is selectable from Main, Delay, or Auxiliary Gate.

Sig Out — Selected by TRIGGER SOURCE switch. Output voltage is 0.5 V/div (±10%) into 1 MΩ, 25 mV/div (±10%) into 50 Ω. Output R is 950 Ω. Bandwidth depends upon vertical plug-in; see Vertical System Specifications Chart.

External Single-sweep Reset — Ground closure, rear panel BNC provides input to reset sweep.

Single-sweep Ready Indicator — Rear panel BNC provides 5 V for single-sweep ready condition.

Option 07, without Signal Outputs/Inputs — No outputs/inputs.

CAMERA POWER OUTPUT

Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

CALIBRATOR

Voltage Output — Rectangular waveshape, positive-going from ground (dc voltage available when selected by internal jumper). Ranges are 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15°C to +35°C); within 2% (0°C to +50°C). Repetition rate is approx 1 kHz.

Current Output — 40-mA rectangular waveshape (dc current available when selected by internal jumper) with optional current-loop accessory (012-0259-00) connected between 4 V and gnd pin jacks.

POWER REQUIREMENTS

Line Voltage Ranges — 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick-change jumpers.

Line Frequency — 50 Hz to 400 Hz (7603); 50 Hz to 60 Hz (R7603).

Option 5, Line Frequency Change (50-400 Hz) — Converts the R7603 to 50-400 Hz operation (not required for 7603).

Max Power Consumption — 180 W, 2.0 A at 115 V line, 60 Hz. Cooling is provided by a fan for the R7603.

Included Accessories — (For 7603 and R7603) 20 in cable (two-pin-to-BNC) (175-1178-00); crt filter (Blue 337-1700-01, Clear 337-1700-04). The R7603 includes rackmounting hardware.

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

The R7603 requires only 5¼ in of rack height in a standard 19 in rack. It is fan cooled and comes complete with slide-out chassis tracks.

ORDERING INFORMATION

(Plug-ins not Included)

7603 Oscilloscope $1850

R7603 Oscilloscope $2050

7603 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $100
Option 06	with Internal Spectrum Analyzer Graticule	No charge
Option 07	without Sig Out/In	Sub $50
Option 08	Protective Panel Cover	Add $100

R7603 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $100
Option 05	Line Freq Change (50-400 Hz) (not required for 7603)	Add $125
Option 06	with Internal Spectrum Analyzer Graticule	No charge
Option 07	without Sig Out/In	Sub $50

7603 CONVERSION KITS

040-0654-02	Crt Readout	$550
040-0662-00	Emi Modification	$165
040-0629-01	Sig Out/In	$120
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30
040-0718-00	X-Y Horiz Comp	$150

R7603 CONVERSION KITS

040-0674-02	Crt Readout	$550
040-0679-00	Emi Modification	$165
040-0633-00	Sig Out/In	$85
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30
040-0718-00	X-Y Horiz Comp	$150

PHOSPHOR OPTIONS (7603/R7603)

Option 76	P7 Phosphor	No charge
Option 77	P7 Phosphor with Internal Spectrum Analyzer Graticule	No charge
Option 78	P11 Phosphor	No charge

7000-Series Ruggedized Oscilloscope System | 7603N11S

Ruggedized for Extreme Environments

Meets or Exceeds MIL-O-24311 (EC) (AN/USM-281C Specifications)

Large Bright Display—6½ in Crt (15 kV)

5 ns/div Delaying Sweep

0.5 mV Vertical Sensitivity

Three-plug-in Flexibility

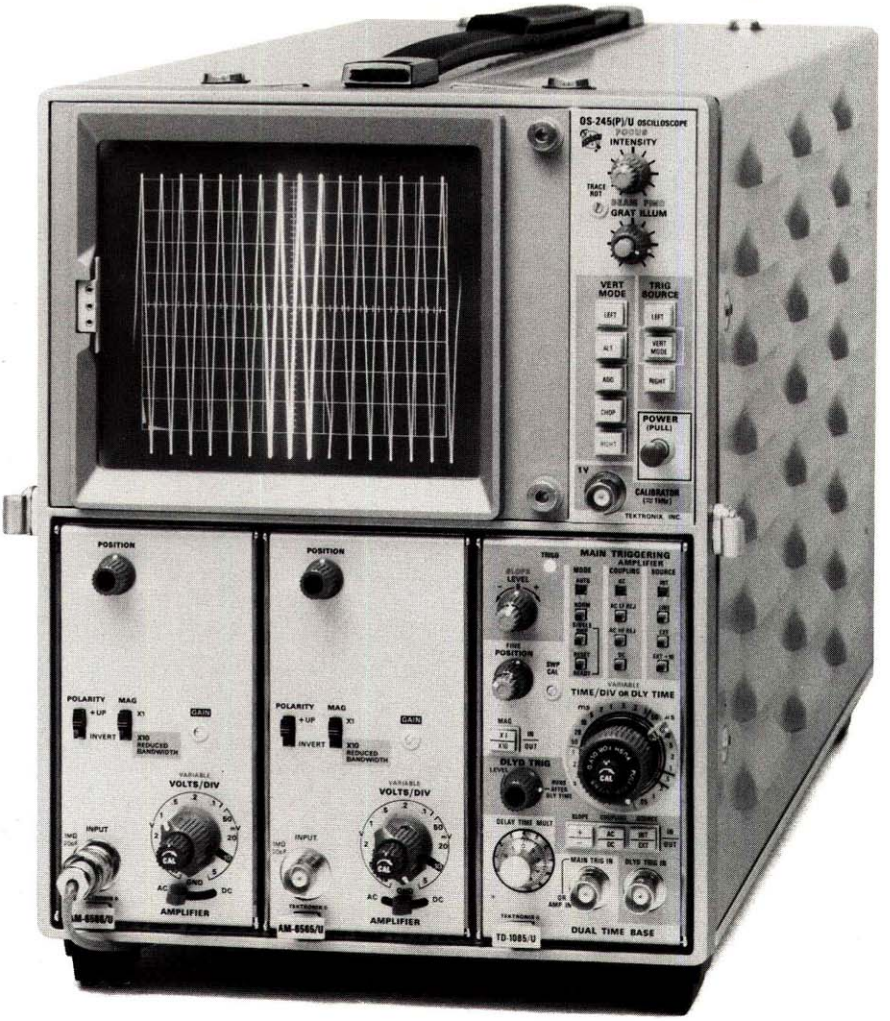
Versatile Trigger-source Selection

Pushbutton Switching

Illuminated No-Parallax Graticule

Color-keyed Panels

Protective Cover with Accessories



The 7603N11S Ruggedized Oscilloscope System meets the rigid environmental and electrical specifications required by MIL-O-24311 (EC) and appears on U.S. Navy QPL-24311. The system consists of a three-plug-in mainframe, two single-trace amplifiers, a dual time base, and a front-panel cover with probes and accessories.

Although the military spec requires only 50-MHz performance, this system actually performs to 65 MHz. Other better-than-required specs include operating altitude, sensitivity at reduced bandwidth with X10 gain, "X" sensitivity in X-Y mode, triggering frequency range, delaying and delayed sweep speeds, and crt size.

7603N11S Ruggedized Oscilloscope System

The mainframe and plug-ins are compatible with the TEKTRONIX 7000-Series product line. The system does not have crt readout, and it can't be used with the digital plug-ins.

ENVIRONMENTAL

Temperature — Nonoperating −62°C to +75°C, operating −28°C to +65°C.

Humidity — 0 to 95% rh over entire temperature range, operating or nonoperating.

Altitude — Nonoperating sea level to 50,000 ft, operating sea level to 15,000 ft.

Vibration (Operating) — 5 to 15 Hz at 0.060 in ±0.012 in p-p amplitude, 16 to 25 Hz at 0.040 in ±0.008 in p-p amplitude, 26 to 33 Hz at 0.020 in ±0.004 in p-p amplitude.

Shock (Operating) — 9 consecutive 400-pound hammer blows without failure from 1, 3, and 5 ft in vertical, horizontal, and longitudinal axis as per MIL-S-901 for Grade A, Class 1, Type A for lightweight equipment.

Inclination (Operating) — As per MIL-E-16400.

Drip Proof (Nonoperating) — As per MIL-STD-198.

Salt Spray (Nonoperating) — As per MIL-E-16400.

Electromagnetic Interference — As per MIL-STD-462 performed by MIL-STD-461 for the following tests:

CE-01	30 Hz to 20 kHz	Power lead emission
CE-03	20 kHz to 50 MHz	Power lead emission
CS-01	30 Hz to 50 kHz	Power lead, radiation susceptibility
CS-02	50 kHz to 4C0 MHz	Power lead, radiation susceptibility
CS-06	Spike Test	Power lead, spike susceptibility
RE-01	30 Hz to 30 kHz	Instrument radiation, magnetic
RE-02	14 kHz to 10 GHz	Instrument radiation, electric
RS-01	30 Hz to 30 kHz	Instrument susceptibility, magnetic
RS-03	14 kHz to 10 GHz	Instrument susceptibility, electric

Reliability — Optimum performance and reliable service are provided during continuous or interrupted operation. The MIL-O-24311(EC) MTBF requirement of greater than 600 hours is met as tested under the following conditions: temperature +40°C ±2°C; relative humidity 70% ±5%; vibration 25 Hz at 0.040 in ±0.0008 in p-p amplitude for 10 minutes of each "Power On" hour during each day of the 8 hour manned schedule; power cycled at 4 hour intervals with 10 minutes power off for each 4 hour period of the manned test schedule. An MTBF of greater than 2000 hours was achieved during testing.

VERTICAL SYSTEM
(Includes Two 7A15AN11 Plug-ins)

Channels — Two left-hand plug-in compartments, with a delay line which allows the leading edge of the displayed waveform to be viewed. All 7000-Series Plug-ins are compatible (except those which require crt readout).

Display Modes — LEFT, ALT, ADD, CHOP, RIGHT. Chopped frequency is approx 1 MHz. Added mode displays signals algebraically with a cmrr of 20:1 to 25 MHz.

Bandwidth/Sensitivity — Dc to 65 MHz from 5 mV/div to 10 V/div, accuracy within 2%, variable extends to 25 V/div. Max sensitivity is 0.5 mV at 10 MHz with X10 gain. Ac-coupling lower −3 dB point is less than 2 Hz. Rise time is 5.4 ns with less than 2% aberrations.

Input R and C — 1 MΩ within 2%, less than 27 pF.

Max Input Voltage — 400 V (dc + peak ac).

Dc Stability — Less than 1 div/hr drift at 25°C.

HORIZONTAL SYSTEM
(Includes One 7B53AN11 Plug-in)

Channels — One right-hand plug-in compartment. All 7000-Series Plug-ins are compatible (except those which require crt readout).

Internal Trigger Modes — LEFT VERT, VERT MODE, RIGHT VERT.

X-Y Mode — The phase shift between vertical and horizontal channels is less than 2° from dc to 35 kHz. Bandwidth is at least 2 MHz. Rise time is less than 175 ns. Using the 7B53AN11 time-base external amplifier, 10 mV, 100 mV, and 1 V sensitivities (±10%) are available. Input R and C for 7B53AN11 is 1 MΩ within 2%, 20 pF within 2 pF. Any vertical plug-in, such as the 7A15AN11, may be used in the horizontal compartment, providing a greater number of sensitivities for calibrated X-Y displays.

Sweep Display Modes — Main Sweep, Main Sweep Intensified by Delayed Sweep, Delayed Sweep.

MAIN (DELAYING) SWEEP

Sweep Rate — 0.05 μs/div to 5 s/div in 25 steps (1-2-5 sequence). 5 ns/div fastest calibrated sweep rate, obtained with X10 magnifier. The uncalibrated variable is continuous between steps and to 12.5 s/div.

Sweep Accuracy — Within 3% from 0.05 μs/div to 5 s/div, within 5% at 5 ns/div.

Sweep Modes — Normal, Auto, Single Sweep.

Delay Time — Multiplier range is 0 to 10 times the Time/Div setting. Accuracy is within 1% from 0.5 s/div to 0.5 μs/div, within 2% from 5 s/div to 1 s/div. Incremental linearity is within 0.2% of full scale. Jitter is less than 1 part in 20,000 of X10 Time/Div setting.

Triggering (Source/Sensitivity) — Internal 0.5 cm to 50 MHz. External, 0.25 V to 20 MHz, 0.5 V to 50 MHz. Ext ÷ 10, 2.5 V to 20 MHz, 5 V to 50 MHz. Triggering extends to 100 MHz with reduced sensitivity in both Internal and External Modes. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF.

Triggering Frequency Range — Ac, 30 Hz to 50 MHz; ac lf Rej, 30 kHz to 50 MHz; ac hf Rej, 30 Hz to 50 kHz; dc, dc to 50 MHz. With external level range, slope is ±30 V.

DELAYED SWEEP

Triggering (Source/Sensitivity) — Internal 0.3 div to 10 MHz increasing to 1.5 div at 50 MHz. External, 0.1 V to 10 MHz increasing to 0.5 V at 100 MHz. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF.

Triggering Frequency Range — Ac, 30 Hz to 50 MHz; dc, dc to 50 MHz.

Sweep Rate — 0.05 μs/div to 0.5 s/div in 22 steps (1-2-5 sequence). The delayed sweep runs after delay time or is triggerable after delay time.

Sweep Accuracy — Within 3% from 50 ms/div to 0.5 μs/div, within 4% for all other sweep rates except the magnified X10 sweep rate of 5 ns/div, which is within 6%.

CRT

Accelerating Potential — 15 kV.

Phosphor — P31.

Graticule — Internal 8 x 10 cm with variable illumination. The 6½ in crt permits 2 cm of linear overscan in both axes, making a total viewing area of approx 10 x 12 cm.

Crt Controls — Located on front panel are Focus, Intensity, Graticule Illumination, Beam Finder, and Trace Rotation. Astigmatism is an internal control.

External Z-Axis Input (BNC Connector on Rear Panel) — 2 V p-p for full intensity range from dc to 2 MHz, intensity range diminishes to 20% of full range at 10 MHz. Max input voltage is 10 V (dc + peak ac).

OUTPUTS

Calibrator (BNC Connector on Front Panel) — 1 V within 1%, 1 kHz square wave within 20%.

Horizontal — Main Sweep +5 V, Delayed Sweep +5 V, Main Sweep Gate +2 V, Delayed Sweep Gate +2 V, Delayed Trigger +1 V with pulse width of greater than 50 ns. All amplitudes are minimum and measured when working into at least 100 kΩ and 15 pF.

POWER REQUIREMENTS

Input Voltages — 100, 110, 120, 220, and 240 V ac ± 10% internally selectable with quick-change jumpers with 47.5—440 Hz single phase line frequency. Max power consumption is 125 W.

C281 COVER WITH ACCESSORIES

The cover provides protection during transport and packages the included accessories.

INCLUDED ACCESSORIES
(All Packaged in Cover)

Two P6006 probe packages (010-0127-00); two 8 ft long 50-Ω BNC cables (012-0366-00); two BNC female to uhf male adapters (103-0015-00); two BNC male to uhf female adapters (103-0032-00); two BNC male to binding post adapters (103-0033-00); two BNC T connectors (103-0030-00). One set of technical manuals (not packaged in cover).

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION

7603N11S Oscilloscope System (AN/USM-281C)
Order 7603NMS **$3450**

System Includes — One each 7603N11 Oscilloscope, two each 7A15AN11 Amplifier Plug-ins, one each 7B53AN11 Time Base*, and one each C281 Cover with Accessories.

To Order Separately:

7603N11 Oscilloscope (OS-245(P)/U) **$1775**

7A15AN11 Amplifier Plug-in (AM-6565/U) **$350**

7B53AN11 Time Base* Plug-in (TD-1085/U) **$975**

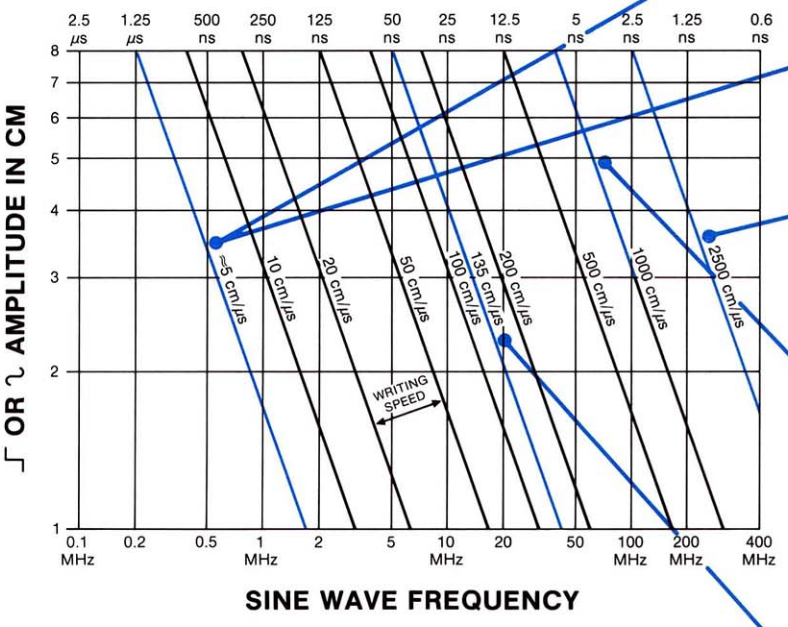
016-0553-00, C281 Cover W/Accessories **$120**

*Not compatible with 7844.

7000-Series Storage Mainframes

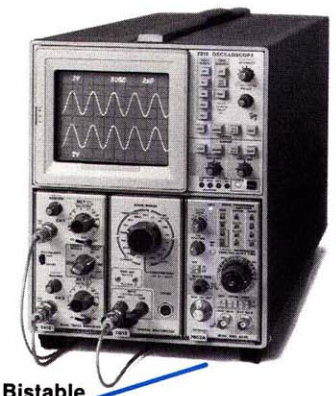
Storage mainframes in the 7000 Series offer a full selection of stored writing speeds: from ≈0.03 cm/μs for mechanical, spectrum analysis, or TDR applications, to 2500 cm/μs for capturing fast single events such as high speed digital logic. A selection of storage modes offer the following features:

Bistable	**Long View Time**
Variable Persistence	**High Contrast Displays**
FAST Bistable	**Captures Fast Single or Multiple Events**
FAST Variable Persistence	**Provides Maximum Stored Writing Rate**



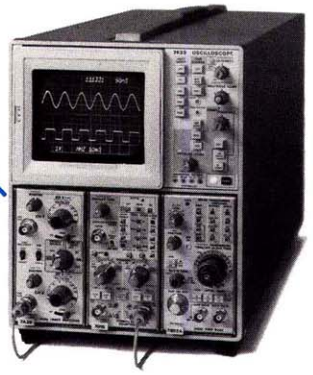
Graph shows the stored writing speed needed to display a given sine wave or step rise time at a given amplitude.

7613
Variable Persistence

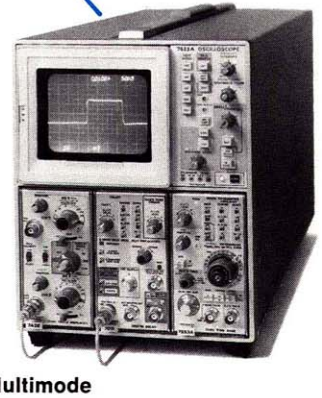


7313
Split Screen Bistable

7834
FAST Multimode



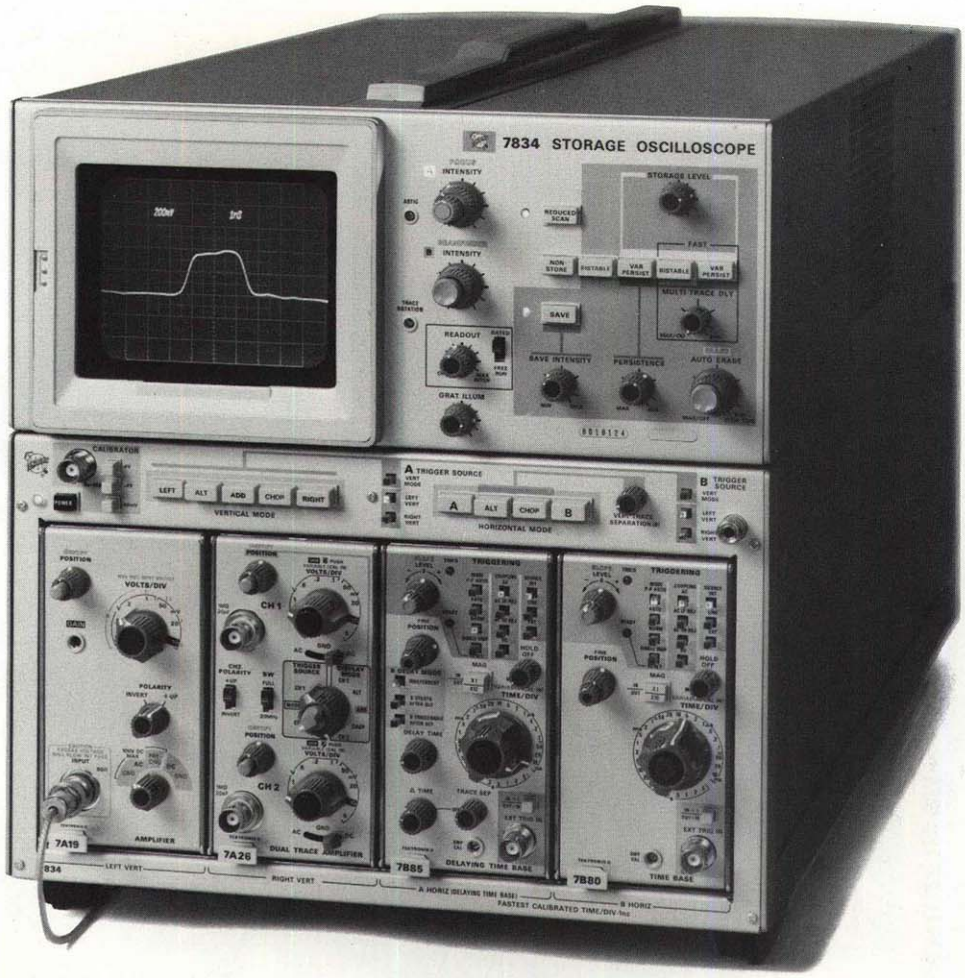
7633
FAST Multimode



7623A
FAST Multimode

7800-Series Storage	**400 MHz**	**page 62**
7600-Series Storage	**100 MHz**	**page 64**
7300-Series Storage	**25 MHz**	**page 68**

2500 cm/ns Stored Writing Speed
4 Plug-in Compartments
Dc-to-400 MHz Bandwidth
Multimode Storage
Long View Time



The 7834 Storage Oscilloscope has a stored writing speed of 2500 cm/μs, enabling you to capture single-shot rise times to 1.4 ns, 3.5 cm high, at full reduced scan amplitude. The 7834's mainframe bandwidth is 400 MHz (nonstore). The system bandwidth may vary from 160 MHz to 400 MHz depending on the plug-in selected.

This instrument has four storage modes—bistable and variable persistence, FAST bistable and FAST variable persistence.

FAST Variable Persistence provides the maximum stored writing rate of 2500 cm/μs (reduced scan). View time at least 30 s.

FAST Bistable increases bistable writing rates to 350 cm/μs (reduced scan).

Bistable lets you store displays for long periods of time.

Variable Persistence gives you high contrast displays of both single-shot and repetitive phenomena. When viewing changing waveshapes, you get continuous bright displays of new information as old information fades from the crt.

The 4-compartment flexibility lets you perform more than one measurement at the same time without switching plug-ins. The 7834 also offers auto-erase for automatic display updating . . . a save control for 30 times longer viewing . . . gated readout which prevents the blooming that tends to occur between sweeps with nongated readout . . . and an adjustable multitrace delay for varying the viewing time prior to the next sweep in the FAST transfer mode.

The multimode storage unit is designed for single shot, low-rep-rate or fast pulse analysis in laser fusion, digital design and nondestructive component testing applications.

VERTICAL SYSTEM

Input—Two left-hand plug-in compartments; compatible with all 7000-Series plug-ins.

Modes of Operation—LEFT, ALT, ADD, CHOP, RIGHT.

Mainframe Bandwidth—400 MHz with 7A19 Amplifier plug-in (325 MHz at 10 mV).

Mainframe Step Response—0.9 ns or less with 7A19 Amplifier plug-in (1.1 ns at 10 mV).

Chopped Mode—Repetition rate is approximately 1 MHz.

Delay Line—Permits viewing leading edge of displayed waveform (not recommended for use with 7B50 Series time bases).

Trace Separation Range—In dual-sweep modes, B trace can be positioned 4 divisions above or below the A trace.

HORIZONTAL SYSTEM

Input—Two right-hand plug-in compartments; compatible with all 7000-Series Plug-ins. 7000-Series Vertical Amplifiers and specialized plug-ins may also be used.

Modes of Operation—A, ALT, CHOP, B.

Fastest Calibrated Sweep Rate—1 ns/div.

Chopped Mode—Repetition rate is approx 200 kHz.

X-Y Mode—Phase shift between vertical and horizontal channels is within 2° from dc to 35 kHz without phase correction (dc to 1 MHz with phase correction, B horizontal only, Option 02). Bandwidth is dc to at least 1 MHz.

CRT AND DISPLAY FEATURES

Graticule—Internal variable illuminated graticule. 8 x 10-division (0.9 cm/div) graticule in full scan and 8 x 10-division (0.45 cm/div) in reduced scan.

Option 01, without crt readout and probe power—Deletes crt readout and probe power.

Accelerating Potential—Approx 10 kV full scan mode, and 12 kV in reduced scan mode.

Phosphor—P31.

Crt Display Modes—Nonstore, Bistable, Variable Persistence, FAST Bistable and FAST Variable Persistence (full and reduced scan).**

Persistence—(Variable Persistence mode only) controls rate of continuous erasure of the variable persistence and fast variable persistence stored displays.

Auto Erase—Continuously variable from less than 1 s to greater than 10 s.

Multitrace Delay—Adjusts the transfer cycle time in the FAST transfer modes. Continuously variable from less than 1 s to greater than 4 s.

Save—Prevents display from being accidentally erased, and provides up to 30 times longer viewing times in all modes.

External Z-Axis Input—2 V peak-to-peak for full intensity range from dc to 1 MHz. Positive signal blanks the trace. Maximum input voltage is 15 V (dc plus peak ac).

Auto-Focus—Maintains crt focus following changes in display intensity after focus control has been initially set.

Beam Finder—Limits display within graticule.

STORAGE WRITING SPEED

FULL SCAN (Center 6 x 8 div at 0.9 cm/div)

Display Mode	Fast Variable Persistence	Fast Bistable	Variable Persistence	Bistable
Store Writing Speed	270 cm/μs (300 div/μs)	45 cm/μs (50 div/μs)	1.8 cm/μs (2 div/μs)	0.027 cm/μs (.03 div/μs)
View Time	30 s*	30 min	30 s*	30 min
Erase Time (Approx)	1.4 s	1.4 s	0.9 s	0.9 s

**REDUCED SCAN Center 8 x 10 div at 0.45 cm/div

Display Mode	Fast Variable Persistence	Fast Bistable	Variable Persistence	Bistable
Stored Writing Speed	2500 cm/μs (5,500 div/μs)	350 cm/μs (776 div/μs)	5.4 cm/μs (12 div/μs)	0.09 cm/μs (.2 div/μs)
View Time*	30 s	30 min	30 s	30 min
Erase Time (Approx)	1.4 s	1.4 s	0.9 s	0.9 s

*View times are at full stored display intensity; they may be increased more than 30 times by using reduced intensity in the SAVE display mode.

Fast Variable Persistence Writing Speed

Scan Mode	Sweep Speed	Peak-to-peak Sine wave	Step Response
Reduced Scan 5,500 div/μs (0.45 cm/div)	≥1 ns/div	7.1 div 250 MHz 8 div 221 MHz	7.7 div 1.4 ns 8 div 1.45 ns
Full Scan 300 div/μs (0.9 cm/div)	≥10 ns/div	3.2 div 30 MHz 6.4 div 15 MHz	3 div 10 ns 5 div 16.6 ns

OUTPUTS/INPUTS

+Sawtooth—Positive going with baseline at 0 V ±1 V into 1MΩ. Voltage is 1 V/div (±10%) into 1 MΩ, 50mV/div (±15%) into 50 Ω. Output R is approx 950 Ω.

+Gate—Positive pulse of the same duration and coincident with sweep. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Output R is approx 950 Ω. Source is selectable from A Gate, B Gate, or A Delayed Gate.

Vertical Signal Out—Selected by A TRIGGER SOURCE switch. Output votlage is 0.5 V (±10%) into 1 MΩ, 25 mV (±10%) into 50 Ω. Output R is approx 950 Ω. Bandwidth depends upon vertical plug-in.

Remote Single Sweep Reset, Remote Save and Remote Erase—Rear panel BNC connector inputs, ground closure activated.

Remote FAST Transfer Gate—TTL compatible. Low to high transition enables high speed target to receive information to be stored; high to low transition initiates transfer from high speed target to storage target.

CAMERA POWER OUTPUT—Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

CALIBRATOR

Voltage Output—Square wave, positive-going from ground. Ranges are 40 mV, 0.4 V, and 4 V into 100 kΩ; 4 mV, 40 mV, and 0.4 V into 50 Ω. Amplitude accuracy is within 1%; repetition rate is 1 kHz within .25%.

Current Output—40 mA availabel through CALIBRATOR output with optional BNC to current loop adapter.

Dimensions and Weight. See page 49.
For Recommended Cameras — See page 50.

POWER REQUIREMENTS

Line Voltage Ranges—90 V-132 V.
180 V-250 V.

Line Frequency—48-440 Hz.

Max Power Consumption—215 watts.

Included Accessories—Gray crt filter (installed) (378-062-02); green crt filter (378--0625-08); power cord (161-0066-00).

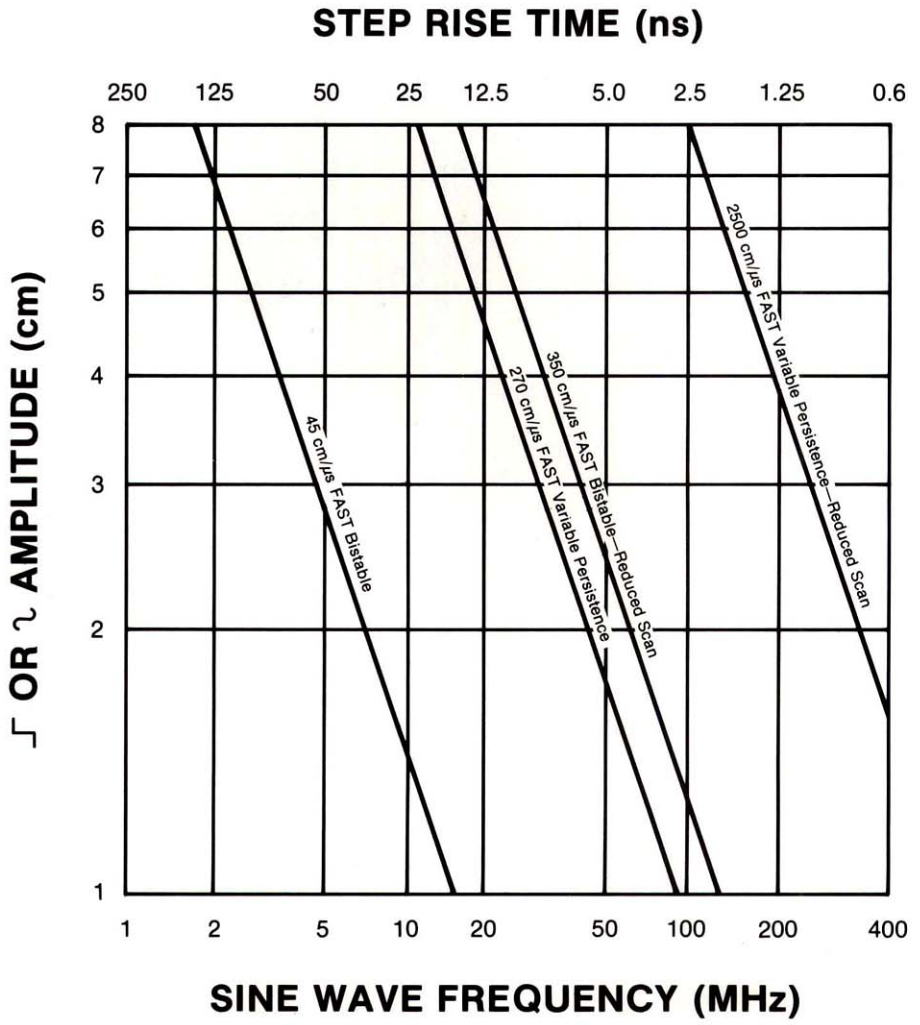
ORDERING INFORMATION

(Plug-ins not Included)

7834 Storage Oscilloscope **$6900**

OPTIONS

Option 01 Without Crt Readout and Probe Power ..... **Sub $400**
Option 02 X-Y Mode Phase Correction .... **Add $100**
Option 03 Emi Modification ..... **Add $100**

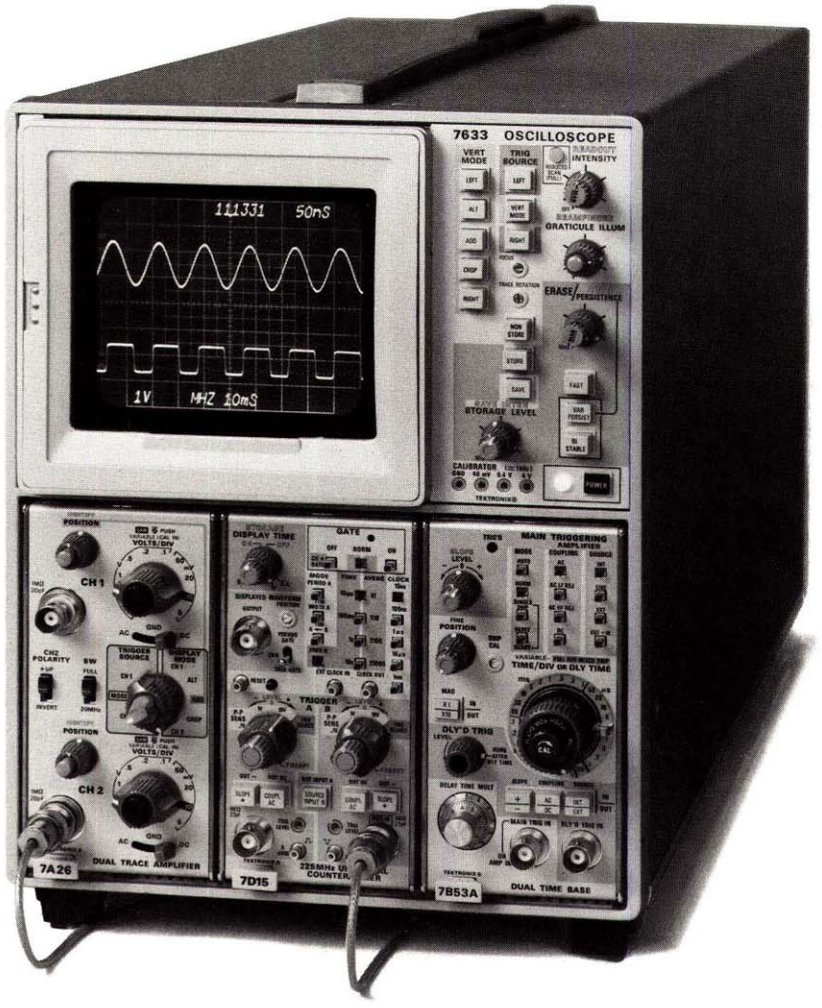


Graph showing the stored writing speed needed to display a given sine wave or step rise time at a given amplitude.

7000-Series Multimode Storage Oscilloscopes

7633

1000 cm/μs Stored Writing Speed
Long View Time
Multimode Storage
Dc-to-100 MHz Bandwidth



The TEKTRONIX 7633 Storage Oscilloscope provides 2200 div/μs (1000 cm/μs) stored writing speed and 100-MHz bandwidth. The instrument has three display modes—store, nonstore, and save—and four storage modes—bistable, variable persistence, fast bistable, and fast variable persistence. The top writing speed of 1000 cm/μs (using the center 8 x 10 reduced scan divisions, 0.45 cm/div) is achieved in reduced scan mode.

This multimode storage instrument allows for retention and viewing of fast-rise, low-repetition-rate, single-shot, or slow-moving waveforms. The instrument's capability and versatility make it a problem solver in computer sciences, aerospace, ballistics, communications, and many other fields.

Characteristics are common to the 7633 and the 7623A unless noted.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — Repetition rate is approx 1 MHz.

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channel — One right-hand plug-in compartment; compatible with all 7000-Series Plug-ins.

Fastest Calibrated Sweep Rate — 5 ns/div.

X-Y Mode — The phase shift between vertical and horizontal channels is less than 2° from dc to 35 kHz. Bandwidth is dc to at least 2 MHz.

CRT AND DISPLAY FEATURES

Crt — Internal 8 x 10 div (0.9 cm/div) and 8 x 10 div (0.45 cm/div) graticule with variable illumination.

Phosphor — P31.

Option 01 — No crt readout.

Accelerating Potential — Approx 8.5 kV in normal mode, 10 kV in reduced scan mode.

Storage Display Modes — Nonstore, FAST variable persistence, FAST bistable, variable persistence, bistable. Full or reduced scan may be selected on the 7633 in all display modes. Select normal scan to view the entire crt; select reduced scan for the fastest writing rate.

Persistence — Variable. When set to max, provides the longest retention of high contrast stored displays, without the characteristic fading of variable persistence.

Autoerase — Variable up to 10 s.

Save — Prevents erasing and storing additional displays; also extends view time in variable persistence mode.

External Z-Axis Input — 2 V p-p for useful intensity range from dc to 2 MHz; intensity range diminishes to 20% of full range at 10 MHz. A positive signal blanks the trace. Max input voltage is 10 V (dc + peak ac) and p-p ac.

Autofocus — Reduces the need for calibrated manual focusing with changes in intensity after focus control has been set.

Beam Finder — Limits display within graticule area.

STORAGE WRITING SPEED

Full Scan (7633 and 7623A)

Display Mode	FAST Variable Persistence	FAST Bistable	Variable Persistence	Bistable
Stored Writing Speed	135 cm/μs	45 cm/μs	0.45 cm/μs	0.027 cm/μs
View Time	30 s*	30 min. minimum	30 s*	30 min. minimum
Erase Time (Approx)	1.4 s	1.4 s	0.9 s	0.9 s

Reduced Scan (7633 Only)

Display Mode	FAST Variable Persistence	FAST Bistable	Variable Persistence	Bistable
Stored Writing Speed	1000 cm/μs	180 cm/μs	1.35 cm/μs	0.9 cm/μs
View Time	30 s*	30 min. minimum	30 s*	30 min. minimum
Erase Time (Approx)	1.4 s	1.4 s	0.9 s	0.9 s

*These times are at full stored display intensity; they may be increased more than 30 times by using reduced intensity in the save display mode.

7623A

135 cm/μs Stored Writing Speed
Long View Time
Multimode Storage
Dc-to-100 MHz Bandwidth

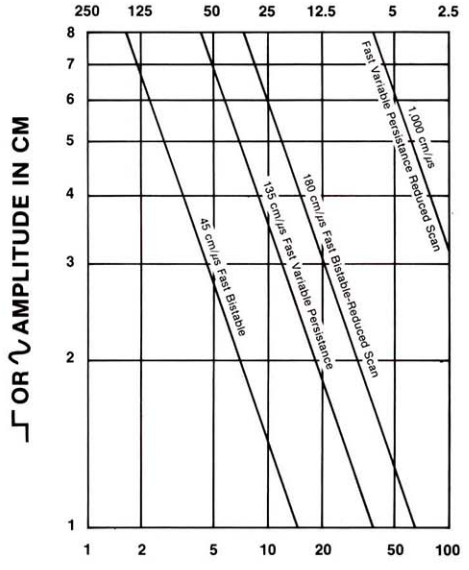
The TEKTRONIX 7623A Storage Oscilloscope has all the features and performance of the 7633 except the reduced scan mode.

Fast Variable Persistence Writing Speed

Scan Mode	Sweep Speed	Peak-to-peak Sine	Step Response
Reduced Scan** 2200 div/μs (0.45 cm/div)	≥5 ns/div	7.1 div 100 MHz 8 div 89 MHz	7.7 div 3.5 ns 8 div 3.7 ns
Full Scan 150 div/μs (0.9 cm/div)	≥50 ns/div	3.2 div 15 MHz 6.4 div 7.5 MHz	3 div 20 ns 5 div 33 ns

**Applies to 7633 only.

STEP RISE TIME (ns)



SINE WAVE FREQUENCY (MHz)

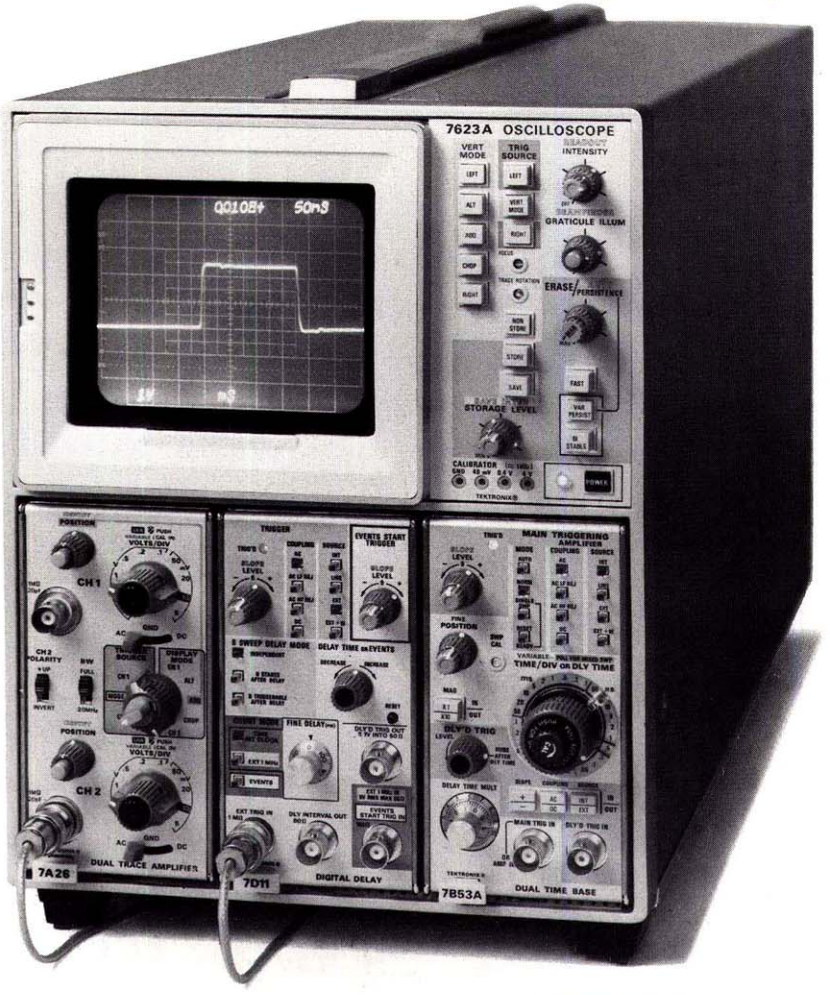
Graph showing the stored writing speed needed to display a given sine wave or step rise time at a given amplitude.

OUTPUTS/INPUTS

+Sawtooth — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is 950 Ω within 2%.

+Gate — Positive pulse of the same duration and coincident with sweep. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%) into 1 MΩ. Rise time is 20 ns or less into 50 Ω, output R is 950 Ω within 2%. Source is selectable from main, delay, or auxiliary gate.

Vertical Signal Out — Selected by TRIGGER SOURCE switch. Output voltage is 25 mV/div (±10%) into 50 Ω, 0.5 V/div (±10%) into 1 MΩ. Bandwidth depends on vertical plug-in. Output R is 950 Ω within 2%.



External Single-Sweep Reset — Ground closure; rear panel BNC provides input to reset sweep.

Remote Erase — Ground closure; rear panel BNC provides input to erase stored trace.

Option 07 — No outputs/inputs.

CAMERA POWER OUTPUT

Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

CALIBRATOR

Voltage Output — Rectangular waveshape, positive-going from ground (dc voltage available when selected by internal jumper). Ranges are 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15°C to +35°C); within 2% (0°C to +50°C). Repetition rate is approx 1 kHz.

Current Output — 40-mA dc or 40-mA rectangular waveshape with optional current-loop accessory (012-0259-00) connected between 4 V and gnd pin jacks.

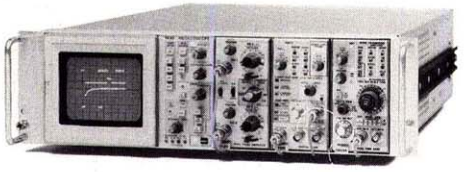
POWER REQUIREMENTS

Line Voltage Ranges — 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick-change jumpers.

Line Frequency — 50-60 Hz.

Option 05, Line Frequency Change (50-400 Hz) — Converts the 7633 and R7633 to 50-400 Hz operation.

Max Power Consumption — 180 W, 2.0 A at 115 V line, 60 Hz. Fan cooling is provided for both models.



Included Accessories — 20 in cable (two-pin-to-BNC) (175-1178-00); crt filter Green (378-0625-08). The R7633 and R7623A include rackmounting hardware.

Weights and Dimensions — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION
(Plug-ins not Included)

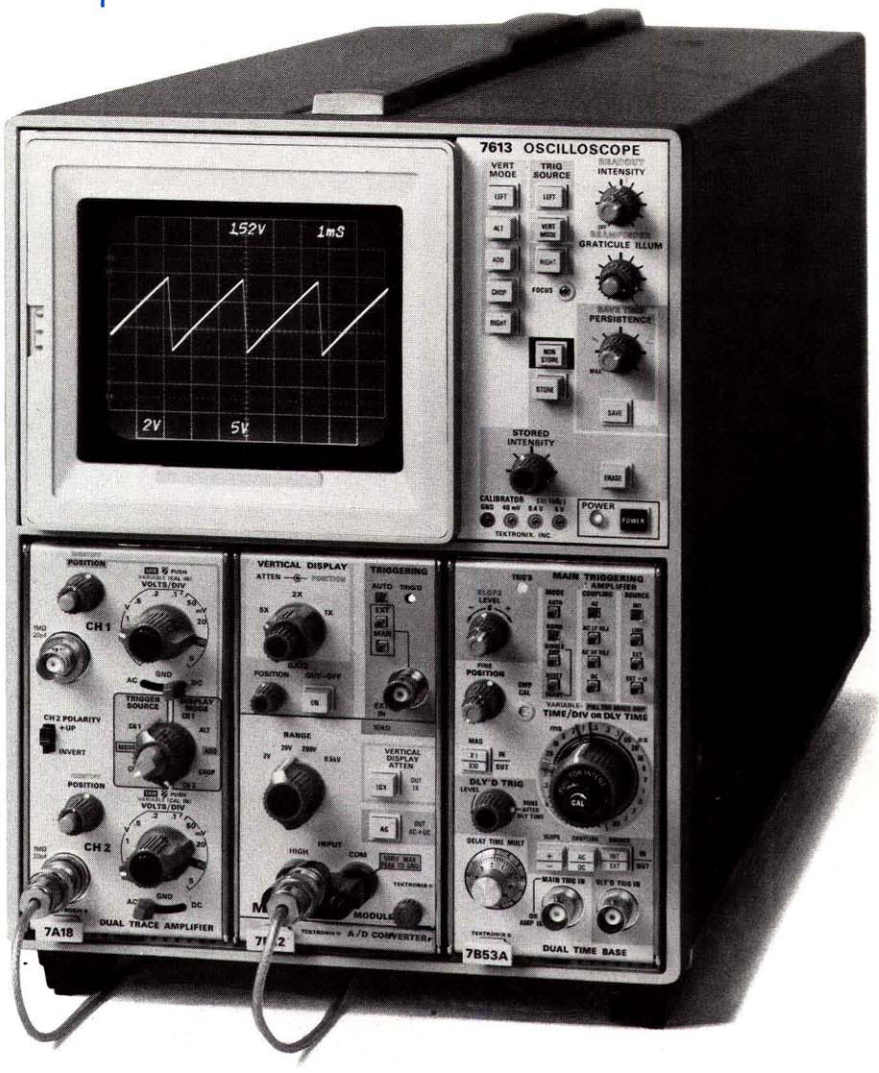
7633 Storage Oscilloscope $4725
R7633 Storage Oscilloscope $4925
7623A Storage Oscilloscope $3750
R7623A Storage Oscilloscope $3800

OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 05	Line Freq Change (50—400 Hz)	Add $125
Option 07	without Sig Out/In	Sub $50

CONVERSION KITS

Crt Readout (040-0748-01 Cabinet)	$550
(040-0759-01 Rackmount)	$550
Emi Modification (040-0663-00 Cabinet)	$200
(040-0678-00 Rackmount)	$200
Sig Out/In (040-0629-01 Cabinet)	$120
(040-0633-00 Rackmount)	$85
Power Supply to Light Plug-in Pushbuttons (040-0686-00)	$30



Variable Persistence Storage
4.5 cm/μs Stored Writing Speed
Dc-to-100 MHz Bandwidth
Burn Resistant Crt
5¼ in Rackmount

The TEKTRONIX 7613 Storage Oscilloscope offers variable persistence operation with a stored writing speed of 5 div/μs or nonstorage operation. Stored traces may be viewed up to 60 minutes on a display area of 8 x 10 div (0.9 cm/div). The 7613 crt is burn resistant and doesn't require any special operating precautions.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit; see Vertical System Specifications Chart.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — Repetition rate is approx 1 MHz.

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channel — One right-hand plug-in compartment; compatible with all 7000-Series Plug-ins.

Fastest Calibrated Sweep Rate — 5 ns/div.

X-Y Mode — The phase shift between vertical and horizontal channels is within 2° from dc to 35 kHz. Bandwidth is dc to at least 2 MHz.

CRT AND DISPLAY FEATURES

Variable Persistence Storage Crt — Internal 8 x 10 div (0.9 cm/div) graticule with variable illumination.

Phosphor — P31.

Option 01 — No crt readout.

Accelerating Potential — 8.5 kV.

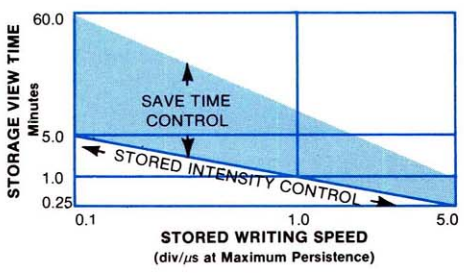
Nonstore Mode — For displaying waveforms in the conventional (nonstorage) mode.

Store Mode — For displaying waveforms using the variable persistence storage feature.

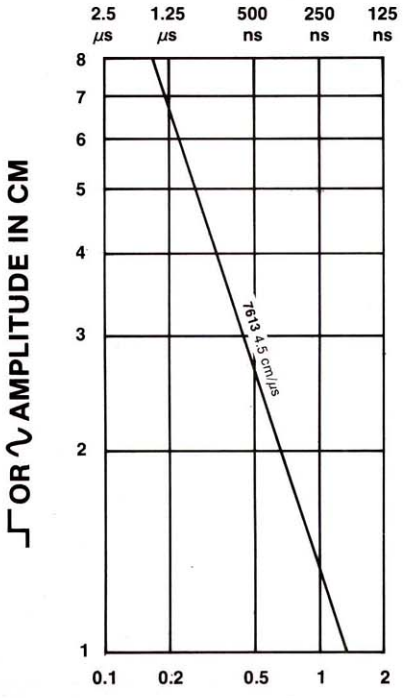
Max Stored Writing Speed — Greater than 4.5 cm/μs.

View Time — The view time is the amount of time the stored signal can be viewed before it fades away.

At the max writing speed the view time is 15 seconds or 0.25 minutes with the stored intensity control fully cw. Adjusting the stored intensity ccw will reduce the stored writing speed, but view time can be increased up to 5 minutes (see the chart below).



STEP RISE TIME



SINE WAVE FREQUENCY (MHz)

Graph showing the stored writing speed needed for a given sine wave or step rise time at a given amplitude.

Erase Time — 0.5 s or less.

Persistence — The persistence control also varies the view time. The persistence can be adjusted from almost instantaneous disappearance (fade away), to off, which provides the view time selected by the stored intensity control.

Save — Prevents erasure of the stored display and activates the save time control.

Save Time Control — Allows an extension of the view time (see Storage View Time Chart).

External Z-Axis Input — 2 V p-p for full intensity range from dc to 2 MHz; intensity range diminishes to 20% of full range at 10 MHz. A positive signal blanks the trace. Max input voltage is 10 V (dc + peak ac) and p-p ac.

Autofocus — Reduces the need for additional manual focusing with changes in intensity after focus control has been set.

Beam Finder — Limits display within graticule area.

OUTPUTS/INPUTS

+Sawtooth — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 50 mV/div (± 15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is 950 Ω within 2%.

+Gate — Positive pulse of the same duration and coincident with sweep. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%) into 1 MΩ. Rise time is 20 ns or less into 50 Ω; output R is 950 Ω within 2%. Source is selectable from main, delay, or auxiliary gate.

Sig Out — Selected by TRIGGER SOURCE switch. Output voltage is 25 mV/div (±10%) into 50 Ω, 0.5 V/div (±10%) into 1 MΩ. Bandwidth depends upon vertical plug-in; see Vertical System Specifications Chart. Output R is 950 Ω within 2%.

External Single-Sweep Reset — Ground closure; rear panel BNC provides input to reset sweep.

Remote Erase — Ground closure; rear panel BNC provides input to erase stored trace.

Option 07 — No outputs/inputs.

CAMERA POWER OUTPUT

Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

CALIBRATOR

Voltage Output — Rectangular waveshape, positive-going from ground. (Dc voltage available when selected by internal jumper.) Ranges are 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15°C to +35°C); within 2% (0°C to +50°C). Repetition rate is approx 1 kHz.

Current Output — 40-mA dc or 40-mA rectangular waveshape with optional current-loop accessory (012-0259-00) connected between 4 V and gnd pin jacks.

POWER REQUIREMENTS

Line Voltage Ranges — 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick-change jumpers.

Line Frequency — 50-60 Hz.

Option 05, Line Frequency Change (50-400 Hz) — Converts the 7613 and R7613 to 50-400 Hz operation.

Max Power Consumption — 180 W, 2.0 A at 115 V line, 60 Hz. Fan cooling is provided for both models.

The R7613 requires only 5¼ in of rack height in a standard 19 in rack. It is fan cooled and comes complete with slide-out chassis tracks.

Included Accessories (for 7613 and R7613) — 20 in cable (two-pin-to-BNC) (175-1178-00); crt filter (gray, 378-0625-02). The R7613 includes rackmounting hardware.

Weights and Dimensions — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION
(Plug-ins not Included)

7613 Storage Oscilloscope $2950
R7613 Storage Oscilloscope $3150

7613 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 05	Line Freq Change (50-400 Hz)	Add $125
Option 06	Special Int Graticule (Spectrum Analyzer)	Add $50
Option 07	without Sig Out/In	Sub $50
Option 08	Protective Panel Cover	Add $100

R7613 OPTIONS

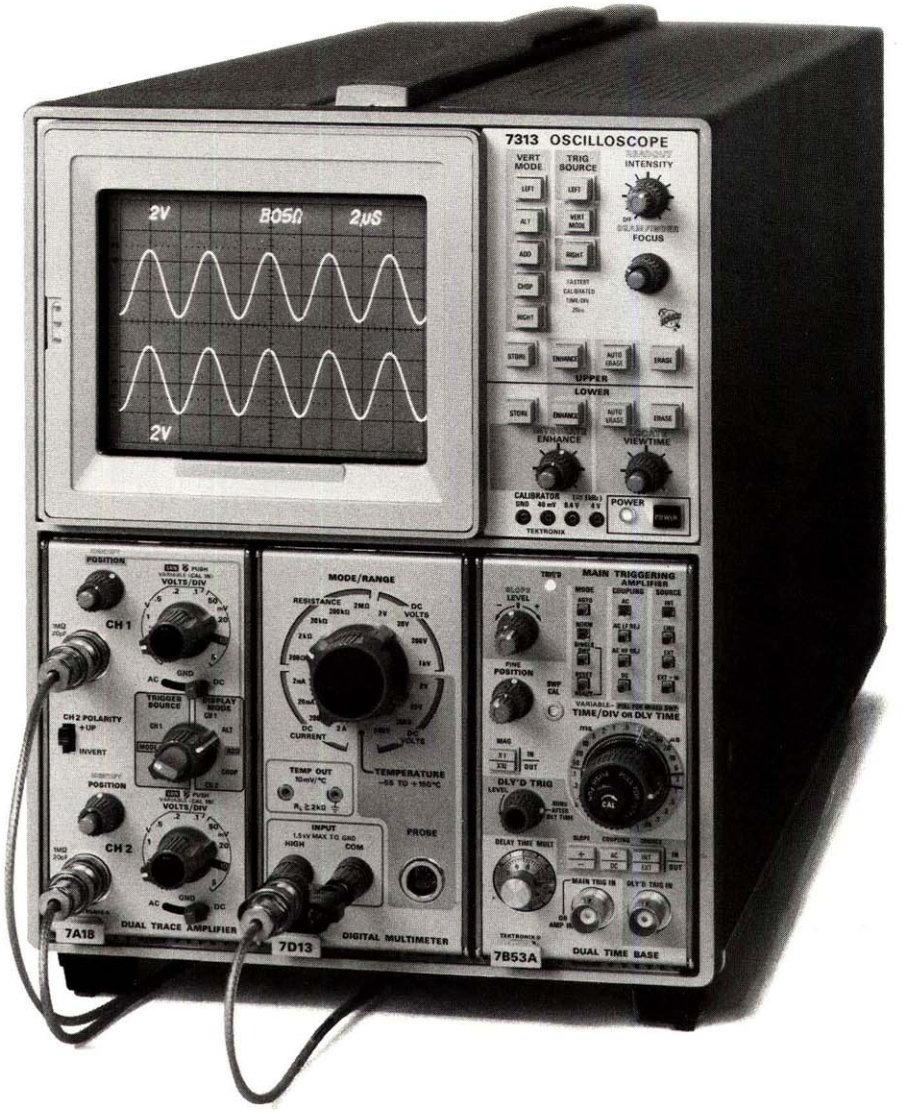
Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 05	Line Freq Change (50-400 Hz)	Add $125
Option 06	Special Int Graticule (Spectrum Analyzer)	Add $50
Option 07	without Sig Out/In	Sub $50

7613 CONVERSION KITS

040-0656-02	Crt Readout	$550
040-0663-00	Emi Modification	$200
040-0629-01	Sig Out/In	$120
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30

R7613 CONVERSION KITS

040-0676-02	Crt Readout	$550
040-0678-00	Emi Modification	$180
040-0633-00	Sig Out/In	$85
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30



Split-Screen Bistable Storage
4.9 cm/μs Stored Writing Speed
Dc-to-25 MHz Bandwidth
Burn-Resistant Crt
5¼ in Rackmount

The TEKTRONIX 7313 Storage Oscilloscope offers split-screen bistable operation or non-storage operation. It has a stored writing speed of 5 div/μs. Stored traces may be viewed for at least 30 minutes on a display area of 8 x 10 div (0.98 cm/div). The 7313 crt is burn resistant.

The split-screen storage crt allows for both a stored display and a real-time display on the same crt at the same time. This capability is useful in many applications. The operator may wish to store a reference trace and then view the change in waveform characteristics as he varies circuit components. He can do this easily by operating half the display in a stored mode and the other half in a conventional mode. Thus, amplitude, duration, and other characteristics of waveforms displayed in the conventional mode may be precisely adjusted to the stored reference trace.

7313 and R7313 Bistable Storage Oscilloscopes

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit, limited to 25 MHz.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — Repetition rate is approx 1 MHz.

Delay Line — Permits viewing leading edge of waveform.

HORIZONTAL SYSTEM

Channel — One right-hand plug-in compartment; compatible with all 7000-Series Plug-ins.

Fastest Calibrated Sweep Rate — 20 ns/div.

X-Y Mode — The phase shift between vertical and horizontal channels is within 2° from dc to 35 kHz. Bandwidth is dc to at least 2 MHz.

STORAGE CRT AND DISPLAY FEATURES

Split-Screen Bistable Storage Crt — Internal 8 x 10 div (0.98 cm/div) **non-illuminated** graticule. Store on upper or lower half of screen with nonstore display on other half. Store on entire screen or nonstore on entire screen. Independent operation on both halves.

Accelerating Potential — 4 kV.

Phosphor — P1.

Stored Writing Speed — Normal, 500 div/ms; adjustable to at least 5000 div/ms in Enhance Mode.

Storage View Time — At least 30 minutes.

Autoerase View Time Range — 0.5 or less to at least 10 s after end of sweep.

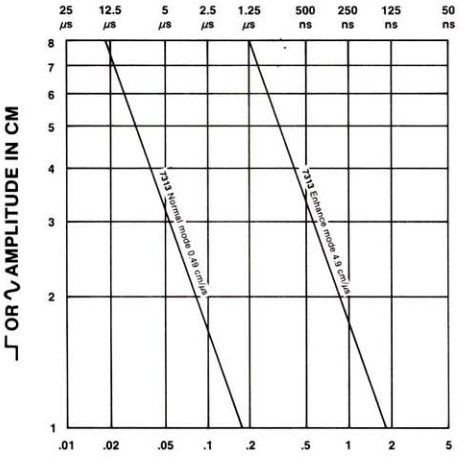
Erase Time — 400 ms or less.

Enhance Mode — Controls single-sweep writing capabilities of the storage crt. Up to 5000 cm/ms or better can be stored with minimal loss of resolution and contrast.

Integrate Mode — Provides additional writing speed for repetitive signals by allowing the storage target to integrate the written information over several signal repetitions.

Autoerase Mode — Viewing time continuously variable up to 10 s. The sequence begins with the arrival of the signal. The signal initiates a sweep. After each sweep, the stored display is retained and further sweeps are locked out for the viewing interval selected by the VIEW TIME Control. Then the display is erased and the time-base enabled for the next sweep. This cycle will automatically repeat itself as long as a signal is available. The stored display may also be erased by the MANUAL control.

STEP RISE TIME



Graph showing the stored writing speed needed to display a given sine wave or step rise time at a given amplitude.

External Z-Axis Input — 2 V p-p for full intensity range from dc to 2 MHz; intensity range diminishes to 20% of full range at 10 MHz. A positive signal blanks the trace. Max input voltage is 10 V (dc + peak ac) and p-p ac.

Beam Finder — Limits display within graticule area.

OUTPUTS/INPUTS

+Sawtooth — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is 950 Ω within 2%.

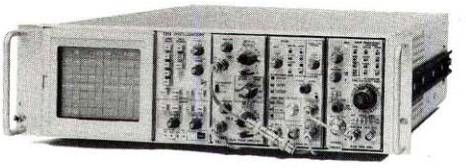
+Gate — Positive pulse of the same duration and coincident with sweep. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%) into 1 MΩ. Rise time is 20 ns or less into 50 Ω; output R is 950 Ω within 2%. Source is selectable from main, delay, or auxiliary gate.

Sig Out — Selected by TRIGGER SOURCE switch. Output voltage is 25 mV/div (±10%) into 50 Ω, 0.5 V/div (±10%) into 1 MΩ. Bandwidth depends on vertical plug-in. Output R is 950 Ω within 2%.

External Single-Sweep Reset — Ground closure; rear panel BNC provides input to reset sweep.

Remote Erase — Ground closure; rear panel BNC provides input to erase stored trace. Internally selectable for either or both halves of crt.

Option 07 — No outputs/inputs.



The R7313 requires only 5¼ in of rack height in a standard 19 in rack. It is fan cooled and comes complete with slide-out chassis tracks.

CAMERA POWER OUTPUT

Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

CALIBRATOR

Voltage Output — Rectangular waveshape, positive-going from ground (dc voltage available when selected by internal jumper). Ranges are 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15°C to +35°C); within 2% (0°C to +50°C). Repetition rate is approx 1 kHz.

Current Output — 40-mA dc or 40-mA rectangular waveshop with optional current-loop accessory (012-0259-00) connected between 4 V and gnd pin jacks.

POWER REQUIREMENTS

Line Voltage Ranges — 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick-change jumpers.

Line Frequency — 50-400 Hz (7313), 50-60 Hz (R7313).

Option 05, Line Frequency Change (50-400 Hz) — Converts the R7313 to 50-400 Hz operation (not required for 7313).

Max Power Consumption — 180 W, 2 A at 115 V line, 60 Hz. Fan cooling is provided for the R7313.

Included Accessories (for 7313 and R7313) — 20 in cable (two-pin-to-BNC) (175-1178-00); green crt light filter (378-0625-08). The R7313 includes rackmounting hardware.

Weights and Dimensions — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION

(Plug-ins not Included)

7313 Storage Oscilloscope $2850

R7313 Storage Oscilloscope $3050

7313 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 07	without Sig Out/In	Sub $50

R7313 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 05	Line Freq Change (50-400 Hz) Not Required for 7313	Add $125
Option 07	without Sig Out/In	Sub $50

7313 CONVERSION KITS

040-0655-02	Crt Readout	$550
040-0664-00	Emi Modification	$180
040-0629-01	Sig Out/In	$120
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30

R7313 CONVERSION KITS

040-0675-02	Crt Readout	$550
040-0678-00	Emi Modification	$180
040-0633-00	Sig Out/In	$85
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30

7000-Series Plug-ins

For the 7000-Series you can select from over thirty different plug-ins. For example, digital multimeters, counters and A-D converters. With this plug-in selection you can solve problems in many applications including spectrum analysis, curve tracing, spectroscopy, logic analysis, and sampling. This variety lets you tailor your instrument to meet your immediate need. And to expand its capabilities later as your needs change.

Amplifiers **Pages 70-72**

Eleven vertical amplifiers offer choices in system bandwidth, number of input channels, vertical sensitivity, input impedance, and differential inputs.

Time Bases **Pages 73-76**

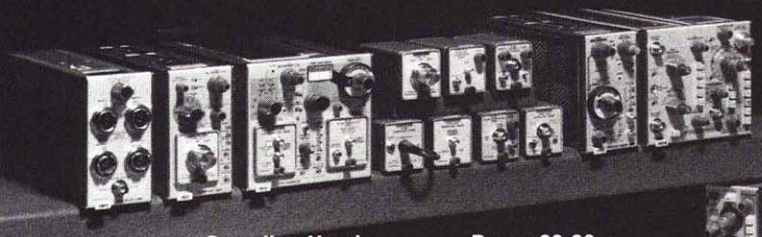
Five horizontal time bases offer choices in sweep speeds, single or dual sweeps, and now, digital delta delay measurements.

Sampling and TDR **Pages 82-86**

Five plug-in units offer a choice of single- and dual-channel sampling, general-purpose sampling combined with time domain reflectometry, sampling sweep, and dual delay line.

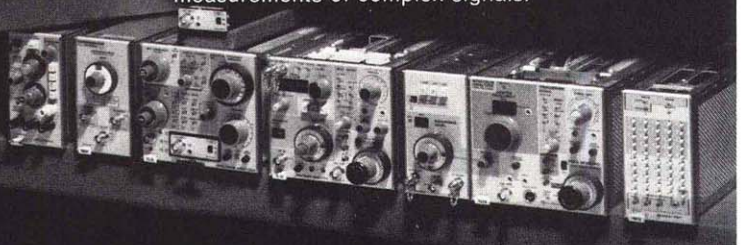
Digital Measurements **Pages 77-81**

Six digital instruments, one with three interchangeable modules, offer unique solutions to complex measurement problems. Timing and amplitude measurement instruments interact with the oscilloscope to easily obtain accurate measurements of complex signals.



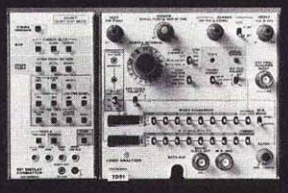
Sampling Heads **Pages 83-86**

Ten sampling heads offer choices in input impedance, equivalent bandwidth, and triggering for a matched sampling system.



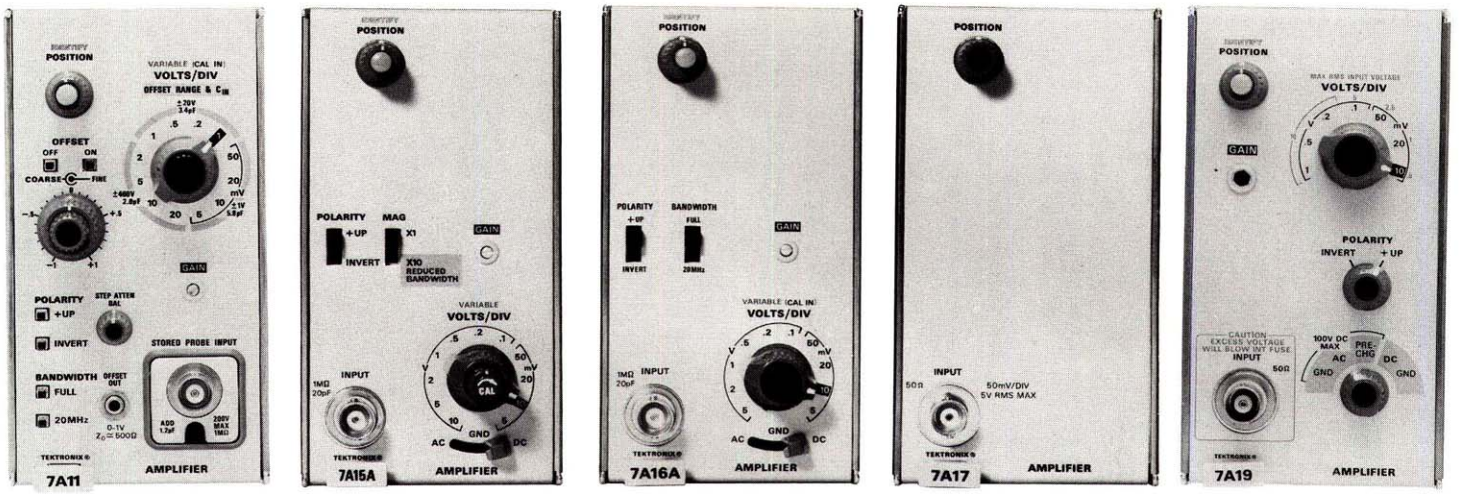
Special Purpose Plug-ins

7CT1N Curve Tracer see page 214
7L5/L1/L2 Spectrum Analyzer see page 187
7L12 Spectrum Analyzer see page 191
7L13 Spectrum Analyzer see page 192
7K11 CATV Preamplifier see page 197
7M13 Readout Unit see page 76



7D01 Logic Analyzer, see page 20
DF1 Display Formatter, see page 20

7A11 7A15A 7A16A 7A17 7A19



7A11

Built-in FET Probe

DC-to-250 MHz Bandwidth (7900 Family)

5 mV/div to 20 V/div

Calibrated Deflection Factors

Dc Offset

Lit Pushbuttons

The 7A11 is a wideband plug-in amplifier. The captive FET probe input configuration optimizes signal acquisition with high resistance (1 MΩ) and low capacitance (5.8 pF at 5 mV/div), without loss of signal amplitude by probe attenuation. Two 20X attenuators, physically mounted in the probe tip, are relay-switched into the input signal path at the appropriate deflection factor. Therefore you need not concern yourself with manual plug-in attenuators and dynamic signal range.

Deflection Factor — 5 mV/div to 20 V/div in 12 calibrated steps (1-2-5 sequence). Accuracy is within 2% of gain adjustment at 0.1 V/div. Uncalibrated VARIABLE is continuous between steps to at least 50 V/div.

Input R and C — 1 MΩ within 1%; ≈ 5.8 pF (5 mV/div to 50 mV/div), ≈ 3.4 pF (0.1 V/div to 1 V/div), ≈ 2 pF (2 V/div to 20 V/div).

Signal and Offset Range

Deflection Factor Settings	5 mV/div to 50 mV/div	0.1 V/div to 1 V/div	2 V/div to 20 V/div
Offset Range	+1 V to −1 V	+20 V to −20 V	+400 V to −400 V
Offset Range to Offset Out	1:1 within 1% ±0.5 mV	20:1 within 1.5% ±0.5 mV	400:1 within 2% ±0.5 mV
Max Dc-coupled Input	200 V (dc + peak ac, ac component to 50 kHz)	200 V (dc + peak ac, ac component to 40 MHz)	200 V (dc + peak ac, ac component to 70 MHz)
Max Ac-coupled Input (Dc Component)	±200 V		

Dc Stability — Drift with time (constant ambient temperature and line voltage): short term, 0.1 div or less per minute after 20 minute warm-up. Long term, 0.3 div or less per hour after 20 minute warm-up. Drift with ambient temperature (constant line voltage), 200 μV/°C or less.

Displayed Noise—0.5 mV or 0.1 div, whichever is greater, in FULL BANDWIDTH mode, measured tangentially.

Offset Function — An internal dc source, continuously variable between +1 V and −1 V, may be used to offset the trace. (See chart for offset range.) An OFFSET OUT jack allows for monitoring of the offset voltage. OFFSET OUT source resistance is 500 Ω within 3%.

Included Accessories — Capacitor-coupler head (011-0110-00); retractable hook tip (013-0106-00); probe tip ground adapter (013-0085-00); 3 in ground lead (nose) (175-0849-00); 3 in ground lead (screw-in) (175-0848-00); 12 in ground lead (screw-in) (175-0848-02); three miniature alligator clips (344-0046-00); two insulated sleeves (166-0404-01); probe hook tip (206-0114-00); probe tip to GR 50 Ω termination (017-0088-00); 18 in cable (offset out) (175-1092-00).

Order 7A11 Amplifier **$1350**

7A15A

Dc-to-80 MHz Bandwidth (7900 Family)

5 mV/div to 10 V/div

Calibrated Deflection Factors

500 μV/div at 10 MHz (X10 Gain)

The 7A15A is an easy-to-use, 80-MHz amplifier that features a X10 magnifier to increase the sensitivity to 500 μV/div with 10 MHz bandwidth. It has a constant bandwidth at all deflection factors in the X1 setting. Polarity of the display is selectable.

Deflection Factor — 5 mV/div to 10 V/div in 11 calibrated steps (1-2-5 sequence). X1 gain accuracy is within 2% with X1 gain adjusted at 10 mV/div. X10 gain (increases sensitivity to 500 μV) accuracy is within 10% at 10-MHz bandwidth throughout deflection factor settings. Uncalibrated VARIABLE is continuous between steps to at least 25 V/div.

Input R and C — 1 MΩ within 2%; ≈ 20 pF.

Max Input Voltage — Dc-coupled: 250 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less. Accoupled: 500 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less.

Order 7A15A Amplifier **$390**

7A16A

Dc-to-225 MHz Bandwidth (7900 Family)

5 mV/div to 5 V/div

Calibrated Deflection Factors

The 7A16A is an easy-to-use, 225-MHz amplifier. It features constant bandwidth over the deflection factor range of 5 mV/div to 5 V/div. Polarity of the display is selectable; bandwidth is selectable to FULL or limited to 20 MHz for low-frequency applications.

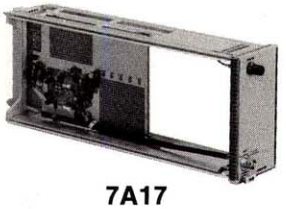
Deflection Factor — 5 mV/div to 5 V/div in 10 calibrated steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 10 mV/div. Uncalibrated VARIABLE is continuous between steps to at least 12.5 V/div.

Input R and C — 1 MΩ within 2%; ≈ 20 pF.

Max Input Voltage — Dc-coupled: 250 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less. Accoupled: 500 V (dc + peak ac); ac component 500 V p-p max, 1 kHz or less.

Dc Stability — Drift with ambient temperature (constant line voltage) is 0.01 div/°C. Drift with time (ambient temperature and line voltage constant) is 0.02 div in any one minute after 1 hour warm-up.

Order 7A16A Amplifier **$650**



7A17

Low Cost

Dc-to-150 MHz Bandwidth (7900 Family)

50 mV/div Calibrated Deflection Factor

Easy to Customize

The 7A17 is a unique wideband, plug-in amplifier electrically and mechanically suitable for do-it-yourself design and modification.

The layout of the circuit board assembly provides a blank soldering pad matrix and ground plane surface totaling approximately 40 square inches. Circuits may be installed here. Mainframe power is identified and available on the circuit board. The front subpanel is prepunched with holes of various sizes and shapes which allow for the mounting of connectors, switches, indicators, etc.

Deflection Factor — Adjustable to 50 mV/div. There is no step attenuation.

Input Z — 50 Ω.

Max Input Voltage — 5 V rms.

Order 7A17 Amplifier **$180**

For recommended probes — refer to page 49.

7A19

Dc-to-500 MHz Bandwidth (7900 Family)

10 mV/div to 1 V/div Calibrated Deflection Factors

Optional ±500 ps Variable Delay Line

The 7A19 is a high-performance, wide-bandwidth, single-trace plug-in amplifier designed primarily for use with the 7900-, 7800-, and 7700-Family Mainframes. The polarity of the display is selectable, either normal or inverted.

Deflection Factor — 10 mV/div to 1 V/div in 7 calibrated steps (1-2-5 sequence). Accuracy is within 3%.

Input R — 50 Ω.

Option 04, Variable Signal Delay — Permits matching the transit time of two preamps and probes to better than 50 ps. Range is ±500 ps.

Max Input — 50 div peak or 10 V rms (2 W), whichever is less, in the dc-coupled mode. 100 V dc additional in the ac-coupled mode.

Order 7A19 Amplifier **$1000**

7A19 OPTION

Order Option 04 Variable Sig Delay . . . . . **Add $150**

7A21N

Bandwidth to 1 GHz (7900 & 7800 Family Only)

Less than 4 V/div Deflection Factor

Single and Differential Inputs

Positioning Control

The 7A21N unit is designed so that high-frequency or fast rise time signals may be ac-coupled directly into the wide-bandwidth crt of the 7900- and 7800-Family Oscilloscopes. Two front-panel input connectors allow single-ended or differential operation (internally selected). Vertical-trace positioning is controlled on the front panel.

Direct access means that the vertical amplifier is bypassed. Interconnection boards and coupling cables are supplied with each 7A21N. The 7A21N is not a plug-in since it is hardwired to the crt vertical deflection system even though it is installed in a vertical compartment. The 7A21N does not incorporate crt readout or an internal trigger.

When used in 7900-Family Oscilloscopes, vertical mode switching is inoperative, and plug-ins can't be used in the adjacent vertical channel.

With the 7844 or R7844 Osciloscopes, the 7A21N may be used in one or both vertical compartments. When one 7A21N is used with Beam 1 left vertical compartment, preamps or specialized plug-ins may be used with Beam 2 right vertical compartment, leaving the crt readout operative for Beam 2 and the horizontal compartments. Vertical mode switching is inoperative when a 7A21N is used in Beam 1. When two 7A21Ns are used, crt readout and vertical mode switching are inoperative. Horizontal mode switching is always operative.

An 80-ns pretrigger should be provided for fast single-shot events. If this is impractical, use a 7M11 Dual Delay Line in the signal path. The 7A21N is compatible only with the 7900- and 7800-Family Oscilloscopes.

Bandwidth — 20 kHz to 1 GHz.

Deflection Factor — Less than 4 V/div.

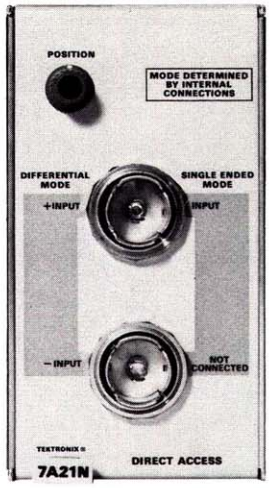
Input Z — 50 Ω.

Max Input Voltage — 25 V dc, 100 V pulsed ac.

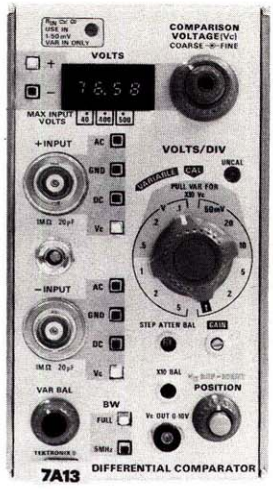
Included Accessories — Interconnecting board assembly.

Order 7A21N Direct Access **$700**

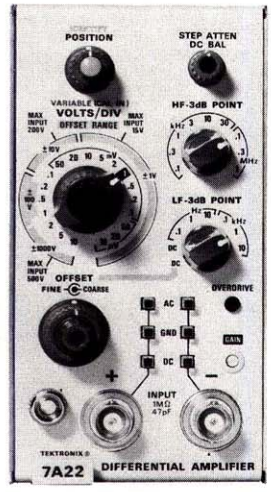
7A21N



7A13



7A22



7A13

Dc-to-105 MHz Bandwidth (7900 Family)

1 mV/div to 5 V/div Calibrated Deflection Factors

20,000:1 Cmrr

10,000 Cm Effective Screen Height

Lit Pushbuttons

The 7A13 is a differential comparator amplifier. It incorporates a number of features which make it particularly versatile, especially in mulitrace combination with other 7000-Series vertical plug-ins.

The 7A13 has constant bandwidth over the 1 mV/div to 5 V/div deflection factor range. The bandwidth is selectable to FULL or 5 MHz for best displayed noise conditions for low-frequency applications.

As a differential amplifier the 7A13 provides a balanced (+ and −) input for applications requiring rejection of a common-mode signal. The cmrr is 20,000:1 from dc to 100 kHz, derating to 200:1 at 20 MHz. The unit can reject up to 10 V of common-mode signal at a deflection factor setting of 1 mV/div, increasing to 100-V rejection potential at 10 mV/div (X10 Vc pulled) and 500 V at 0.1 V/div.

As a comparator amplifier the 7A13 loses its differential capability, but provides an accurate (0.1%) positive or negative internal offsetting voltage covering the common-mode signal range of the unit. A signal of up to ±10 V may be applied to an input (+ or −) at a deflection factor setting of 1 mV/div and, with an opposing Vc (offset voltage), viewed in 10,000 segments of 1 mV. The offset voltage is also available as an output for external monitoring.

Input R and C — 1 MΩ within 0.15%; ≈ 20 pF. R in ≈ ∞, is available in the 1 mV to 50 mV/div range, selectable by an internal switch.

Deflection Factor — 1 mV/div to 5 V/div in 12 calibrated steps (1-2-5 sequence). Accuracy is within 1.5% with gain adjusted at 1 mV/div. Uncalibrated VARIABLE is continuous between steps to at least 12.5 V/div.

Signal Range

Deflection Factor Settings	1mV to 50mV/div	10 mV to 50 mV/div (X10 Vc out) and 0.1 V to 0.5 V/div	0.1 V to 0.5 V/div (X10 Vc out) and 1 V to 5 V/div
Common-mode Signal Range	±10 V	±100 V	±500 V
Max Dc-coupled Input (Dc + Peak Ac at 1 kHz or Less)	±40 V	±400 V	±500 V
Max Ac-coupled Input (Dc Voltage)	±500 V		

Max Input Gate Current — 0.2 nA or less from 0°C to +35°C; 2 nA or less at +35°C to +50°C.

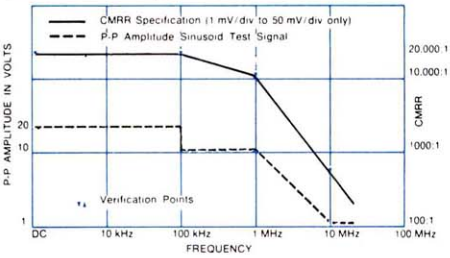
Dc Stability — Drift with time (constant ambient temperature and line voltage): short term, 1 mV p-p or 0.1 div, or less (whichever is greater) over any 1-minute interval after 20 minute warm-up. Long term, 1 mV p-p or 0.1 div or less (whichever is greater) during any 1 hour interval after 20 minute warm-up. Drift with ambient temperature (constant line voltage), 2 mV/10°C to 0.2 div/10°C or less, whichever is greater.

Displayed Noise (Tangentially measured) — With X10 Vc in, 400 μV (200 μV rms) or less at 1 mV/div; 0.2 div or less at 2 mV/div to 5 mV/div; 0.05 div or less at 10 mV/div to 5 V/div. With X10 Vc out, 0.4 div or less at 10 mV/div to 0.5 V/div.

Overdrive Recovery — 1 μs to recover to within 2 mV and 0.1 ms to recover to within 1 mV after a pulse of ±10 V or less, regardless of pulse duration.

Internal Comparison Voltage — Range, 0 V to ±10 V; accuracy, ±(0.1% of setting + 3 mV); Vc output R, approx 15 kΩ.

Common-Mode Rejection Ratio



At least 2000:1, 10 mV/div to 50 mV/div (X10 Vc out) and 0.1 V/div to 5 V/div. Ac-coupled input at least 500:1 at 60 Hz.

Order 7A13 Amplifier **$1695**

7A22

Dc-to-1 MHz Bandwidth

10 μV/div to 10 V/div Calibrated Deflection Factors

100,000:1 Cmrr

Selectable Upper and Lower —3 dB Points

Dc Offset

10 μV/Hour Dc Drift*

The 7A22 is a differential amplifier well suited for difficult low-amplitude, low-frequency measurements.

*With constant temperature. See dc stability specifications.

Bandwidth — Hf −3 dB point; selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz, accurate within 10% of selected frequency; rise time in 1 MHz position is 350 ns ±9%. Lf −3 dB point; selectable in 6 steps (1-10 sequence) from 0.1 Hz to 10 kHz, accurate with-

For recommended probes — refer to page 49.

in 12% of selected frequency. The switch also contains dc and dc with OFFSET positions. Ac-coupled at input, 2 Hz or less.

Deflection Factor — 10 μV/div to 10 V/div in 19 calibrated steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted to 1 mV/div. Uncalibrated VARIABLE is continuous between steps to at least 25 V/div.

Input R and C — 1 MΩ within 1%; ≈ 47 pF.

Max Input Gate Current — Differentially measured, 40 pA (+25°C) and 200 pA (+50°C) at 10 μV/div to 10 mV/div; 10 pA (+25°C) and 20 pA (+50°C) at 20 mV/div to 10 V/div. Single ended, one-half the differential measurement. Display shift is ±4 div (+25°C) and ±20 div (+50°C) at 10 μV/div (ac-coupled).

Signal and Offset Range

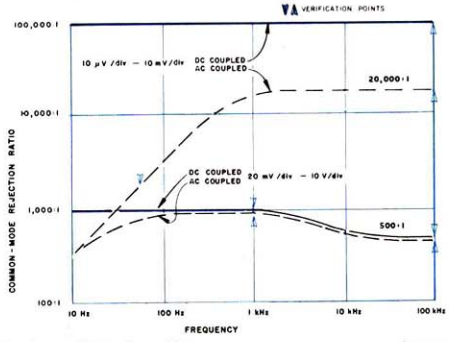
Deflection Factor Settings	10 μV to 10 mV/div	20 mV to 0.1 V/div	0.2 V to 1 V/div	2 V to 10 V/div
Common-mode Signal Range	±10 V	±100 V	±500 V	
Max Dc-coupled Input (Dc + Peak Ac at 1 kHz or Less)	±15 V	±200 V	±500 V	
Max Ac-coupled Input (Dc Voltage)	±500 V dc rejection, at least 4 x 10^5:1			
Dc Offset Range	+1 V to −1 V	+10 V to −10 V	+100 V to −100 V	+1000 V to −1000 V

Dc Stability — Drift with time (constant ambient temperature and line voltage): short term, 5 μV (p-p) or 0.1 div, whichever is greater in any minute after 1 hour warm-up. Long term, 10 μV (p-p) or 0.1 div, whichever is greater in any hour after 1 hour warm-up. Drift with ambient temperature (constant line voltage) is 50 μV/°C or less.

Displayed Noise — 16 μV or 0.1 div (whichever is greater) at max bandwidth; source resistance 25 Ω or less measured tangentially.

Overdrive Recovery — 10 μs or less to recover within 0.5% of zero level after removal of a test signal applied for 1 s (signal amplitude not to exceed differential dynamic range). Front-panel OVERDRIVE light indicates that an overdrive condition is being approached.

Common-mode Rejection Ratio (For Signals not Exceeding Common-mode Signal Range)



Order 7A22 Amplifier **$875**

7A18

Dc-to-75 MHz Bandwidth

5 mV/div to 5 V/div
Calibrated Deflection Factors

The 7A18, the basic building block of 3- and 4-trace operation, is a dual-trace plug-in amplifier. The 7A18 features constant bandwidth for all deflection factors, 5 operating modes (CH 1, CH 2, ALT, CHOP, ADD), trigger source selectivity and color-keyed control grouping. The 7A18 has a trace identify function. Polarity of channel 2 is selectable.

7A18

Deflection Factor — 5 mV/div to 5 V/div in 10 calibrated steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted to 10 mV/div. Uncalibrated VARIABLE is continuous between steps to at least 12.5 V/div.

Input R and C — 1 MΩ within 2%; ≈ 20 pF.

Max Input Voltage — Dc-coupled: 250 V (dc + peak ac); ac component 500 V p-p max, 1 kHz or less. Ac-coupled: 500 V (dc + peak ac); ac component 500 V p-p max, 1 kHz or less.

Dc Stability — Drift with ambient temperature (constant line voltage) is 0.01 div/°C. Drift with time (ambient temperature and line voltage constant) is 0.02 div in any one minute after 1 hour warm-up.

Common-Mode Rejection Ratio (ADD, CH 2 Invert) — At least 10:1, dc to 50 MHz.

Order 7A18 Amplifier **$750**

DC OFFSET OPTION

Dc Offset is for the user who needs to analyze small signals that are riding on larger signals, such as power supply ripple.

Option 06, Dc Offset — Two separate Channel-1 and Channel-2 variable offset controls are concentric with the position controls replacing the identify push-buttons of the standard 7A18. The ac-dc-ground switch of each channel is expanded to accommodate a fourth position for dc offset.

Offset Range Display — ±200 div max, equivalent to ±1 V at 5 mV/div.

Accuracy — When in DC OFFSET the deflection accuracy is derated by 1%.

Order Option 06 Dc Offset . . . . . **Add $115**

7A24

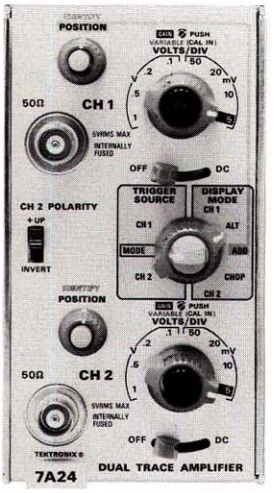
Dc-to-350 MHz Bandwidth (7900 Family)

5 mV/div to 1 V/div
Calibrated Deflection Factors

50-Ω Input

The 7A24, a high-performance, wide-bandwidth, dual-trace amplifier, is designed primarily for use with the 7700-, 7800-, and 7900-Series Mainframes. The 7A24 offers 350 MHz bandwidth and 5 mV/div sensitivity; this provides the basic building block for 3 or 4 trace operation. It features constant bandwidth for all deflection factors, 5 operating modes (CH 1, CH 2, ALT, CHOP, ADD), trigger source selection (CH 1, CH 2, MODE), and color-keyed control groupings. Polarity of channel 2 is selectable.

7A24



Deflection Factor — 5 mV/div to 1 V/div in 8 calibrated steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted to 5 mV/div. Uncalibrated VARIABLE is continuous between steps to at least 2.5 V/div.

Input R — 50 Ω within 0.5%; vswr 1.25:1 or less at 5 mV/div and 10 mV/div, 1.15:1 or less from 20 mV/div to 1 V/div at 250 MHz.

Max Input — 5 V rms; 0.5 W max input power, internally protected.

Common-Mode Rejection Ratio — At least 10:1, dc to 50 MHz.

Dc Stability — Drift with ambient temperature (constant line voltage) is 0.02 div/°C. Drift with time (ambient temperature and line voltage constant), 0.02 div in any one minute after 1 hour warm-up.

Order 7A24 Amplifier **$1250**

7A26

Dc-to-200 MHz Bandwidth (7900 Family)

5 mV/div to 5 V/div
Calibrated Deflection Factors

1-MΩ Input

The 7A26, a dual-trace plug-in amplifier, is a basic building block for 3- or 4-trace operation. It features constant bandwidth for all deflection factors, 5 operating modes (CH 1, CH 2, ALT, CHOP, ADD), trigger source selection (CH 1, CH 2, MODE), and color-keyed control groupings. Polarity of channel 2 is selectable. Bandwidth may be set at FULL or limited to 20 MHz for low-frequency applications.

Deflection Factor — 5 mV/div to 5 V/div in 10 calibrated steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 10 mV/div. Uncalibrated VARIABLE is continuous between steps to at least 12.5 V/div.

Input R and C — 1 MΩ within 2%; ≈ 20 pF.

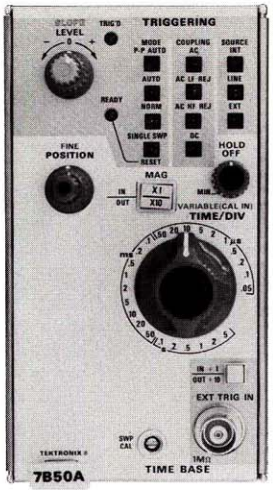
Max Input Voltage — Dc-coupled: 250 V (dc + peak ac); ac component 500 V p-p max, 1 kHz or less. Ac-coupled: 500 V (dc + peak ac); ac component 500 V p-p max, 1 kHz or less.

Common-Mode Rejection Ratio (ADD, CH 2 Invert) — At least 10:1, dc to 50 MHz.

Dc Stability — Drift with ambient temperature (constant line voltage) is 0.02 div/°C. Drift with time (ambient temperature and line voltage constant) is 0.02 div in any one minute after 1 hour warm-up.

Order 7A26 Amplifier **$1200**

For recommended probes — refer to page 49.



7B50A

5 ns/div to 5 s/div Calibrated Time Base

Triggering to 150 MHz

Variable Trigger Holdoff

Peak-to-Peak Auto Triggering

Single-Sweep Operation

The easy-to-use 7B50A Time Base is recommended for use with 7313 and 7600-Series Mainframes to provide optimum bandwidth/sweep-speed compatibility. It may, however, be used in any 7000-Series Mainframe. The fastest rate (5 ns/div) is obtained with the X10 MAGNIFIER.

This new time base features expanded capability in maximum triggering frequency — now 150 MHz — and variable trigger holdoff — for stability on lengthy asynchronous data trains.

Pushbutton positions select triggering mode, coupling method, and source. For routine applications, hands-off triggering is accomplished by actuating three switches: INT SOURCE, AC COUPLING, and P-P AUTO MODE. The P-P AUTO MODE provides a base line trace in the absence of a signal and a triggered trace at any position of the LEVEL/SLOPE control when a signal of 0.5 div or greater is present. Except for the selection of + or — SLOPE this mode is automatic. The other triggering positions are useful for specific applications.

AC LF REJ attenuates undesirable trigger components below 30 kHz. AC HF REJ attenuates components above 50 kHz, which can cause triggering problems during low-frequency applications. Single-sweep functions with lighted READY indicator and manual reset are associated with the trigger mode controls.

X-Y displays are available with Option 02 installed. A front-panel button (DISPLAY MODE) selects either normal sweep or X-Y display. Both signals are applied to vertical (Y) amplifiers and the desired horizontal (X) signal is then routed through plug-in and mainframe trigger paths to the 7B50A. An X-Y mode selection then applies the signal to the horizontal deflection system.

CHARACTERISTICS

Sweep Rates — 0.05 μs/div to 5 s/div in 25 steps (1-2-5 sequence). 5 ns/div, the fastest calibrated sweep rate, is obtained with the X10 MAGNIFIER. The uncalibrated VARIABLE allows continuous sweep rate selection between steps.

Sweep Accuracy — Measured over center 8 div, +15°C to +35°C, with any 7000-Series Mainframe. Derate accuracies by an additional 1% each for 0°C to +50°C.

Time/Div[1]	Unmagnified	Magnified
5 s/div to 1 s/div	4%	*
0.5 s/div to 0.5 μs/div	2%	3%
0.2 μs/div to 0.05 μs/div	3%	4%

[1]Fastest calibrated sweep rate is limited to 20 ns/div by 7313 mainframe.
*Unspecified

Trigger Holdoff Time —

MIN Holdoff Setting	5 s/div to 1 μs/div	2 times TIME/DIV setting or less
	0.5 μs/div to 50 ns/div	2.0 μs or less
Variable Holdoff Range	Extends holdoff time through at least 2 sweep lengths for sweep rates of 20 ms/div or faster	

Triggering —

Sensitivity (AUTO and NORM modes)

Coupling	Triggering Frequency Range[1]	Min Signal Required Int	Min Signal Required Ext
AC	30 Hz to 50 MHz	0.3 div	50 mV
	50 MHz to 150 MHz	1.5 div	250 mV
AC LF REJ[2]	30 kHz to 50 MHz	0.3 div	50 mV
	50 MHz to 150 MHz	1.5 div	250 mV
AC HF REJ	30 Hz to 50 kHz	0.3 div	50 mV
DC[3]	Dc to 50 MHz	0.3 div	50 mV
	50 MHz to 150 MHz	1.5 div	250 mV

[1] *Triggering frequency ranges are limited to the frequency of the vertical system when operating in the Internal mode.*

[2] *Will not trigger on sine waves of less than 8 div Int, or 3 V Ext, at or below 60 Hz.*

[3] *Triggering Frequency Range for dc coupling applies to frequencies above 30 Hz when operating in the Auto Triggering mode.*

Sensitivity (P-P AUTO MODE) (Ac or Dc Coupling)

Triggering Frequency Range	Min Signal Required Int	Min Signal Required Ext
200 Hz to 50 MHz	0.5 div	125 mV
50 MHz to 150 MHz	1.5 div	375 mV

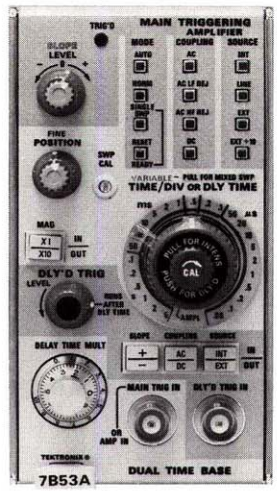
Option 02

X-Y Phase Shift (Determined by the circuitry in mainframe) — For mainframes without X-Y horizontal compensation, the mainframe phase shift specification is retained for frequencies of 50 kHz and below. For mainframes with optional X-Y horizontal compensation, the extra delay adds to the phase shift error above 50 kHz.

Order 7B50A Time Base $575

7B50A OPTION

Order Option 02, X-Y . . . . . Add $50



7B53A

5 ns/div to 5 s/div Calibrated Time Base

Calibrated Mixed Sweep

Triggering to 100 MHz

Single-Sweep Operation

Optional Tv Sync-Separator Triggering

The easy-to-use 7B53A Dual Time Base is recommended for use with 7313 and 7600-Mainframes to provide optimum bandwidth/sweep-speed compatibility. It may, however, be used in any 7000-Series Mainframe. The fastest rate (5 ns/div) is obtained with the X10 MAGNIFIER.

The 7B53A Time Base features four kinds of sweep: normal, intensified delaying, delayed, and mixed. The pushbutton switches cannot be lit.

DELAYING SWEEP

Sweep Rate — 0.05 μs/div to 5 s/div in 25 steps (1-2-5 sequence). 5 ns/div, the fastest calibrated sweep rate, is obtained with the X10 MAGNIFIER. The uncalibrated VARIABLE is continuous between steps. The variable control is internally switchable between main, delayed-sweep, and variable main-sweep holdoff.

Sweep Accuracy — Measured over the center 8 div.

Time/Div	Unmagnified +15°C to +35°C	Unmagnified 0°C to +50°C	Magnified +15°C to +35°C	Magnified 0°C to +50°C
5 s/div to 1 s/div	3%	4%	*	*
0.5 s/div to 0.05 μs/div	3%	4%	3.5%	5%
50 ms/div to 0.5 μs/div	2%	3%	2.5%	4%

*Unspecified

Delay Time Multiplier Range — 0 to 10 times the DELAY TIME/DIV setting from 5 s/div to 1 μs/div.

Differential Delay Time Measurement Accuracy — 5 s/div to 1 s/div ±1.4% of measurement + 0.3% of full scale; 0.5 s/div to 1 μs/div: ±0.7% of measurement +0.3% of full scale. Full scale is 10 times the DELAY TIME/DIV setting. Accuracy applies over the center 8 DTM divisions from +15°C to +35°C.

Jitter — 0.05% or less of TIME/DIV setting.

Triggering —

Coupling	Triggering Frequency Range	Min Signal Required Int	Min Signal Required Ext
Ac	30 Hz-10 MHz	0.3 div	100 mV
	10 MHz-100 MHz	1.5 div	500 mV
Ac Lf Rej*	30 kHz-10 MHz	0.3 div	——
	150 kHz-10 MHz	——	100 mV
	10 MHz-100 MHz	1.5 div	500 mV
Ac Hf Rej	30 Hz-50 kHz	0.3 div	100 mV
Dc	Dc-10 MHz	0.3 div	100 mV
	10 MHz-100 MHz	1.5 div	500 mV

*Will not trigger on sine waves of 3 div or less INT or 1.5 V EXT below 120 Hz.

7000-Series Delayed and Δ Delaying Time Bases

Single Sweep — Triggering requirements are the same as normal sweep. When triggered, sweep generator produces one sweep only until reset.

Internal Trigger Jitter — 1 ns or less at 75 MHz.

External Trigger Input — Max input voltage is 500 V (dc + peak ac), 500 V p-p ac at 1 kHz or less. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF. LEVEL range is at least +1.5 V to −1.5 V in EXT, at least +15 V to −15 V in EXT ÷ 10.

DELAYED SWEEP

Sweep Rate — 0.05 μs/div to 0.5 s/div in 22 steps (1-2-5 sequence). 5 ns/div, the fastest calibrated sweep rate, is obtained with the X10 MAGNIFIER. The uncalibrated VARIABLE is continuous between steps to at least 1.25 s/div and is switchable between the main, delayed sweep, and variable main sweep holdoff.

Sweep Accuracy — Measured over the center 8 div.

Time/Div	Unmagnified		Magnified	
	+15°C to +35°C	0°C to +50°C	+15°C to +35°C	0°C to +50°C
0.5 s/div to 0.1 s/div and 0.2 μs/div to 0.05 μs/div	4%	5%	4.5%	6%
50 ms/div to 0.5 μs/div	3%	4%	3.5%	5%

Delayed Sweep Gate — Output voltage is approx +3.5 V into at least 10 kΩ shunted by 100 pF or less, or 0.5 V into 50 Ω. Rise time is 50 ns or less; output R is 350 Ω within 10%. Gate is available at the DLY'D TRIG IN connector when the delayed sweep source switch is set to INT.

Triggering —

Coupling	Triggering Frequency Range	Min Signal Required	
		Int	Ext
Ac	30 Hz-10 MHz	0.3 div	100 mV
	10 MHz-100 MHz	1.5 div	500 mV
Dc	Dc-10 MHz	0.3 div	100 mV
	10 MHz-100 MHz	1.5 div	500 mV

Internal Trigger Jitter — 1 ns or less at 75 MHz.

External Trigger Input — Max input voltage is 500 V (dc + peak ac), 500 V p-p ac at 1 kHz or less. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF. LEVEL range is at least +1.5 V to −1.5 V in EXT.

MIXED SWEEP

Sweep Accuracy — Within 2% plus measured main sweep error. Exclude the following portions of mixed sweep: first 0.5 div after start of main sweep display and 0.2 div or 0.1 μs (whichever is greater) after transition of main to delayed sweep.

EXT HORIZONTAL INPUT

Deflection Factor — 10 mV/div within 10% when in EXT, MAG X10, 100 mV/div within 10% when in EXT; 1 V/div within 10% when in EXT ÷ 10.

Bandwidth

Coupling	Lower —3 dB	Upper —3 dB
Ac	40 Hz	2 MHz
Ac Lf Rej	16 kHz	2 MHz
Ac Hf Rej	40 Hz	100 kHz
Dc	Dc	2 MHz

TV SYNC

Option 05, Tv Sync Separator Triggering — Permits stable internal line or field rate triggering from displayed composite video or composite sync waveforms. Conventional waveform displays and measurements can be made from standard broadcast or closed circuit tv systems, domestic or overseas, with up to 1201-line, 60-Hz field rates. Individual lines may be displayed with delayed sweep features. The wide range of delayed sweeps permits accurate alternate-frame, color-burst observations in the PAL color system.

Order 7B53A Dual Time Base $975

7B53A OPTION

Order Option 05, Tv Triggering . . . . . Add $75

Option 05 — Deletes ac line trigger and External ÷ 10 from trigger source.

7B85 Features:

Δ Time Measurements with Crt Readout

Delay Time Measurements with Crt Readout

Vertical Trace Separation between Two Delayed Sweeps

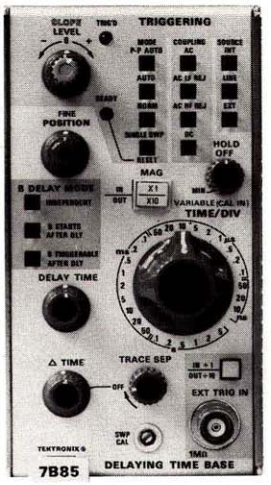
Both Feature:

1 ns/div to 5 s/div Calibrated Time Bases

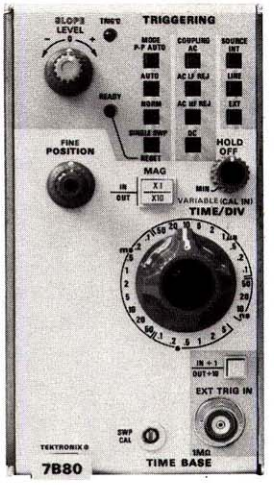
Triggering to 400 MHz

Variable Trigger Holdoff

Peak-to-Peak Auto Triggering



7B85



7B80

The 7B80 and 7B85 are horizontal time bases recommended for use with 7700-, 7800-, and 7900-Series Mainframes to provide optimum bandwidth/sweep-speed compatibility. (Each may be used in any slower 7000-Series Mainframe with some reduction in sweep accuracy at the fastest sweep speed.)

Together they provide the Δ time measurement capability in addition to the standard delay time capability. Either time interval is digitally displayed on the crt. A single intensified zone which you can position anywhere on the trace identifies the delay time interval (the time from the "A" or main sweep to the start of the intensified zone). Two intensified zones which you can position anywhere on a trace identify the Δ time interval (time between intensified zones). Alternate sweep switching makes it possible to display the information between the intensified zones full screen at the "B" sweep speed. By overlapping the two expanded waveforms, you are confident of the exact positioning of the intensified zones on the "A" sweep. This results in easy-to-make, precise and repeatable timing measurements.

By rotating the TRACE SEPARATION control out of the OFF position, the Δ time mode is activated. Two intensified zones can be independently positioned. As in the conventional delay mode, the DELAY TIME knob adjusts the time to the first intensified zone; the Δ TIME knob adjusts the time between the two intensified zones. Now, the crt digital readout shows the Δ time between the two delays.

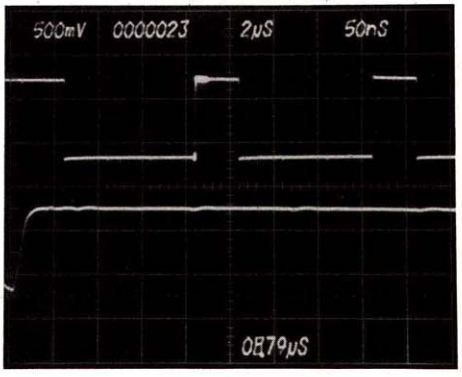


Fig 1. Delaying and delayed sweeps are shown with the mainframe selecting ALT sweep modes. The delay time to the start of the delayed sweep is digitally presented on the lower edge of the crt.

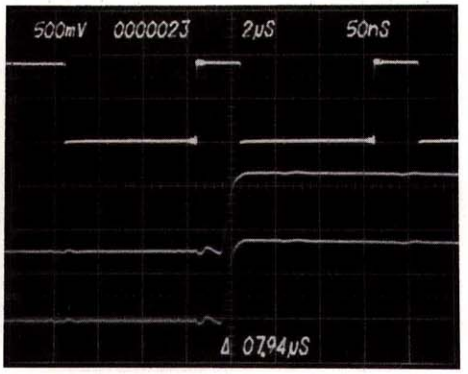


Fig 2. With the mainframe still selecting ALT sweeps, delaying and both delayed sweeps are shown. The digital readout on the lower crt edge shows the time between the two sweep delays. The TRACE SEPARATION knob is used to position the second delayed sweep below the first delayed sweep with up to 3 div of separation.

Either plug-in can be used separately as an independent single time base, or they can be combined in any mainframe with two horizontal compartments for delaying and delayed operation.

X-Y displays are available using a 7B80 with Option 02. A front-panel button (DISPLAY MODE) selects either normal sweep or X-Y display. Both signals are applied to vertical (Y) amplifiers, and the desired horizontal (X) signal is then routed through plug-in and mainframe trigger paths to the 7B80. An X-Y mode selection then applies the signal to the horizontal deflection system.

CHARACTERISTICS

Characteristics are common to both units unless otherwise noted.

Sweep Rates — 5 s/div to 10 ns/div in 27 steps (1-2-5 sequence). X10 MAGNIFIER extends fastest calibrated sweep rate to 1 ns div. The uncalibrated VARIABLE is continuous to at least 2.5 times the calibrated sweep rate.

Sweep Accuracy — Over center 8 div, with 7700, 7800, or 7900-Series Mainframe.[1]

Time/Div Setting	Unmagnified +15°C to +35°C	Unmagnified 0°C to +50°C	Magnified +15°C to 35°C	Magnified 0°C to +50°C
5 s/div to 1 s/div	4.0%	6.0%	*	*
0.5 s/div to 0.1 μs/div	1.5%	3.5%	2.5%	4.5%
50 ns/div to 10 ns/div	2.5%	4.5%	4.0%	6.0%

*Unspecified

(Fastest calibrated sweep rate is limited by 7700, 7600 and 7300-Series Mainframes.)

[1]If used in the slower 7300 or 7600 Mainframes, the sweep accuracies at 0.2 μs/div and 0.1 μs/div are derated to the 50 ns/div accuracy. The two fastest sweep rates permitted by these mainframes are specified only for magnified sweeps.

Trigger Holdoff Time —

Minimum Holdoff Setting	5 s/div to 1 μs/div	2 times TIME/DIV setting or less
	0.5 μs/div to 10 ns/div	2.0 μs or less
Variable Holdoff Range	Extends holdoff time through at least 2 sweep lengths for rates of 20 ms/div or faster	

△ **Time Range** — 0 to at least 9 times TIME/DIV setting.

△ **Time Accuracy** — (+15°C to +35°C)

Within (0.5% measurement + 0.3% of TIME/DIV setting + 1 least significant digit) from 20 ms/div to 100 ms/div.

(Full scale equals 10 times the TIME/DIV setting.)

Trace Separation Range — Functional only in △ Delay Time mode when alternating or chopping between time-base units. The second delayed sweep display can be vertically positioned at least 3 div below the first delayed sweep display.

Delay Time Range — 0.2 or less to at least 9.0 times TIME/DIV setting.

Jitter — 0.02% of TIME/DIV setting + 0.1 ns, or less.

TRIGGERING

Triggering Sensitivity (Auto and Norm Modes) — (from repetitive signals)

Coupling	Triggering Frequency Range[1]	Min Signal Required Int	Min Signal Required Ext
Ac	30 Hz to 50 MHz	0.3 div	50 mV
	50 MHz to 400 MHz	1.5 div	250 mV
Ac Lf Rej[2]	30 kHz to 50 MHz	0.3 div	50 mV
	50 MHz to 400 MHz	1.5 div	250 mV
Ac Hf Rej	30 Hz to 50 kHz	0.3 div	50 mV
Dc[3]	Dc to 50 MHz	0.3 div	50 mV
	50 MHz to 400 MHz	1.5 div	250 mV

1 Triggering frequency ranges are limited to the frequency of the vertical system when operating in the Internal mode.

2 Will not trigger on sine waves of less than 8 div Int, or 3 V Ext, at or below 60 Hz.

3 Triggering Frequency Range for dc coupling applies to frequencies above 30 Hz when operating in the Auto triggering mode.

Single Sweep — Requirements are same as for repetitive inputs.

Internal Trigger Jitter — 0.1 ns or less at 400 MHz.

Sensitivity (P-P AUTO Mode) — (ac or dc coupling)

Triggering Frequency Range	Min Signal Required Int	Min Signal Required Ext
200 Hz to 50 MHz	0.5 div	125 mV
50 MHz to 400 MHz	1.5 div	375 mV
Low Frequency Response: At least 50 Hz	2.0 div	500 mV

External Trigger Input — Max input voltage is 250 V (dc + peak ac). Input R and C is 1 MΩ within 5% and 20 pF within 10%. The level range (excluding P-P AUTO) is at least ±1.5 V in EXT ÷ 1, and at least ±15 V in EXT ÷ 10.

7B80 Option 02

X-Y Phase Shift (Determined by the circuitry in mainframe) — For mainframe without X-Y horizontal compensation, the mainframe phase shift specifications are retained for frequencies of 50 kHz and below. For mainframes with optional X-Y horizontal compensation, the extra delay adds to the phase shift error above 50 kHz.

Order 7B80 Time Base $745
Order 7B85 Delaying Time Base $895

7B80 OPTION

Order Option 02, X-Y . . . . . Add $50

7B92A

0.5 ns/div to 0.2 s/div Calibrated Time Base

Triggering to 500 MHz

Alternate Display of Intensified Delaying and Delayed Sweeps

Contrast Regulation between Delaying and Delayed Sweeps

Lit Pushbuttons

The 7B92A Dual Time Base is recommended for use only in the 7800- and 7900-Series Mainframes (the 7B92A may be used in all other mainframes at slower sweep speeds).

There are four display modes: normal sweep, intensified delaying sweep, delayed sweep, and alternate sweep (excepting alternate in R7704).

The 7B92A features calibrated sweeps from 0.2 s/div to 0.5 ns/div. Other features include alphanumeric readout for those oscilloscopes having crt readout systems, contrast control to regulate intensity differences between main and delayed sweeps, and continuous sweep delay from 0 to 9.8 times the delay time selector setting. When operating in the AUTO mode of main triggering, a bright base line is displayed in the absence of a trigger signal.

DELAYING SWEEP (MAIN SWEEP)

Sweep Rate — 0.2 s/div to 10 ns/div in 23 calibrated steps (1-2-5 sequence). An uncalibrated variable rate is continuous between steps, and extends sweep rate to at least 0.5 s/div. The VARIABLE control is internally switchable between delaying and delayed sweeps.

Sweep Accuracy — Measured over the center 8 div in a 7900-Family Oscilloscope:

Time/Div	+15°C to +35°C	0°C to +50°C
0.2 s/div to 20 ns/div	Within 2%	Within 3%
10 ns/div	Within 3%	Within 4%

Delay Time Multiplier Range — 0 to 9.8 times the DLY TIME/DIV setting from 0.2 s/div to 10 ns/div (0 to 1.96 seconds).

Differential Delay Time Measurement Accuracy — (+15°C to +35°C)

Sweep Speed

0.2 s/div to 0.1 μs/div	Both delay time mult dial settings at 0.5 or greater	±(0.75% of measurement + 0.25% of full scale)
	One or both delay time mult dial settings at less than 0.5	±(0.75% of measurement + 0.5% of full scale + 5 ns)
50 ns/div to 10 ns/div	Both delay times equal to or greater than 25 ns	±(1% of measurement + 0.5% of full scale)
	One or both delay times less than 25 ns	±(1% of measurement + 1% of full scale + 5 ns)

Full scale is 10 times the TIME/DIV or DLY TIME setting. Accuracy applies over the center 8 Delay Time Multiplier div from +15°C to +35°C.

Delay Time Jitter — Not applicable for the first 2% of max available delay time (DELAY TIME MULT dial setting greater than 0.2).

0.2 s/div to 50 μs/div	1 part in 50,000 of the max available delay time
20 μs/div to 10 ns/div	1 part in 50,000 of the max available delay time + 0.5 ns

Max available delay time is 10 times the TIME/DIV or DLY TIME switch setting.

MAIN TRIGGERING

Auto, Norm

Coupling	Triggering Frequency Range	Min Signal Required Int	Min Signal Required Ext
Ac	30 Hz-20 MHz	0.5 div	100 mV
	20 MHz-500 MHz	1.0 div	500 mV
Ac Lf Rej	30 kHz-20 MHz	0.5 div	100 mV
	20 MHz-500 MHz	1.0 div	500 mV
Ac Hf Rej	30 Hz-50 kHz	0.5 div	100 mV
Dc	Dc-20 MHz	0.5 div	100 mV
	20 MHz-500 MHz	1.0 div	500 mV

EXT ÷ 10 switch attenuates external signal 10 times.

HF SYNC — Triggering sensitivity is 0.5 div INT or 100 mV EXT, from 100 MHz to 500 MHz for any coupling except Ac Hf Rej.

Single Sweep — Triggering requirements are the same as normal sweep. When triggered, time base produces one sweep only until reset.

7000-Series Curve Tracer and Readout Unit

Internal Trigger Jitter — 50 ps or less at 500 MHz.

External Trigger Input — Selectable 50 Ω or 1 MΩ inputs (1 MΩ is paralleled by approx 20 pF). Max safe input is 250 V (dc + peak ac) for 1 MΩ input, and 1 W average for 50 Ω input. Range of trigger level is at least ±3.5 V in EXT, and at least ±35 V in EXT ÷ 10.

DELAYED SWEEP

Sweep Rate — 0.2 s/div to 0.5 ns/div in 27 steps (1-2-5 sequence). An uncalibrated variable rate is continuous between steps, and extends sweep rate to at least 0.5 s/div. The VARIABLE control is internally switchable between delaying and delayed sweeps.

Sweep Accuracy — Measured over the center 8 div in a 7900-Family Oscilloscope:

Time/Div	+15°C to +35°C	0°C to +50°C
0.2 s/div to 20 ns/div	Within 2%	Within 3%
10 ns/div to 5 ns/div	Within 3%	Within 4%
2 ns/div to 1 ns/div	Within 4%	Within 5%
0.5 ns/div	Within 5%	Within 6%

Delayed Triggering

Coupling	Triggering Frequency Range	Min Signal Required	
		Int	Ext
Ac	30 Hz to 20 MHz	0.5 div	100 mV
	20 MHz to 500 MHz	1.0 div	500 mV
Dc	Dc to 20 MHz	0.5 div	100 mV
	20 MHz to 500 MHz	1.0 div	500 mV

Internal Trigger Jitter — 50 ps or less at 500 MHz.

External Trigger Input — Selectable 50 Ω or 1 MΩ inputs (1 MΩ is paralleled by approx 20 pF). Max safe input is 250 V (dc + peak ac) for 1-MΩ input, and 1 W average for 50-Ω input. Range of trigger level is at least ± 3.5 V in EXT.

Order 7B92A Dual Time Base $1795

7CT1N

10 nA/div to 20 mA/div Vertical Deflection Factors

0.5 V/div to 20 V/div Horizontal Deflection Factors

The 7CT1N Curve Tracer Plug-in displays characteristic curves of small-signal semiconductor devices to power levels up to 0.5 W. The 7CT1N operates in horizontal or vertical compartments of 7000-Series Oscilloscopes.

CHARACTERISTICS

COLLECTOR/DRAIN SUPPLY

	X1		X10	
Horizontal Volts/Div	0.5	2	5	20
Voltage Range	0 - 7.5 V	0 - 30 V	0 - 75 V	0 - 300 V
Max Current	240 mA	60 mA	24 mA	6 mA

Max Open Circuit Voltage — Within ±20%. Max short-circuit current, within 30%.

Series Resistance — Automatically selected with horizontal V/div switches. Peak power is 0.5 W or less, depending upon control settings.

High Voltage Warning — When the horizontal V/div switch is in the X10 position, a flashing warning light, indicating that dangerous voltages may exist at the test terminals, appears on the front panel.

STEP GENERATOR

Transistor Mode — Step amplitude range is 1 μA/step to 1 mA/step, 1-2-5 sequence. Max current (steps plus aiding offset) is X15 amplitude setting. Max voltage (steps plus aiding offset) is at least 13 V. Max opposing offset current is at least X5 amplitude setting.

FET Mode — Step amplitude range is 1 mV/step to 1 V/step, 1-2-5 sequence. Voltage amplitude (steps plus aiding offset) is X15 amplitude setting, 13 V max. Source impedance is 1 kΩ ± 1%.

Accuracy — Incremental: within 3% between steps. Absolute: within ± (3% + X0.3 amplitude setting).

Step Polarity — The step generator polarity is the same as the collector/drain supply in the transistor mode and opposing in the FET mode.

Number of Steps — Selectable in 1 step increments between 0 and 10.

Offset — Selectable to 5 steps. Polarity aids or opposes the step polarity.

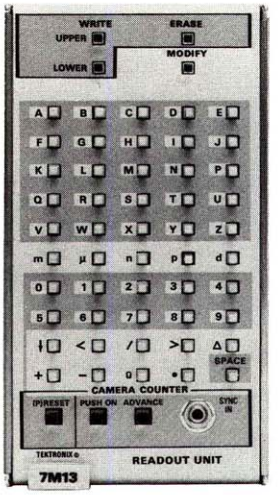
Vertical Deflection Factors — 10 nA/div to 20 μA/div with the ÷1000 control activated. 10 μA/div to 20 mA/div in the X1 mode.

Vertical Display Accuracy — Within 5% in the X1 mode. Within 5% ±0.2 nA per displayed horizontal volt in the ÷1000 mode.

Horizontal Deflection Factors — Selectable: 0.5 V, 2 V, 5 V, or 20 V.

Horizontal Display Accuracy — Within 5% plus the deflection factor accuracy on the plug-in being driven. The plug-in is a vertical or horizontal amplifier with a 100 mV/div deflection factor and an input R of at least 50 kΩ when it is used in the horizontal compartment.

Order 7CT1N Curve Tracer $815



7M13

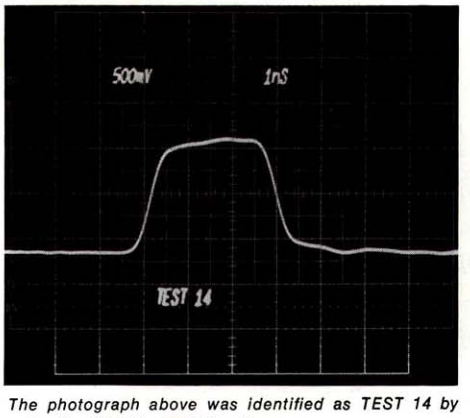
Easy and Convenient Identification of Photographed Displays

Automatic Sequence Advance with Each Camera Exposure

The 7M13 Readout Unit provides front-panel keyboard operation for convenient access to the crt readout characters. Up to ten alphanumeric characters can be displayed at the top and/or at the bottom of the crt. The 7M13 is designed for use in all 7000-Series Mainframes with crt readout. A remote-advance cable is supplied with the 7M13 to connect it to the shutter x-sync connector of the C-50-Series Cameras. An optional cable is available for cameras using an ASA connector for x-sync.

Included Accessory — Remote-advance cable (012-0339-01).

Order 7M13 Readout Unit $500

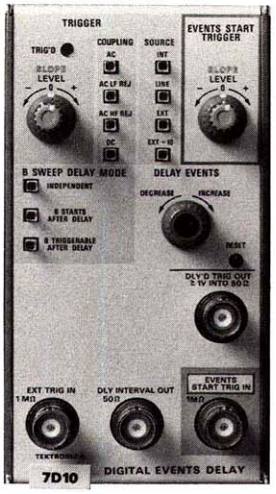


The photograph above was identified as TEST 14 by using the 7M13 in 7834 Oscilloscope.

Optional Accessory — Remote-advance cable with ASA connector for camera x-sync

Order 012-0364-01 . . . . . $15.00

Delay by Time or Events
Digital Delay Readout to 7½ Digits
100-ns to 1-s Delay Time
1-ns Resolution
2.2 ns Delay Time Jitter
0.5-ppm (±2 ns) Accuracy
Delay Interval Crt Display



The 7D10/7D11 Digital Delay Plug-ins give stable delayed trigger for measurements requiring low jitter. The 7D11 also provides precision time delays. The 7D10/7D11 may be used in any compartment of a 7000-Series Mainframe equipped with crt readout. It provides a variety of outputs.

The delay-by-events mode is used to eliminate jitter in mechanically based systems such as disc file memories. It is also useful for selecting a certain time frame in data for analysis and for making other measurements under complex timing conditions.

In the delay-by-events, the 7D10/7D11 counts arbitrary trigger events, periodic or aperiodic, and delivers an output after the preselected count has been reached (see Fig 2).

An accurate and jitter-free delay-by-time is very useful when working with digital logic, pcm telemetry, sonar, radar, shock tube testing, and delay line measurements, to name a few. On receipt of a trigger, the 7D11 in the delay-by-time mode counts a highly accurate clock; at the selected delay time, it delivers a delayed trigger to its front-panel connector and mainframe. In both modes, delay time or number of events to be counted is selected by a single front-panel control.

When the 7D10/7D11 is installed in a vertical compartment, the crt can display a waveform that lasts for the duration of the delay interval. This waveform may be displayed together with the signal waveform the 7D10/7D11 triggers on. From a vertical compartment, the 7D10/7D11 can trigger a time base such as 7B80, 7B53A, or another 7D10/7D11 through the internal mainframe trigger path.

In any horizontal compartment, the 7D11 generates a display similar to the "A Intensified By B" mode of conventional delayed sweep (see Fig 2). When used in the A horizontal compartment, the 7D10/7D11 B sweep delay mode controls will permit the B sweep to run after the delay generated by the 7D10/7D11. This delay interval is also available at the front panel for such uses as gated interval counter measurements and generating pulses of highly accurate width.

In delay-by-events, an external pulse (events start trigger) may be used to enable counting of the events. In such applications as a line selector on a video monitor, the vertical sync pulse is the events start trigger. Then the 7D10/7D11 counts "n" number of horizontal sync pulses (events) into the field or frame. In a similar manner, the origin pulse of a disc memory can be used as the events start trigger, and the disc clock pulses become the events that are counted.

For timing measurements that require a higher degree of accuracy than the 0.5 ppm source available in the 7D11, the delay-by-time clock may be referenced to an external 1-MHz timing standard through the EXT 1-MHz input.

Time delay resolution up to 1 ns may be obtained by using the front-panel fine delay control.

By setting an internal switch, the indicated delay time is half the actual delay time. In such applications as tdr, radar timing, etc, the crt readout would display the "one-way-trip" time.

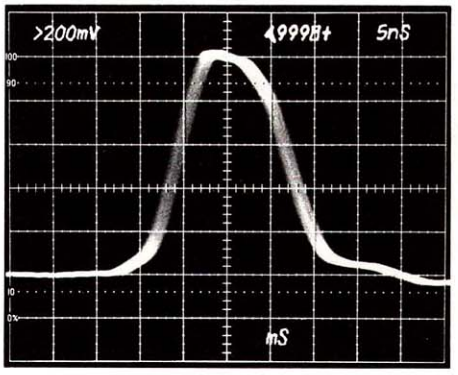


Fig 1. Delay-by-time. A 0.2 μs time marker delayed 4.9998 ms by the 7D11 and displayed at 5 ns/div.

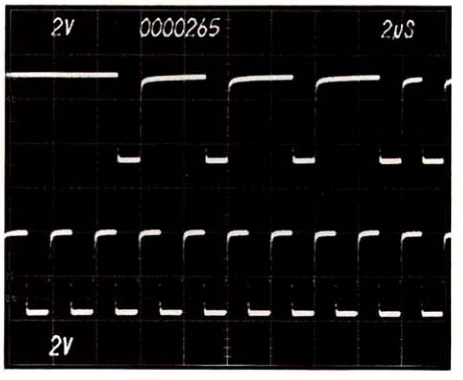


Fig. 2. Delay-by-events. The lower trace is the master clock in our logic circuit. The top trace is our data which is delayed by 265 clock pulses.

EVENTS DELAY

Events Delay Range — One to 10^7 events.
Delay Increment — One event.
Insertion Delay — 35 ns ±5 ns.
Recycle Time — Less than 500 ns.
Max Event Frequency — At least 50 MHz.

TRIGGERING

	External Trigger
Source	Int, Line, Ext, Ext ÷ 10
Coupling	Dc, Ac, Ac Lf Rej, Ac Hf Rej
Max Input Voltage	250 V dc + peak ac
Level Range	±1.75 V in Ext ±17.5 V in Ext ÷ 10
Input R and C	1 MΩ ±5%, 20 pF ±2 pF

	Coupling	Frequency Range	Min Signal Required	
			Int	Ext
Sensitivity	Ac	30 kHz-10 MHz 10 MHz-50 MHz	0.3 div 1.0 div	150 mV 750 mV
	Ac Lf Rej*	30 kHz-10 MHz 150 kHz-10 MHz 10 MHz-50 MHz	0.3 div — 1.0 div	— 150 mV 750 mV
	Ac Hf Rej	30 Hz-50 kHz	0.3 div	150 mV
	Dc	Dc-10 MHz 10 MHz-50 MHz	0.3 div 1.0 div	150 mV 750 mV

*Will not trigger on sine waves of 3 div or less INT or 1.5 V EXT below 120 Hz.

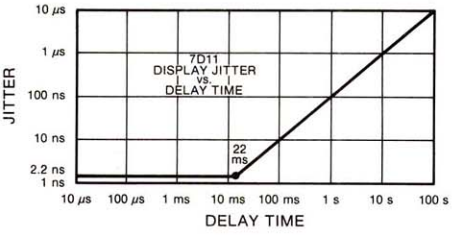
	Events Start Trigger
Source	External Only
Coupling	Dc Only
Max Input Voltage	150 V dc + peak ac
Level Range	±3 V
Input R and C	1 MΩ within 5%, 20 pF ± 2 pF
Sensitivity	100 mV minimum, 30 Hz to 2 MHz; increasing to 250 mV, 2 MHz to 20 MHz; increasing to 500 mV, 20 MHz to 50 MHz.

TIME DELAY

Digital Delay Range — Normal mode: 100 ns to 1 s in 100 ns increments. Echo mode: 200 ns to 2 s in 200 ns increments.

Analog Delay — Continuously variable from 0 to at least 100 ns, accuracy within 2 ns of indicated delay.

Jitter with Internal Clock — 2.2 ns or delay time X10^{-7} whichever is greater.



Insertion Delay — Zero within 2 ns.
Recycle Time — Less than 575 ns.
Time Base — 500 MHz oscillator phase-locked to internal or external clock.
Internal Clock — 5 MHz crystal oscillator. Accuracy is 0.5 ppm.
External Clock — 1 MHz within 1%, ac coupled, 50 Ω.

OUTPUTS

Delayed Trigger Out — Amplitude: 2 V or greater into open circuit, 1 V or greater into 50 Ω. Rise time into 50 Ω Load: 2 ns or less. Fall time into 50 Ω Load: 5 ns or less. Pulse width: 200 to 250 ns.

Delay Interval Out — Amplitude: 2 V or greater into open circuit, 1 V or greater into 50 Ω. Rise time and fall time: 5 ns or less. Accuracy: equal to delay interval less 20 to 30 ns.

READOUT

Display — 7½ digit with leading zero suppression, ms legend in time delay mode. Plus (+) symbol reminds the operator to add on the FINE DELAY (ns) setting.

Order 7D10 Digital Events Delay Unit . . $925
Order 7D11 Digital Delay Unit $1700

Versatile 0.01% A/D Converter with Vertical Amplifier

3 Plug-in Modules Available

Automatic, Manual, or External Triggering

Automatic Polarity and Overrange Indicators

Lit Pushbuttons

The 7D12 A to D Converter, constructed in modules, is a versatile and expandable DVM measurement system. The 7D12 and three interchangeable modules will make most DVM measurements, including dc volts, resistance, temperature, one- or two-point sample and hold, and true rms volts.

The 7D12 is designed for use with all 7000-Series Oscilloscope Mainframes with crt readout.

7D12/M1 MULTIFUNCTION MODULE

Temperature Mode

4½ Digit Crt Readout

100 μV Resolution

Probe Measures Temperature or Voltage

The M1 Multifunction Module measures dc volts, resistance, and temperature. The input can be elevated 1 kV above ground without probe, with a 10-MΩ input impedance on the dc volts scale. When the temperature probe is used, a front-panel analog output of 10 mV/°C (0°C = 0 V) is available regardless of model selected.

Dc Voltage Range — 0 to 1000 V in four ranges. 4½-digit presentation of 1.9999 V, 19.999 V, 199.99 V, 1,000 kV. Accuracy is ±0.03% of reading ±0.005% of full scale from +20°C to +30°C; ±0.04% of reading ±0.005% of full scale from +15°C to +40°C. Input impedance is 10 MΩ on all ranges. Max safe input is 1 kV peak between either connector and ground. Polarity is automatic. Cmrr is at least 80 dB at 60 Hz (100 Ω imbalance). Normal-mode rejection ratio is at least 50 dB at 60 Hz.

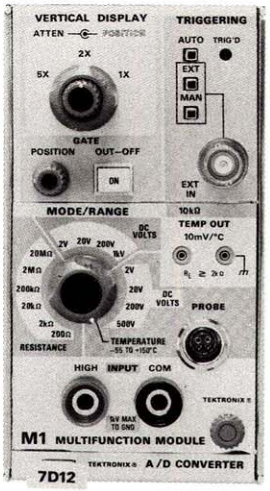
Resistance Range — 0 to 20 MΩ in six ranges. 4½-digit presentation of 199.99 Ω, 1.9999 kΩ, 19.999 kΩ, 199.99 kΩ, 1.9999 MΩ, 19.999 MΩ full scale. Accuracy is ±0.09% of reading ±0.01% of full scale from +15°C to +40°C. Input is fuse protected.

Temperature Range — −55°C to +150°C in one range. Accuracy (+15°C to +40°C ambient) is ±1°C from −55°C to +125°C, ±2°C above +125°C. Temperature out is 10 mV/°C into a load of at least 2 kΩ.

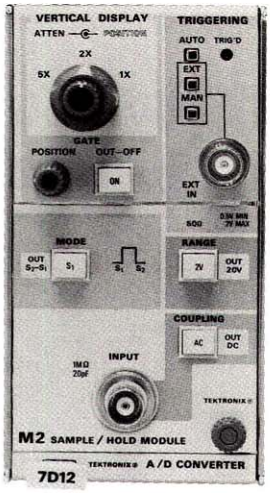
Settling Time — 2 s or less to within 1 count of final reading (voltage and resistance modes).

Measurement Rate — External Trigger: 1 to 12 measurements per second, depending on external trigger frequency and internal adjustment. Auto Trigger: 1 to 4 measurements per second, internally adjustable.

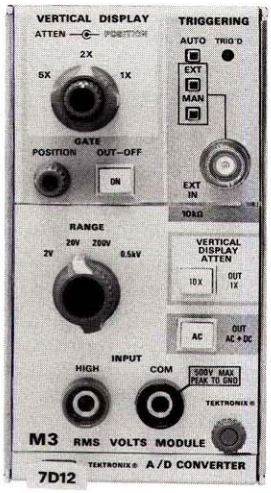
Overrange Indication — When overrange occurs, a > symbol appears to the left of the reading.



7D12/M1



7D12/M2



7D12/M3

Included Accessories — P6058 voltage/temperature probe package (010-0260-00); pair of test leads (012-0427-00). (See 7D13 for P6058 probe specs.)

7D12/M2 SAMPLE/HOLD MODULE

Oscilloscope-controlled Sampling DVM

10-ns Aperture Uncertainty

Input Signal and Sample Points Displayed on Crt

3½ Digit Crt Readout

Approaching 0.25% Accuracy

1-mV Resolution

25-MHz Bandwidth

0-to-2 V and 0-to-20 V Input Range, 200 V with P6055 Probe

The M2 Sample/Hold Module measures voltage amplitude from ground to a selected point or the difference voltage between any two selected points (independent control of each point). The sample point(s) may be triggered automatically, manually, or externally from sources such as the oscilloscope's Delayed B gate, the 7D15's pseudo gate, 7D11's delayed trigger out, etc.

On command, the 7D12/M2 samples the displayed waveform and also generates a gate display. Both the signal and 7D12/M2 gate are displayed together, providing a visual indication of where the sample(s) is taken. In the S1 mode (sample one), a single sample coincident with the rise of the 7D12/M2 displayed gate is taken, and the voltage amplitude, from the 0 V level, is digitally displayed on the crt readout. In the S2-S1 mode (sample two minus sample one), two samples are taken, one at the rise and one at the fall of the 7D12/M2 displayed gate, and the voltage difference between these two points is digitally displayed on the crt readout.

Sample-gate Display Amplitude — 2 div, rise time and fall time 5 ns or less.

Analog-signal Display — Bandwidth is dc to 25 MHz (dc-coupling), 3.4 Hz to 25 MHz (ac-coupling). Vertical sensitivity is 100 mV/div to 5 V/div in 6 steps (1-2-5 sequence in combination with M2 range and 7D12 vertical display attenuation). Accuracy is within 5%.

Input R and C — 1 MΩ and 20 pF.

Max Input Voltage — 100 V peak.

Measurement Readout — 0 to 20 V in two ranges. 3½-digit presentation of 1.999 V and 19.99 V full scale, extended to 199.9 V with P6055 probe.

Overrange Indication — When overrange occurs, a > symbol appears to the left of the reading.

Aperture Uncertainty — 10 ns or less.

Pulse-width Sample Time (S2-S1 mode) — 30 ns to 5 ms with repetitive signal. 150 μs to 5 ms with single-shot signal.

Measurement Rate — External Trigger: 1 to 12 measurements per second, depending on external trigger frequency and internal adjustment. Auto Trigger: 1 to 4 measurements per second, internally adjustable.

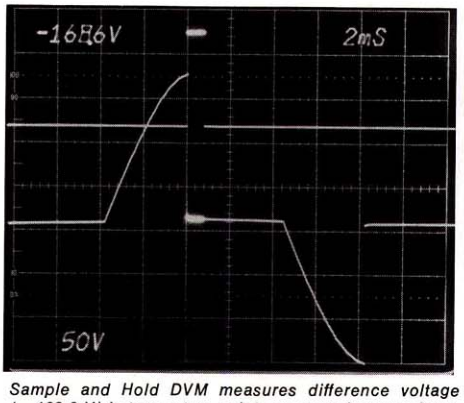
Settling Time — 40 ns.

Accuracy without Probe (40 ns after Input Signal Step Function)

Temperature Range	S1 Mode	S2-S1 Mode
+20°C to +30°C	±0.15% of p-p input voltage, ±0.1% of reading, ± 2 counts, ± % of ac decay*	±0.25% of p-p input voltage, ±0.15% of reading, ± 2 counts, ± % of ac decay*
+15°C to +40°C	±0.25% of p-p input voltage, ±0.2% of reading, ± 3 counts, ± % of ac decay*	±0.35% of p-p input voltage, ±0.25% of reading, ± 3 counts, ± % of ac decay*

*Applicable when M2 is ac-coupled.

Included Accessory — 3.5 ft P6055 probe package (010-6055-01).



Sample and Hold DVM measures difference voltage (−168.6 V) between two points on complex waveform. Gate waveform indicates two points: leading and trailing edges where voltage difference is made.

7D12/M3

True Rms Measurements with Isolated-analog Display (Floating Common-mode Capability)

Measures Ac + Dc or Ac Only

40 Hz-to-100 kHz Ac Voltage Range

0.25% Accuracy from 40 Hz to 40 kHz

3½ Digit Crt Readout

1 mV Resolution

500 V Max Peak Common-mode Voltage

The M3 RMS Volts Module measures the true rms voltage of signals from 40 Hz to 100 kHz. Voltages up to 1 kV peak may be measured while floating the input connectors.

Input R and C — 1 MΩ; ≃ 50 pF.
Max Crest Factor — 5 (crest factor = $\frac{E_{pk}}{E_{RMS}}$).
Max Input Voltage

Range		2 V, 20 V, 200 V	0.5 kV
Ac or Dc coupled†	Max Input between connectors	2.5 X range peak	500 rms 1 kV peak
	Max Input between either connector and chassis ground	500 V peak	500 V peak

†Ac-coupling adds an additional 200 V dc isolation.

Digital System Cmrr — 66 dB at dc to 60 Hz, decreasing 20 dB per decade for higher frequencies (100-Ω imbalance load).

Measurement Readout — 0 to 500 V rms in four ranges. 3½ digit presentation of 1.999 V, 19.99 V, 199.9 V, 0.500 kV full scale.

Overrange Indication — When overrange occurs, a > symbol appears to the left of the reading.

Measurement Rate — External Trigger: 1 to 12 measurements per second, depending on external trigger frequency and internal adjustment. Auto Trigger: 1 to 4 measurements per second, internally adjustable.

Accuracy — Stated with form factor of 1.2 or less (form factor = $\frac{E_{RMS}}{E_{average}}$); +15°C to +40°C*.

Range	Dc	40 Hz to 4 kHz	4 kHz to 40 kHz	40 kHz to 100 kHz
2 V, 20 V	±0.5%	±0.25%	±0.25%	±0.5%
200 V	±0.5%	±0.25%	±0.5% plus 1% of reading	±0.5% plus 1% of reading
500 V	±1%	±1%	±2% plus 1% of reading	±2% plus 1% of reading

*Accuracies represent a percentage of full scale. For signals with form factors greater than 1.2, add ± [0.1% x (form factor −1)] to the above percent of full scale accuracy specifications.

Analog-Signal Display — Bandwidth is dc to 700 kHz, max slew rate limited to full scale voltage ÷ 1 μs (100 V/μs max). Vertical sensitivity is 100 mV/div to 500 V/div in 12 steps (1-2-5 sequence, combining M3 and 7D12 vertical display attenuation). Accuracy is within 5%, and aberrations are 5% or less.

Included Accessories — Pair of test leads (012-0427-00).

7D12/M1/M2/M3 ORDERING INFORMATION

7D12 A/D Converter (Modules not Included) **$800**

M1 Multifunction Module **$395**

Option 02 without P6058 ..... **Sub $100**

M2 Sample/Hold Module **$750**

Option 02 without P6055 ..... **Sub $120**

M3 RMS Volts Module **$595**

7D13

Temperature Mode

1.5 kV Max Common-mode Voltage

Probe Measures Temperature or Voltage

3½ Digit Crt Readout

The 7D13 is a digital multimeter designed for use in all 7000-Series Oscilloscope Mainframes with crt readout. The 7D13 functions in any compartment.

The 7D13 measures dc volts, dc current, and resistance. It also measures temperature from a temperature sensor on the tip of the P6058 voltage/temperature probe. The temperature probe functions regardless of 7D13 mode or range setting and provides a front-panel analog signal output of 10 mV/°C (0°C = 0 V). Temperature may be measured simultaneously along with any other function. Almost any npn transistor may be used as a separate sensor to make small-space "free air" measurements.

When the 7D13 is used, the character generator traces out a 3½ digit display on the crt and a legend for units like kΩ, mA, °C.

Dc Voltage Range — 0 to 1000 V in four ranges. 3½-digit presentation of 1.999 V, 19.99 V, 199.9 V, and 1000 V full scale. Accuracy is ±0.1% of reading ±1 count from +15°C to +40°C, ±0.2% of reading ±2 counts from 0°C to +50°C. Input impedance is 10 MΩ on all ranges. Max safe input is 1.5 kV peak between either contact and ground, 1.0 kV peak between voltage contacts.

Dc Current Range — 0 to 2 A in four ranges. 3½ digit presentation of 1.999 mA, 19.99 mA, 199.9 mA, and 1999 mA full scale. Accuracy is ±0.5% of reading ±2 counts from +15°C to +40°C, ±0.7% of reading ±4 counts from 0°C to +50°C. Max input is 3 A (fuse protected). Input impedance is 0.2 V/full scale current +0.3 Ω.

Resistance Range — 0 to 2 MΩ in five ranges. 3½-digit presentation 199.9 Ω, 1999 Ω, 19.99 kΩ, 199.9 kΩ, and 1999 kΩ full scale. Accuracy is ±0.5% of reading ±1 count from +15°C to +40°C, ±0.8% of reading ±2 counts from 0°C to +50°C. Input is fuse protected.

Temperature Measurement Range — −55°C to +150°C in one range. 3½ digit presentation to +150°C. Accuracy (+5°C to +40°C ambient) is ±1°C from −55°C to +125°C, ±2°C above +125°C. Accuracy (0°C to +50°C ambient) is ±2°C from −55°C to +125°C, ±3°C above +125°C.

Setting Time — 1.5 s or less (voltage, current, and resistance modes).

Polarity — Automatic indication.

Max Common-mode Voltage — 1.5 kV peak between two terminals and ground.

Normal-mode Rejection Ratio — At least 30 dB at 60 Hz increasing at 20 dB/decade.

Common-mode Rejection Ratio — With a 1 kΩ imbalance, at least 100 dB at dc; 80 dB at 60 Hz.

Overrange Indication — When overrange occurs, the readout blinks and the most significant digit displays a 2.

Recycle Time — 5 measurements per second.

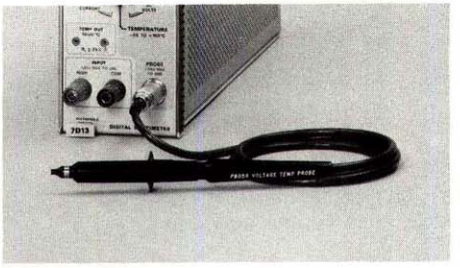
Temperature Out — 10 mV/°C into a load of at least 2 kΩ.

Included Accessories — P6058 Voltage/Temperature Probe package (010-0260-00); pair of test leads (003-0120-00).

Order 7D13 Digital Multimeter **$750**

7D13 OPTION

Order Option 02 without P6058 Probe ..... **Sub $90**



P6058 PROBE

The P6058 Probe is a combination 1X dc voltage and temperature measuring device. The temperature-sensing element consists of a transistor installed in the tip that plugs into the end of the probe body. For voltage measurements, a twelve inch and five inch "common" (low) strap is provided. There is no external ground on the P6058 body; ground or the low-potential point of the circuit under test is referenced to the common strap, a floating common that has no tie to chassis ground. This lead may be floated at up to 40 V dc above chassis ground. The probe tip may be 500 V above ground.

The retractable hook-tip must be used on the probe when voltage measurements are made.

Temperature is measured by applying the flat surface of the probe tip to the device to be measured.

Dc Voltage Range — 0 to 1000 V. Accuracy is ±0.1% of reading ±1 count.

Max Safe Input — 500 V peak between high and common; 40 V peak between common and chassis ground.

Temperature Range — See the 7D13 for the accuracy of a P6058/7D13 combination.

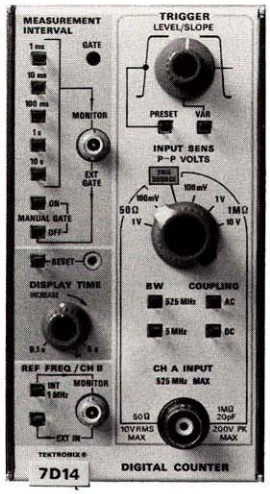
Cable — 46 in including probe body. Output connector is four-pin locking type for attaching the P6058 to the 7D13. Supplies power to the probe sensor transistor and signal to the digital multimeter.

Net Weight — Approx 5 oz.

P6058 Voltage/Temperature Probe
Order 010-0260-00 ..... **$110**

Includes P6058 Probe (010-0259-00): probe retractable hook tip (013-0121-00); 12 in ground lead screw-in (175-0991-00); two miniature alligator clips (344-0046-00).

7000-Series Digital Counter and Universal Counter/Timer



7D14

Frequency Measurements Directly to 525 MHz

Trigger Indicator Display

No-warm-up Oscillator

50-Ω and 1-MΩ Inputs

Signal Conditioning via Mainframe Trigger Source

Lit Pushbuttons

The 7D14 is a directly gated digital counter plug-in unit designed for use in all 7000-Series Oscilloscope Mainframes with crt readout. It will function in any plug-in compartment. The 7D14 has three modes of operation: frequency—0 to 525 MHz, frequency ratio (A/B)—0 to 10^5:1 and totalize—0 to 10^8.

The 7D14 counts directly to 525 MHz. The gated approach makes possible "single event" counting which is frequently very desirable in rapid burst measurements. The resolution and accuracy can be improved by increasing the measurement interval.

Measurements which were previously impossible can now be made with an oscilloscope having a digital counter plug-in. By locating the counter in one of the vertical compartments of the oscilloscope and operating the scope in the delaying time-base mode, the B sweep (delayed sweep) can drive the counter gate. By doing this, signals may be displayed on the screen. Those being counted will be intensified.

With the 7D14 in a vertical compartment, the output of its trigger circuit can be displayed directly on the crt. This provides an indication of the actual triggering point, thus many signals that were difficult to trigger on in the past can now be measured with much greater reliability. Selective triggering is now possible too.

When the 7D14 is used in a horizontal plug-in compartment, a signal connected to a vertical plug-in may be internally routed to it by the trigger source switches. All the 7000-Series vertical plug-ins are available as signal conditioners for the counter. Another advantage is the reduction of circuit loading. One connection to the oscilloscope deflects the vertical and provides the input for the counter.

FREQUENCY MEASUREMENTS

Input — Channel A, 0 to 525 MHz. Upper bandwidth may be restricted to 5 MHz to filter incoming high frequency noise.

Measurement Interval (Time Base) — 1 ms to 10 s in five decade steps. Up to 0.1 Hz resolution can be obtained.

Accuracy — Within $\pm \frac{1}{\text{total count}} \pm$ time base.

Time-base Stability — Within ±0.00005%, 0°C to +50°C ambient temperature.

Long-term Drift — 1 part or less in 10^7/month.

Input Characteristics

	Channel A		Channel B	Internal Trigger Source
	50 Ω	1 MΩ		
Dc-coupled	Dc to 525 MHz	Dc to 525 MHz	Ac-coupling only	Ac-coupling only
Ac-coupled	200 kHz to 525 MHz	5 Hz to 525 MHz	10 Hz to 2 MHz	5 Hz to 525 MHz*
Sensitivity	100 mV p-p (35 mV rms)	100 mV p-p (35 mV rms)	800 mV p-p	1.5 graticule div*
Input R & C	50 Ω	1 MΩ ≈20 pF	10 kΩ ≈30 pF	Depends on amplifier plug-in used
Max Voltage	10 V rms	200 V (dc + peak ac) to 5 MHz 50 V (dc + peak ac) 5 MHz to 525 MHz	15 V (dc + peak ac) to 2 MHz	Depends on amplifier plug-in used

*Bandwidth and sensitivity limited by mainframe, sensitivity derated above 150 MHz.

FREQUENCY RATIO

Range — Channel A: 0 to 525 MHz.
Channel B: 10 Hz to 2 MHz.

TOTALIZE

Range — 0 to 10^8.

Gating — Operated manually or with an electrical gate. The external gate input is compatible with the sweep gate from the oscilloscope mainframe. Reset and external gate signals compatible with TTL logic.

MONITORS

Monitor/Ext Gate — Provides crystal-based time markers of +5 V; width determined by the measurement interval.

REF FREQ/CH B Monitor — Provides a crystal-based, 1-MHz, +5 V output pulse. This connector functions as CH B input in the EXT IN mode.

READOUT

Display — Eight digits with leading zero suppression, positioned decimal, MHz or kHz legend.

Display Time — 0.1 to 5 s; also a preset position for infinite display time.

TRIGGERING

Level/Slope Range — + and −0.5 V with INPUT at 100 mV.

Displayed Trigger Indicator — Displayed amplitude of Schmitt trigger output is approx 0.2 div.

Included Accessory — BSM male to BNC female adapter (103-0036-00).

Order 7D14 Digital Counter **$1775**

7D15

Oscilloscope-controlled Time and Frequency Measurements

10 ns "Single-shot" Time Interval Measurement Resolution

Time Interval Averaging

Crt Display of Counting Interval

10 ps Period Averaging Resolution

Frequency Measurements Directly to 225 MHz

Signal Conditioning via Mainframe Trigger Source

Lit Pushbuttons

The 7D15 is a universal counter/timer designed for use in all 7000-Series Oscilloscope Mainframes with crt readout.

The 7D15 offers all the measurement capabilities of the counter/timer, such as time interval, period, frequency, frequency ratio, totalize, and manual stop watch.

Three displays, the pseudo gate, Ch B Schmitt trigger output, and true gate, are selectable by a 7D15 front-panel switch and are also available at a front-panel connector.

The 7D15 can also be completely controlled by the oscilloscope's delayed gate. Arming inputs are provided for each channel. By using the delayed B gate to control the start and stop count points, visually selective measurements can be made at any point on the crt display.

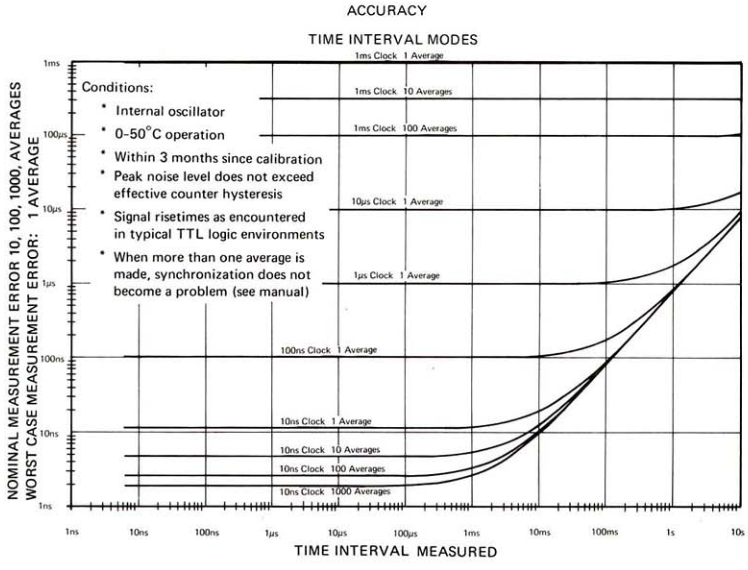
Two identical high-speed trigger circuits provide complete signal processing. Identical trigger circuits also allow single-shot time interval measurements to be made with 10 ns resolution. With repetitive signals, time interval averaging will increase the accuracy of a measurement by a factor of ten or more.

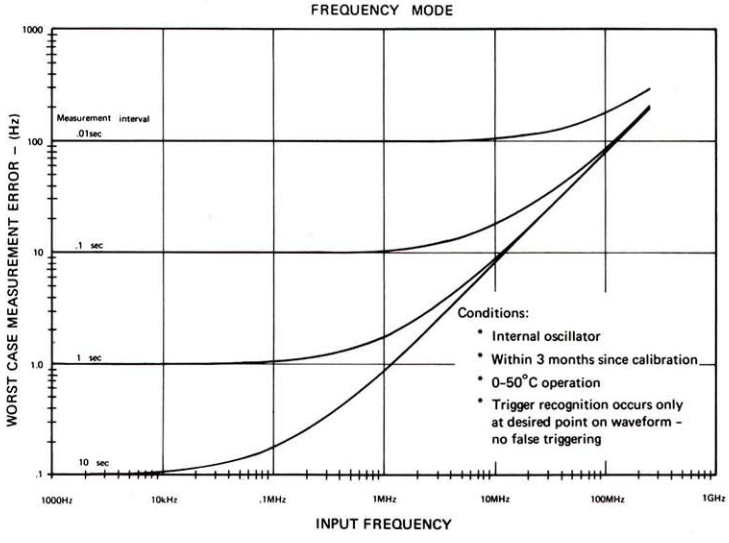
The 7D15 has high resolution because of a 10 ns clock, one of five clock positions obtainable from the front panel. A front-panel Clock Out connector makes the selected

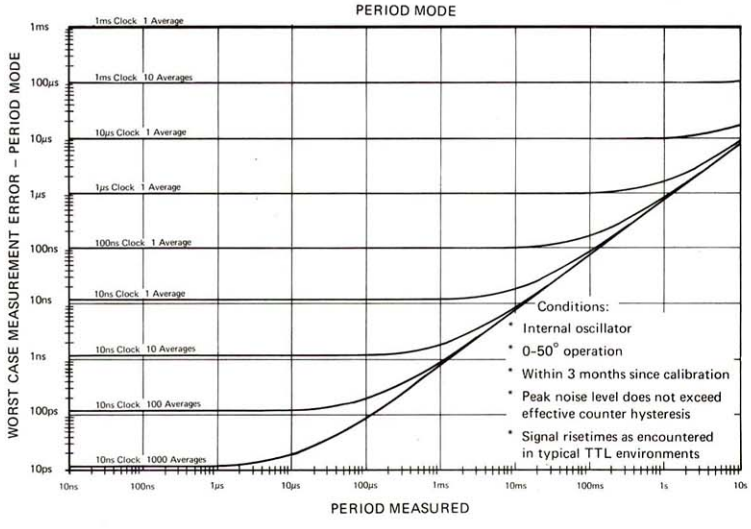
Modes of Operation

Frequency Mode	Range	Dc to 225 MHz Resolution 0.1 Hz maximum
	Accuracy	$\epsilon_{freq(Hz)} = \pm TB \cdot f_{in} \pm \frac{1}{T}$
Period and Multi-Period Mode	Range	10 ns to 10^5 seconds with averaging times of X1 to X1000 in decade steps. Resolution: 10 picoseconds maximum
	Accuracy	$\epsilon_{period(s)} = \pm TB \cdot P_{in} \pm \frac{10^{-9}}{M} \pm \frac{2E_{npk}}{\frac{dv}{dt} \cdot M} \pm \frac{P_{ck}}{M}$
Time Interval TI and (TI Average) Mode	Range	6 ns to 10^5 seconds with averaging times of X1 to X1000. 0.1 ns resolution (usable)
	Accuracy Worst Case (Nominal)	$\epsilon_{TI(s)} = \pm TB \cdot P_{in} \pm \frac{P_{ck}}{\sqrt{M}} \pm 10^{-9} \pm \frac{2E_{npk}}{\frac{dv}{dt}}$
Frequency Ratio, CH B/Ext Clock	Range	10^{-7} to 10^4
Manual Stop Watch	Range	0 to 10^5 seconds
Totalize, Ch B	Range	0 to 10^8 counts

NOTE: Formulas given where ϵ is the error; TB (expressed as a decimal) is the time base accuracy; P_{in} is the period or time interval of unknown signal; M is the number of averages given; P_{ck} is the measurement clock period; T is the gate time; f_{in} is the frequency of the unknown signal; E_{npk} equals peak noise pulse amplitude as presented to Schmitt trigger circuit; dv/dt equals signal slope at input to Schmitt trigger (volts per second). These formulas were used to develop the associated charts.







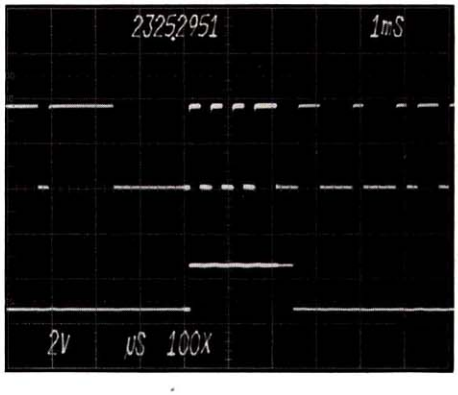


Fig 1. Oscilloscope-controlled digital measurements using the delayed B gate as the arming input logic allow user to make precise *time interval measurement* from third to seventh pulse on crt display. Counter Ch A is "armed" with leading edge of B gate while Ch B Counter is "armed" with falling edge of B gate. Lower trace is pseudo gate of 7D15. Crt readout displays the result of 2325.295 µs.

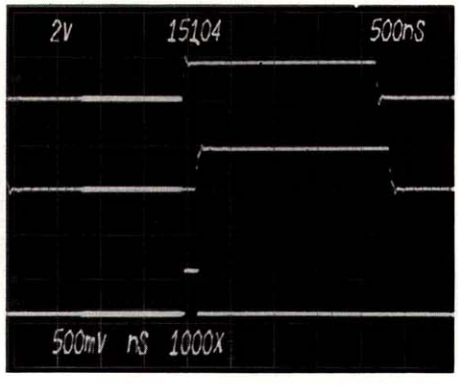


Fig 2. The *propagation delay time* between the input of a delay line (upper trace) and the output of the delay line (middle trace) is measured digitally. Lower trace is 7D15 pseudo gate display. Crt readout displays the result of 151.0 ns.

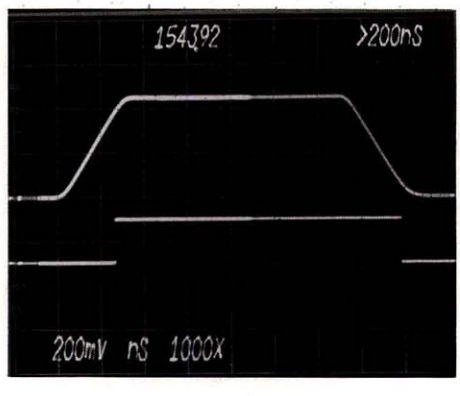


Fig 3. Independent slope and level control allows the user to *visually select* precise points on the waveform where the counter starts and stops. Crt readout displays the result of 1543.9 ns.

clock signal available at a front-panel connector. This provides a time mark function that is TTL compatible and will drive a 50 Ω load.

The Ext Clock In connector allows an external 1 MHz timing standard to be used for measurements requiring a higher degree of accuracy than that provided by the internal time base.

The 7D15 may be used in vertical or horizontal compartments of 7000-Series Mainframes. It provides a full 8 digit crt display with leading zero suppression and positioned decimal. Legend and averaging information appear at the bottom of the crt display.

INTERNAL TIME BASE

Crystal Oscillator — Accuracy: within 0.5 ppm (0°C to +50°C ambient). Long-term drift: 1 part or less in 10^7 per month. Oscillator is temperature compensated; no warm up is required.

OUTPUT SIGNALS

Clock Out — Logical 1 ≥ +0.5 V into 50 Ω. Logical 0 ≤ 0 V into 50 Ω. TTL compatible without 50 Ω load (1.6 mA current capacity).

A and B Trigger Level — $Z_{out} \approx 1$ kΩ, $V_{out} = \pm 0.5$ V into 1 MΩ.

Displayed Waveform (Internally Connected) — Front-panel switch selects true gate, pseudo gate, or channel B signal out. Position controlled by front-panel screwdriver control.

External Display — Same as internal except position control has no effect.

Display Mode Switch — Allows selection of readout "follow or store."

Display Time — 0.1 to 5 s; also a preset position for infinite display time.

Readout — Eight-digit display; the four most significant have zero suppression. Overflow indicated by a > symbol.

INPUT SIGNAL CH A & B

Frequency Range (CH B only) — Dc-coupled: dc to 225 MHz. Ac-coupled: 5 Hz to 225 MHz.

Sensitivity (CH A and B Inputs) — 100 mV p-p. Trigger source: 0.5 division to 100 MHz, 1.0 division to 225 MHz, or to the vertical system bandwidth, whichever is less.

Input R and C — 1 MΩ and 22 pF.

Triggering (Preset Position) — Automatically triggers at 0 V.

Level Control Range (CH A and B Inputs) — 100-mV range: ±500 mV. 1-V range: ±5 V. 10-V range: ±50 V.

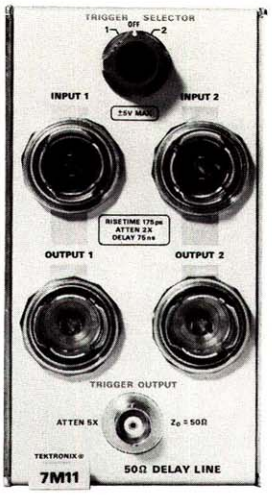
Arming Inputs — Input R and C: 10 kΩ and 20 pF. Sensitivity arm A: logical 1 ≥ +0.5 V, logical 0 ≤ +0.2 V. Sensitivity arm B: logical 1 ≤ +0.2 V, logical 0 ≥ +0.5 V.

External Clock-In — 20 Hz to 5 MHz.

Reset Front Panel — Reset readies the instrument. All counters are affected, including averaging circuits.

Included Accessories — Two cables RF 44 in (012-0403-00, Sealectro to BNC connector).

Order 7D15 Universal Counter/Timer **$1825**



7M11

75 ns Time Delay

Selectable Trigger Out

175 ps Rise Time

The 7M11 is a passive dual delay line unit for use with the 7000-Series Sampling System. In low-repetition-rate applications requiring the sequential mode of operation, the 7M11 provides the trigger source and signal delay necessary to view the triggering event at fast time-per-div settings.

Vertical delay for two 7S11 vertical sampling units is available with the dual 50 Ω, 75 ns delay lines. The closely matched (30 ps) lines have GR874 input-output connectors, 175 ps rise time, and 2X signal attenuation. Trigger selection is from either input, 5X attenuated, with a rise time of 600 ps or less.

CHARACTERISTICS

DELAY LINE

Time Delay — 75 ns within 1 ns.

Delay Difference — 30 ps or less between channels.

Rise Time — 175 ps or less.

Attenuation — 2X within 2% into 50 Ω.

Input Impedance — 50 Ω within 2%.

Max Input Voltage — ±5 V rms.

TRIGGER OUTPUT

Rise Time — 600 ps or less.

Attenuation — 5X within 10% into 50 Ω (referred to INPUT).

Output Impedance — 50 Ω within 10%.

Ambient Temperature — Performance characteristics are valid over an ambient temperature range of 0°C to +50°C.

INCLUDED ACCESSORIES

10 in BNC cable (012-0208-00); two 2 ns GR cables (017-0505-00).

Order 7M11 Delay Line Unit **$450**

7S11

2 mV/div to 200 mV/div Calibrated Deflection Factors

Plug-in Sampling Heads

The 7S11 is a single-channel sampling unit. The input configuration employs the sampling plug-in head concept. The heads, which mount in the 7S11, range in bandwidth from 350 MHz to 14 GHz.

The 7S11 can be used in a variety of combinations. Single-channel sampling uses one 7S11 with a 7T11 Time Base. Two 7S11s and one 7T11 provide dual-trace sampling. One 7S11 and one 7S12 provide dual-trace sampling. Two 7S11s can be used for X-Y operations.

CHARACTERISTICS

Deflection Factor — 2 units/div to 200 units/div in 7 steps (1-2-5 sequence), accurate within 3%. Uncalibrated VARIABLE is continuous (extends deflection factor from 1 unit/div or less to at least 400 units/div). Deflection factor is determined by the plug-in sampling head.

Bandwidth — Determined by the sampling head.

Input Impedance — Determined by the sampling head.

Dc Offset — Range, +1 V to −1 V or more. Offset out is X10 the offset voltage within 2%. Source R is 10 kΩ within 1%.

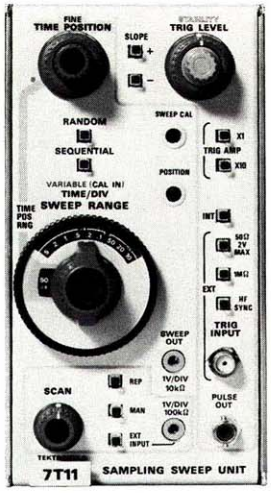
Delay Range — At least 10 ns for comparing two signals in a dual-trace application.

Memory Slash — 0.1 div or less at 20 Hz.

Vertical Signal Out — 200 mV per displayed div within 3%.

Ambient Temperature — Performance characteristics are valid over an ambient temperature range of 0°C to +50°C.

Order 7S11 Sampling Unit without Sampling Head **$840**



7T11

10 ps/div to 5 ms/div Calibrated Time Base

Random or Sequential Sampling

Equivalent or Real-time Sampling

No Pretrigger Required

The 7T11 Sampling Time Base provides equivalent-time and real-time horizontal deflection for single- or dual-trace sampling. Timing accuracy is within 3% and nonlinearity is well below 1%. Triggering range is from ≃ 10 Hz (sequential mode) to above 12.4 GHz.

CHARACTERISTICS

Time/Div Range — 10 ps/div to 5 ms/div (1-2-5 sequence) directly related to time position ranges. Uncalibrated VARIABLE is continuous between steps to at least 4 ps/div.

Time Position Range — Equivalent time is 50 ns to 50 μs in 4 steps; real time is 0.5 ms to 50 ms in 3 steps.

Time/Div Accuracy — Within 3% for all time/div settings over center 8 cm.

TRIGGERING

Ext 50-Ω Input — Frequency range is dc to 1 GHz in X1 TRIG AMP mode. Sensitivity range is 12.5 mV to 2 V p-p (dc to 1 GHz) in X1 TRIG AMP, 1.25 mV to 2 V p-p (1 kHz to 50 MHz) in X10 TRIG AMP. Input R is 50 Ω within 10%. Max input voltage is 2 V (dc + peak ac).

Ext 1-MΩ Input — Frequency range is dc to 100 MHz in X1 TRIG AMP mode. Sensitivity range is 12.5 mV to 2 V p-p (dc to 100 MHz) in X1 TRIG AMP, 1.25 mV to 2 V p-p (1 kHz to 50 MHz) in X10 TRIG AMP. Input R is 1 MΩ within 5%. Max input voltage is 100 V p-p to 1 kHz (derating 6 dB per octave to a min 5 V p-p).

Ext HF Sync — Frequency range is 1 GHz to 12.4 GHz. Sensitivity range is 10 mV to 500 mV p-p. Input R is 1 MΩ. Max input voltage is 2 V p-p.

Int Trigger Source (Sine-wave Triggering)* — Frequency range is 5 kHz to 500 MHz in X1 TRIG AMP; 5 kHz to 50 MHz in X10 TRIG AMP. Sensitivity range is 125 mV to 1 V p-p (referred to the vertical input) in X1 TRIG AMP; 12.5 mV to 1 V p-p (referred to the vertical input) in the X10 TRIG AMP.

Random Mode Trigger Rate — 100 Hz min.

Display Jitter — Measured under optimum trigger conditions with TIME/DIV switch clockwise.

Time Pos Range	Sequential Mode	Random Mode
50 μs to 500 ns	0.4 div or less	1 div or less
50 ns	10 ps	30 ps

Pulse Out — Positive pulse amplitude at least 400 mV (into 50 Ω) with 2.5 ns rise time or less.

*Trigger circuits will operate to dc with pulse triggering, except for HF Sync.

Trigger Kickout — 2 mV or less into 50 Ω (except HF SYNC).

Display Scan Rate — Continuously selectable from at least 40 sweeps/s to less than 2 sweeps/s.

External Scan — Deflection factor is continuously variable from 1 V/div to 10 V/div. Input R is 100 kΩ within 10%. Max input voltage is 100 V (dc + peak ac).

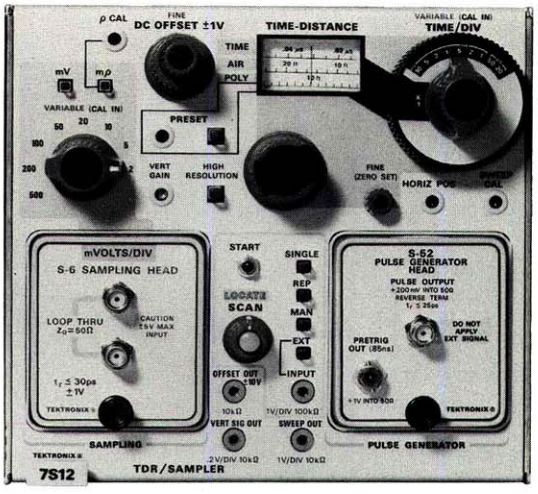
Sweep Out — 1 V/div within 2%. Source R is 10 kΩ within 1%.

Ambient Temperature — Performance characteristics are valid over an ambient temperature range of 0°C to +50°C.

INCLUDED ACCESSORIES

42-in BNC 50 Ω cable (012-0057-01); 10X 50 Ω attenuator (011-0059-02); SMA (3 mm) male to BNC adapter (015-1018-00); SMA (3 mm) male to GR874 adapter (015-1007-00).

Order 7T11 Sampling Sweep Unit $2425



7S12

45 ps TDR or 30 ps General-purpose Sampler

6 Plug-in Sampling Heads Available

2 Plug-in Pulse Sources Available

1 Trigger Recognizer Head Available

1 Trigger Countdown Head Available

The 7S12 is a combined vertical-horizontal, double-width plug-in for high-resolution tdr or general-purpose sampling measurements. As a tdr using the S-6 Sampling Head and S-52 Pulse Generator Head, the 7S12 has a system rise time of 45 ps (return from short-circuit termination) and distance range to 290 ft in any cable. Its vertical scale is calibrated in reflection coefficient (ρ) from 2 mρ/div to 500 mρ/div and in voltage from 2 mV/div to 500 mV/div. Two-way time or one-way distance to a discontinuity of interest is read directly from tape dial calibrated for time, air, polyethylene, or your choice of dielectrics. As a long line tdr using the S-5 Sampling Head and S-54 Pulse Generator Head, distance calibration extends to 4900 ft (air line) and discontinuities to twice this distance may be viewed. System rise time with this combination is 1.5 ns.

General-purpose measurements may be made by using an S-1, S-2, S-3A, S-4, S-5, or S-6 Sampling Head with an S-53 Trigger Recognizer Head or S-51 Trigger Countdown Head. For dual-trace sampling displays, use a 7S11 Sampling Unit with a 7S12. The addition of a 7M11 Dual Delay Line provides the signal delay necessary to view the triggering event when a pretrigger signal is not available.

CHARACTERISTICS

System Performance with S-6 and S-52

System Rise Time — 35 ps or less for the incident step. 45 ps or less for the displayed reflection from a short-circuited, 1 ns test line.

Time and Distance Ranges — Direct-reading tape dial gives calibrated one-way distance to at least 400 ft (air line). Time range is at least 0.9 μs round trip. Both ranges are limited by the duration of the pulse from the S-52.

Pulse Amplitude — At least +200 mV into 50 Ω.

Input Characteristics — Nominal 50 Ω, feed-through signal channel (termination supplied). SMA (3 mm) connectors.

Jitter — Less than 10 ps (without signal averaging).

Aberrations — +7%, −7%, total of 10% p-p within 1.8 ns of step with reference point at 1.8 ns from step; +2%, −2%, total of 4% p-p after first 2.5 ns with reference point at 300 ns from step.

TDR System Performance with S-5 and S-54

System Rise Time — 1.5 ns or less for the displayed reflection from a short-circuited test line.

Time and Distance Ranges — Direct-reading tape dial gives calibrated one-way distances to 4900 ft air line, 3240 ft solid polyethylene. Time range is 20 μs round trip.

Pulse Amplitude — At least +400 mV into 50 Ω.

Input Characteristics — Nominal 50 Ω test-line connection (cable and T supplied). BNC connectors.

Jitter — Less than 20 ps (without signal averaging).

Aberrations — +4%, −6%, total of 10% p-p within first 17 ns of step; +1.5%, −1.5%, total of 3% thereafter.

OTHER 7S12 CHARACTERISTICS

Vertical Scale — Calibrated in mρ (reflection coefficient X10⁻³) and mV from 2 to 500 units/div in 8 steps (1-2-5 sequence), accurate within 3%. Uncalibrated VARIABLE is continuous between steps.

Resolution — Reflection coefficients as low as 0.001 may be observed. Signal averaging reduces test-line noise in display.

Dc Offset Range — +1 V to −1 V. Allows open-circuit reflections to be displayed at full sensitivity. Monitor jack provides X10 dc offset through 10 kΩ.

Time/Distance — Tape dial is calibrated in time and distance: full-scale ranges of 4900 ft, 490 ft, 49 ft (air dielectric); 3200 ft, 320 ft, 32 ft (polyethylene dielectric); and 10 μs, 1 μs, 0.1 μs (time). Accurate within 1%. Distance calibration may be preset for dielectric having propagation factors from 0.6 to 1.

Time/Div — 20 ps/div to 1 μs/div (1-2-5 sequence) in three ranges with direct-reading magnifier. Accurate within 3%. Uncalibrated variable is continuous between steps.

Locate Button — Provides instant return to unmagnified display showing entire full-scale range. Brightened portion of trace indicates time position and duration of magnified display.

Display Modes — Repetitive or single sweep, manual or external scan.

Signal Outputs — Pin jacks provide both vertical signal and sweep outputs.

INCLUDED ACCESSORIES

750 ps rigid "U" delay line (015-1017-01); short-circuit termination (015-1021-00); tdr slide rule (003-0700-00).

Order 7S12 TDR Sampling Unit (Tape Dial in Feet) without Sampling Heads $1750

Order Option 03 Tape Dial Change (Meters) . . . . . No charge

OPTIONAL ACCESSORIES

Patch Cords — available for the OFFSET OUT, EXT SWEEP INPUT, VERT SIG OUT, and SWEEP OUT jacks of the 7S12, Pin-jack to pin-jack, 0.08 in dia. pin.

Red, 8 in, Order 012-0179-00 . . . . . $2.85
Red, 18 in, Order 012-0180-00 . . . . . $2.85
Black, 8 in, Order 012-0181-00 . . . . . $2.85
Black, 18 in, Order 012-0182-00 . . . . . $2.85
Tape Dial (Calibrated in Feet) — Order 331-0273-00 . . . . . $10.50
Tape Dial (Calibrated in Meters) — Order 331-0276-00 . . . . . $10.50

NOTE: See 1502-1503 Portable TDR Cable Tester on page 178.

7000-Series Sampling Heads

S-1

Dc-to-1 GHz Bandwidth

Clean Transient Response

The S-1 Sampling Head is a low-noise, 350-ps rise time unit with a 50 Ω input impedance. The S-1 can be plugged in or attached by a cable for remote use. A trigger pickoff within the S-1 provides a trigger signal output from the plug-in unit.

Rise Time — 350 ps or less.

Bandwidth — Equivalent to dc to 1 GHz at 3 dB down.

Transient Response — Aberrations as observed with the 284 Pulse Generator are +0.5%, −3% or less, total of 3.5% or less p-p, first 5 ns following the step transition; +0.5%, −0.5% or less, total of 1% or less p-p after 5 ns.

Displayed Noise — 2 mV or less, unsmoothed; 1 mV, smoothed.

Signal Range — Variable dc offset allows signals between +1 V and −1 V limits to be displayed at 2 mV/div. Signals between +2 V and −2 V limits may be displayed at 200 mV/div. For best dot response with random-sampling sweep unit, signal amplitude should be less than 500 mV p-p.

Input Characteristics — Nominally 50 Ω. Safe overload is ±5 V. GR874 input connectors.

Included Accessories — 5 ns, 50 Ω RG58 A/U cable (017-0512-00); 10X, 50 Ω GR attenuator (017-0078-00).

Order S-1 Sampling Head $600

S-2

Dc-to-4.6 GHz Bandwidth

Displayed Noise Less than 6 mV (Unsmoothed)

The S-2 Sampling Head is a 75 ps rise time unit with a 50 Ω input impedance. The S-2 can be plugged in or attached by a cable for remote use. A trigger pickoff within the S-2 provides a trigger signal output from the plug-in unit.

Rise Time — 75 ps or less.

Bandwidth — Equivalent to dc to 4.6 GHz at 3 dB down.

Transient Response — Aberrations as observed with the 284 Pulse Generator are +5%, −5% or less, total of 10% or less p-p, first 2.5 ns following a step transition; +2%, −2% or less, total of 4% or less p-p after 2.5 ns.

Displayed Noise — 6 mV or less, unsmoothed; 3 mV, smoothed.

Signal Range — Variable dc offset allows signals between +1 V and −1 V limits to be displayed at 2 mV/div. Signals between +2 V and −2 V limits may be displayed at 200 mV/div. For best dot response with random-sampling sweep unit, signal amplitude should be less than 200 mV p-p.

Input Characteristics — Nominally 50 Ω. Safe overload is ±5 V. GR874 input connectors.

Included Accessories — 5 ns, 50 Ω RG213/U cable (017-0502-00); 10X, 50 Ω GR attenuator (017-0078-00).

Order S-2 Sampling Head $700

OPTIONAL ACCESSORIES

P6040/CT-1 Current Probe,
Order (Std) 015-0041-00 . . . . . $81

P6050 10X Passive Probe,
Order (Std) 010-6056-03 . . . . . $99

P6057 100X Probe,
Order (Std) 010-6057-03 . . . . . $99

Coupling Capacitor, GR874-K,
Order 017-0028-00 . . . . . $41

Power Divider GR874-TPD,
Order 017-0082-00 . . . . . $200

GR to BNC Adapter,
Order 017-0063-00 . . . . . $18.50

S-3A

Compact, 4.5 Ft, 100 kΩ, 2.3 pF Probe

Dc-to-1 GHz Bandwidth

Displayed Noise Less than 3 mV (Unsmoothed)

The S-3A Sampling Head is an active sampling-probe unit with 100 kΩ, 2.3 pF input impedance. Up to 2 V of dc offset may be used while maintaining a 2 mV/div deflection factor.

Rise Time — 350 ps or less.

Bandwidth (Probe Only) — Equivalent to dc to 1 GHz at 3 dB down.

Transient Response (Probe Only) — Aberrations in the first 2 ns following a step are +8%, −2% or less, total of 10% or less p-p, +1%, −1% or less, total of 2% or less p-p after 2 ns, with 284 pulse displayed.

Displayed Noise (Probe Only) — 3 mV or less referred to probe tip (includes 90% of dots).

Signal Range — Variable dc offset allows signals between +1 V and −1 V, X1 range, or +2 V and −2 V, X2 range, to be displayed at 2 mV/div. The signal range may be increased X10 or X100 with the probe attenuators.

Included Accessories — 10X attenuator head (010-0364-00); 100X attenuator head (010-0365-00); coupling capacitor (011-0098-00); probe tip (206-0114-00); tip-ground adapter (013-0085-00); two test-point jacks (131-0258-00); 5½ in ground lead (175-1017-00); 12½ in ground lead (175-1018-00); 3 in cable assembly (175-0249-00); three ground clips (344-0046-00); end cap (200-0834-00); two end caps (200-0835-00); probe holder (352-0090-00); retractable hook tip (013-0097-00); 50 Ω voltage pickoff (017-0077-01); carrying case (016-0121-01); 3 in elec lead (175-0849-00); 6 in elec lead (175-0849-01).

Order S-3A Sampling Head $890

S-4

25 ps Sampling Head

Dc-to-14 GHz Equivalent Bandwidth

Displayed Noise Less than 5 mV (Unsmoothed)

The S-4 Sampling Head is 25 ps rise time unit with a 50 Ω input impedance. The S-4 can be plugged into the sampling unit or attached by a sampling head extender for remote use. A trigger pickoff within the S-4 provides a trigger signal output from the plug-in unit.

Rise Time — 25 ps or less.

Bandwidth — Equivalent to dc to 14 GHz at 3 dB down.

Transient Response — Aberrations in the first 400 ps following a step from S-52 Pulse Generator Head are −10%, +10% or less, total of 20% or less p-p. From 400 ps to 25 ns following a step from a 284 Pulse Generator, 0%, +10% or less, total of 10% or less p-p with 284 pulse displayed; after 25 ns, −2%, +2% or less, total of 4% or less p-p.

Displayed Noise — 5 mV or less, unsmoothed; 2.5 mV, smoothed (includes 90% of dots).

Signal Range — Variable dc offset allows signals between +1 V and −1 V limits to be displayed at 2 mV/div. For best dot-transient response with random-sampling sweep unit, signal amplitude should be less than 500 mV p-p.

Input Characteristics — Nominally 50 Ω. Safe overload ±5 V. SMA (3 mm) input connector.

Included Accessories — 2 ns cable with SMA connectors (015-1005-00); 10X 50 Ω SMA attenuator (015-1003-00); GR874 to SMA male adapter (015-1007-00); SMA male-to-male adapter (015-1011-00); 5/16 in wrench (003-0247-00).

Order S-4 Sampling Head $1290

S-5

1 MΩ, 15 pF Input Impedance

Passive Probe

Internal Trigger Pickoff

The S-5 Sampling Head is a low-noise, 1 ns rise time sampling unit with a 1 MΩ, 15 pF input impedance. When used with the included P6010 passive probe, the input impedance increases to 10 MΩ, 10 pF while maintaining the 1 ns rise time at the probe tip. A switch on the sampling head selects either ac or dc coupling of the input.

Rise Time — S-5 only, 1 ns or less; with 3.5 ft P6010, 1 ns or less.

Bandwidth — Equivalent to dc to 350 MHz at 3 dB down at input connector or probe tip.

Transient Response — S-5 only (driven with a 50 Ω source terminated in 50 Ω): aberrations +2.5%, −5% or less, total of 7.5% or less p-p within 17 ns after step; +1%, −1% or less, total of 2% or less p-p thereafter.

S-5/P6010 (3.5 ft probe, properly compensated): aberrations +5%, −5% or less, total of 10% or less p-p within 25 ns after step; +1%, −1% or less, total of 2% or less p-p thereafter.

Displayed Noise — S-5 only, 500 μV or less (includes 90% of dots). S-5/P6010, 5 mV or less (includes 90% of dots).

Signal Range — S-5 only: dc coupled, 1 V p-p from +1 V to −1 V; ac coupled, 1 V p-p. S-5/P6010: dc coupled (dc + peak ac), 10 V p-p; ac coupling, dc voltage, 100 V.

Input Characteristics — S-5 only, 1 MΩ within 1% paralleled by 15 pF. S-5/P6010, 10 MΩ paralleled by approx 10 pF.

Attenuator Accuracy — Probe attenuation is 10X within 3%.

Included Accessories — P6010 probe package (010-0188-00), 50 Ω termination (011-0049-01).

Order S-5 Sampling Head $600

OPTIONAL ACCESSORIES

Probe Tip-to-BNC Adapter, Order 013-0084-01 . . . . . $8

Probe Tip-to-GR Adapter, Order 017-0076-00 . . . . . $20

Probe Tip-to-GR Terminated Adapter, Order 017-0088-00 . . . . . $35

S-6

30 ps Rise Time

Displayed Noise Less than 5 mV (Unsmoothed)

Loop-through Input

The S-6 Sampling Head is a 50 Ω feed-through unit for high-speed applications.

Rise Time — 30 ps or less. 35 ps or less as observed with S-52 Pulse Generator.

Bandwidth — Equivalent to dc to 11.5 GHz at 3 dB down.

Transient Response — Pulse aberrations following the steps are +7%, −7%, total of 10% p-p within 1.8 ns of step with reference point at 1.8 ns from step; +2%, −2%, total of 4% p-p after first 2.5 ns with reference point at 300 ns from step.

Displayed Noise — 5 mV or less, measured tangentially.

Signal Range — +1 V to −1 V (dc + peak ac). 1 V p-p. Dc offset allows any portion of input signal to be displayed.

Input Characteristics — Nominally 50 Ω, loop-through system, unterminated. SMA (3 mm) connectors. Max safe overload is ±5 V.

Included Accessories — 50 Ω termination (015-1022-00); 1 ns 50 Ω cable (015-1019-00); SMA (3 mm) female-to-female adapter (015-1012-00); SMA male-to-GR874 adapter (015-1007-00); combination wrench (003-0247-00); coaxial termination (015-1020-00).

Order S-6 Sampling Head $1220

OPTIONAL ACCESSORIES FOR SAMPLING HEADS with SMA (3 mm) Connectors

2X 50 Ω Attenuator, Order 015-1001-00 . . . . . $120

5X 50 Ω Attenuator, Order 015-1002-00 . . . . . $120

10X 50 Ω Attenuator, Order 015-1003-00 . . . . . $120

50 Ω Termination, Order 015-1004-00 . . . . . $50

2-ns 50 Ω Signal Cable, Order 015-1005-00 . . . . . $48

5-ns 50 Ω Signal Cable, Order 015-1006-00 . . . . . $85

Male-to-GR874 Adapter, Order 015-1007-00 . . . . . $38

Female-to-GR874 Adapter, Order 015-1008-00 . . . . . $50

Male-to-N Female Adapter, Order 015-1009-00 . . . . . $47

Male-to-7-mm Adapter, Order 015-1010-00 . . . . . $165

Male-to-Male Adapter, Order 015-1011-00 . . . . . $15

Female-to-Female Adapter, Order 015-1012-00 . . . . $15

Coupling Capacitor, Order 015-1013-00 . . . . . $120

50 Ω Power Divider T, Order 015-1014-00 . . . . . $200

500-ps 50 Ω Semirigid Cable, Order 015-1015-00 . . . $30

SMA T Adapter, Order 015-1016-00 . . . . . $25

SMA Male-to-BNC Female Adapter, Order 015-1018-00 . . . . . $5

1-ns 50 Ω Cable, Order 015-1019-00 . . . . . $56

SMA Male Short-Circuit Termination, Order 015-1020-00 . . . . . $15

SMA Female Short-Circuit Termination, Order 015-1021-00 . . . . . $15

SMA Male 50 Ω Termination, Order 015-1022-00 . . . $32

With BNC Connectors

50 Ω Feed-through Termination, Order 011-0049-01 . . . . . $24

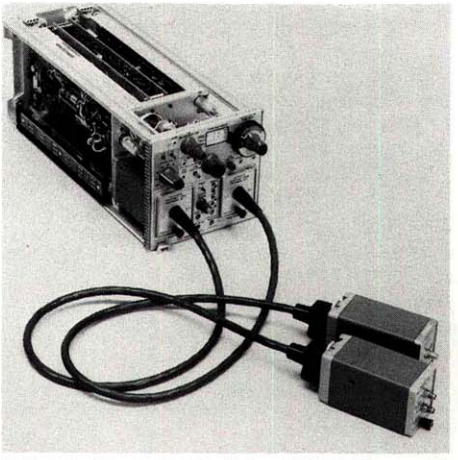
50 Ω Feed-through (5 W), Order 011-0099-00 . . . . . $33

50 Ω 2X Attenuator, Order 011-0069-02 . . . . . $28

50 Ω 2.5X Attenuator, Order 011-0076-02 . . . . . $28

50 Ω 5X Attenuator, Order 011-0060-02 . . . . . $28

50 Ω 10X Attenuator, Order 011-0059-02 . . . . . $28



50 Ω 18 in, Coaxial Cable, Order 012-0076-00 . . . . . $11

50 Ω 42 in, Coaxial Cable, Order 012-0057-01 . . . . . $12

3 ft Sampling-Head Extender, Order 012-0124-00 . . $147

6 ft Sampling-Head Extender, Order 012-0125-00 . . $164

S-51

18 GHz Countdown

10 ps or Less Trigger Jitter

The S-51 Trigger Countdown Head is a free-running tunnel-diode oscillator designed to provide stable sampling displays of signals up to 18 GHz. The S-51 has a front-panel sync control that synchronizes the oscillator frequency to a subharmonic of the input signal. The output from the S-51 is available at a front-panel trigger output connector and through a rear-panel connector for internal triggering. The output signal is a direct countdown of the input and permits triggering by a standard sampling time-base unit.

Input Signal — Frequency range is 1 GHz to 18 GHz. Stable synchronization on signals at least 100 mV p-p, as measured separately into 50 Ω, 5 V, p-p max.

Input Characteristics — 50 Ω SMA (3 mm) connector. Open termination paralleled by 1 pF.

Trigger Output — Front-panel trigger output is at least 200 mV into 50 Ω, BSM type connector. Internal trigger output is at least 100 mV into 500 Ω, internally connected to sampling unit. Jitter is 10 ps or less with signals from 5 GHz to 18 GHz; 15 ps or less with signals from 1 GHz to 5 GHz. Kickout at signal input connector is 400 mV or less; kickout occurs between successive samples.

Order S-51
Trigger Countdown Head $800

S-52

25 ps Rise Time

200 mV into 50 Ω

50 Ω Source

Pretrigger Output

The S-52 Pulse Generator Head is a tunnel-diode step generator designed for use with the 7S12 as a high resolution Time Domain Reflectometer.

For tdr applications, the S-52 features automatic bias circuit control to eliminate effects of tunnel-diode and load changes. A 50 Ω reverse termination minimizes reflections. The pulse width is sufficient for distances up to 32 ft in any cable. A pretrigger output allows the S-52 to be operated in sequential sampling systems without a delay line.

Pulse Output — Rise time is 25 ps or less. Amplitude into 50 Ω is at least 200 mV, positive-going. Pulse duration 800 ns, pulse period 16 μs within 2 μs. Pulse aberrations following the step are +7%, −7%, total of 10% p-p within 1.8 ns of step with reference point at 1.8 ns from step +2%, −2%, total of 4% p-p after first 2.5 ns with reference point at 300 ns from step.

Pretrigger Output — Rise time is 1 ns or less. Amplitude into 50 Ω is at least 1 V, positive going. Pretrigger pulse duration is 4 ns. Pretrigger occurs 85 ns (within 5 ns) before the pulse output. Pretrigger to pulse output jitter is 10 ps or less. Pretrigger output is also available at rear connector for internal triggering of the sampling sweep unit.

Output Connectors — Pulse output uses an SMA (3 mm) connector. Pretrigger output uses a BSM connector.

Included Accessory — 1 ns, 50 Ω semirigid coax delay line (015-1023-00).

Order S-52 Pulse Generator Head $800

SAMPLING HEAD WEIGHTS (Approx)

	S-1		S-2		S-3A		S-4		S-5		S-6		S-51		S-52		S-53		S-54	
	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
Net	1	0.5	1	0.5	3	1.4	1	0.5	0.6	0.3	1	0.5	1	0.5	0.8	0.3	0.8	0.3	0.8	0.3
Shipping	3	1.4	3	1.4	5	2.3	2	0.9	2	0.9	2	0.9	5	2.3	1	0.5	1	0.5	1	0.5

7000-Series Trigger Recognizer and Pulse Generator Heads, Dual-trace Delayed Sweep Sampler

S-53

Dc-to-1 GHz Operation

10 mV Sensitivity

The S-53 Trigger Recognizer Head is intended for use with the 7S12 to permit operation as a general-purpose sampling system. The S-53 supplies triggering for the 7S12 or for other applications.

Input Characteristics — Frequency range is dc to 1 GHz. Sensitivity range is 10 mV to 2 V p-p into 50 Ω. Kickout at input, ±5 mV or less.

Output Characteristics — Rise time is 1 ns or less. Amplitude is at least 1.5 V positive-going into 50 Ω. Pulse duration is 3 ns within 2 ns at the 50% amplitude level. Pulse period is 27 μs minimum. Trigger-to-signal delay is 15 ns or less; jitter is 15 ps or less.

Connectors — Trigger input connector is BNC type. Front-panel trigger output connector is BSM type. Trigger output is also available at rear connector for internal triggering.

Included Accessories — 42 in, 50 Ω cable (012-0057-01); 10X 50 Ω attenuator (011-0059-02).

Order S-53
Trigger Recognizer Head $600

S-54

1 ns Rise Time

Low Aberrations

400 mV into 50 Ω

50 Ω Source

Variable Pretrigger Lead Time

The S-54 Pulse Generator Head is a step generator designed for use with the 7S12 as a long line Time Domain Reflectometer unit.

Intended for tdr applications, the S-54 is 50 Ω reverse terminated to minimize reflections and has a 0 V base line to eliminate base line shift with load changes. A continuously variable front-panel control enables adjustment of pretrigger lead time. The pretrigger output allows the S-54 to be operated in sequential sampling systems without a delay line.

Pulse Output — Rise time is 1 ns or less. Amplitude into 50 Ω is +400 mV or greater. Pulse duration is 25 μs within 2 μs. Pulse aberrations following the step are +1.5%, −1.5%, total of 1.5% p-p, as displayed with S-1 Sampling Head. Base line level is 0 V within 20 mV, terminated in 50 Ω.

Pretrigger Output — Rise time is 5 ns or less. Amplitude into 50 Ω is at least 200 mV, positive-going. Pretrigger pulse duration is 20 ns or less at the 50% amplitude point. Pretrigger lead time is front panel adjustable from 120 ns or less to 1 μs or greater. Pretrigger-to-pulse-output jitter is 100 ps or less at 120 ns lead time to 1 ns or less at 1 μs lead time.

Output Connectors — Pulse output uses a BNC connector. Pretrigger output uses a BSM connector.

Included Accessories — BNC T connector (103-0030-00); 8 in 50 Ω cable (012-0118-00).

Order S-54 Pulse Generator Head $500

7S14

Calibrated Delayed Sweep

Two-dot Measurements

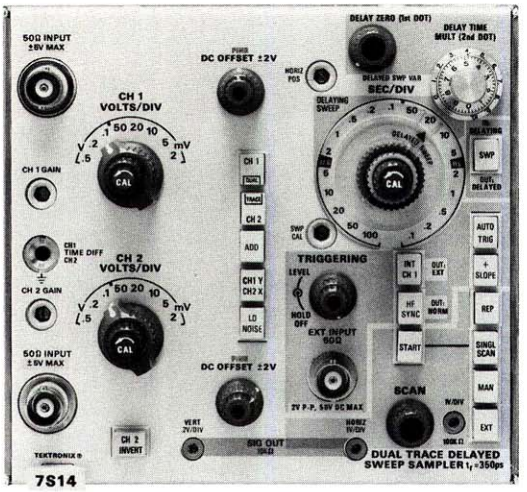
Dc-to-1 GHz Bandwidth

Dual Trace, 2-mV Sensitivity

Crt Readout

Simplified Triggering

Operational Ease of a Conventional Oscilloscope



The 7S14 Sampling Unit combines vertical and time-base functions in one double-width plug-in.

Two identical vertical channels provide dual-trace sampling, a two-ramp time base and calibrated delayed sweep.

Front-panel controls are grouped by color, and the control nomenclature is like conventional oscilloscope nomenclature. Learning to operate the 7S14 requires a minimum of effort for those familiar with conventional oscilloscope operation.

VERTICAL CHANNEL

Modes — Channel 1 only; Channel 2 only; Dual Trace; Channel 1 added to Channel 2; Channel 2 subtracted from Channel 1 (CH 2 INVERT); Channel 1 Vertical (Y), Channel 2 Horizontal (X).

Input Impedance — Nominally 50 Ω.

Bandwidth — Equivalent to dc to 1 GHz.

Rise Time — 350 ps or less.

Step Aberrations — +2%, −4%, total of 6% p-p within first 5 ns, ±1% thereafter, tested with a 284 Pulse Generator.

Deflection Factor — 2 mV/div to 0.5 V/div in 8 steps (1-2-5 sequence). Continuously variable between steps by at least 2.5 to 1.

Accuracy — Within ±3%.

Max Input Voltage — ±5 V.

Input Signal Range — 2 V p-p max within a +2 V to −2 V window at any sensitivity.

Dc Offset Range — At least +2 V to −2 V.

Displayed Noise — 2 mV or less unsmoothed (measured tangentially). Low noise pushbutton reduces random noise by a factor of 4 to 1 or more.

Vertical Signal Output — 0.2 V/div of vertical deflection; 10 kΩ source resistance.

Channel Delay Difference — Adjustable to zero, or for any time difference up to at least 1 ns.

TIME BASE

Scan Modes — Repetitive, single, manual, or external.

Delaying Sweep — May be used as the crt time base or as a delay generator for the delayed sweep. The sweep starts with minimum delay from the instant of trigger recognition. When the delaying sweep mode is selected for the time base, two bright dots in the trace, which may be positioned anywhere on the displayed waveform, are generated. The time between dots is equal to the reading on the Delay Time Multiplier dial multiplied by the time/div.

Delayed Sweep — This mode is used when the signal to be displayed occurs considerably later than the instant of trigger recognition or when the time must be 5 ns or less per div. The delayed sweep may be started with zero delay time with respect to the start of the delaying sweep. Or the start may be delayed by any time interval up to that represented by ten divisions of the delaying sweep selected.

Horizontal Signal Output — 1.0 V per div of horizontal deflection; 10 kΩ source resistance.

DELAYING SWEEP

Range — 10 ns/div to 100 μs/div in 13 steps (1-2-5 sequence).

Accuracy — Within ±3%, excluding first one-half div of displayed sweep.

Delayed Zero (1st Dot) — Adjustable to correspond to any instant within the time interval represented by the first 9 div of the delaying sweep selected.

Delay Time (2nd Dot) — Adjustable to any position of the time interval represented by 10 div of the delaying sweep selected.

Delay Accuracy — Within ±1% of 10 div when measurement is made within the last 9.5 div.

DELAYED SWEEP

Range — 100 ps/div to 100 μs/div in 19 steps (1-2-5 sequence). Variable between steps by at least 2.5 to 1.

Accuracy — Within ±3% excluding first one-half div of displayed sweep.

Start Delay — Depends on the delaying sweep time selected and the setting of the Delay Time Multiplier dial. Adjustable from zero to any time interval up to that represented by 10 div of the delaying sweep selected. The delaying sweep start point corresponds to the position of the second bright dot.

Delay Jitter — Less than 0.05% of the time represented by 1 div of the delaying sweep selected.

TRIGGERING AND SYNC

Signal Sources — Internal from Channel 1 vertical input or external through front-panel connector.

External Triggering — Nominal 50 Ω input, ac coupled, 2 V p-p 50 V dc max. Trigger pulse amplitude 10 mV p-p or more with rise time of 1 μs or less. 10 Hz to 100 MHz. Sine-wave amplitude 10 mV p-p or more from 150 kHz to 100 MHz.

Internal Triggering — Pulse amplitude 50 mV p-p or more with rise time of 1 μs or less. Sine-wave amplitude 50 mV p-p or more from 150 kHz to 100 MHz.

Triggered Mode — Trigger recognition may be made to occur at any selected voltage level between +0.5 V and −0.5 V on either a + slope or a − slope of the triggering signal.

Auto Trigger Mode — For small signals or when there may be no triggering signal. Sampling pulses are automatically generated at a low rate in the absence of a triggering signal so that a trace may always be generated and displayed. The trigger level range automatically adjusts to approx the p-p voltage of the signal.

Holdoff — Varies the length of the interval during which recognition is inhibited. Variation is at least 5 to 1. The control is particularly useful for displaying digital words when triggering on binary pulses.

HF SYNC Mode — For sine waves from 100 MHz to 1 GHz, 10 mV p-p or more from external source, 50 mV p-p or more from internal pickoff.

Order 7S14 Dual-Trace
Delayed Sweep Sampler $2650

5000-Series Instruments

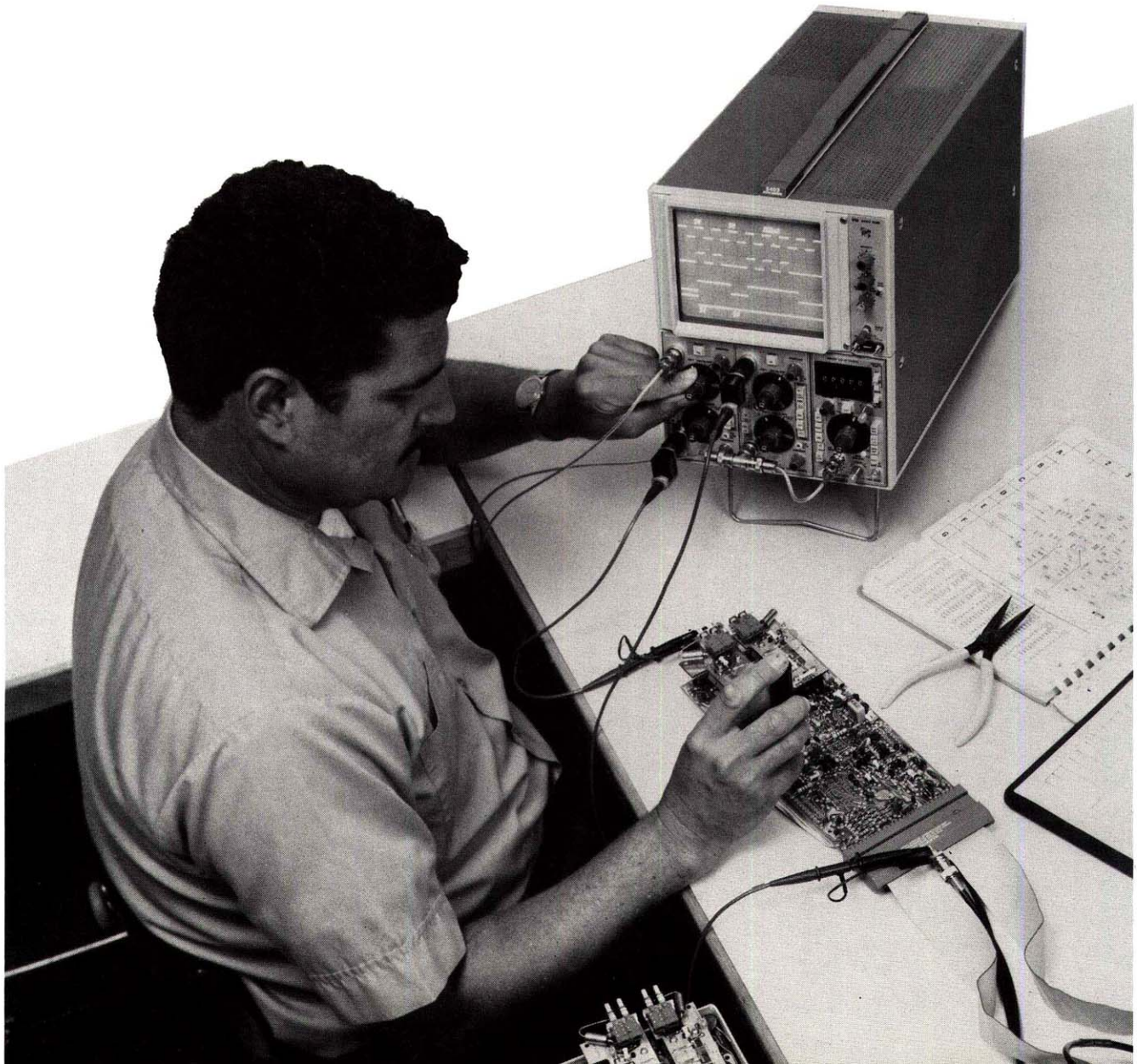
Pick a 5000-Series Plug-in Oscilloscope for:

Performance Value . . . The 5400 Series is designed for the cost-conscious user as an alternative to the monolithic scope; it gives you 60-MHz bandwidth in both non-store and variable persistence storage mainframes with crt readout.

Maximum Flexibility . . . The 5100 Series is perfect for low-frequency applications such as medical and mechanical measurements requiring up to 2-MHz bandwidth; it gives you unparalleled choices in measurement flexibility such as dual-beam, split-screen, bistable storage displays, differential inputs, and spectrum analysis.

Expandability . . . With the 5000-Series Plug-in Oscilloscope, you are making a cost-effective investment in current technology —and insuring yourself a share in the future.

The 5000 Series . . . an extra margin of value.



Low Cost

2 MHz or 60 MHz Bandwidth

Sampling to 1 GHz

0 to 100 kHz Spectrum Analysis

7 Oscilloscope Models

Dual-Beam and Storage Displays

Crt Readout (5400 Series Only)

Large 6½ in Crt (8 x 10 div)

10 μV/div High Gain Differential Amplifier

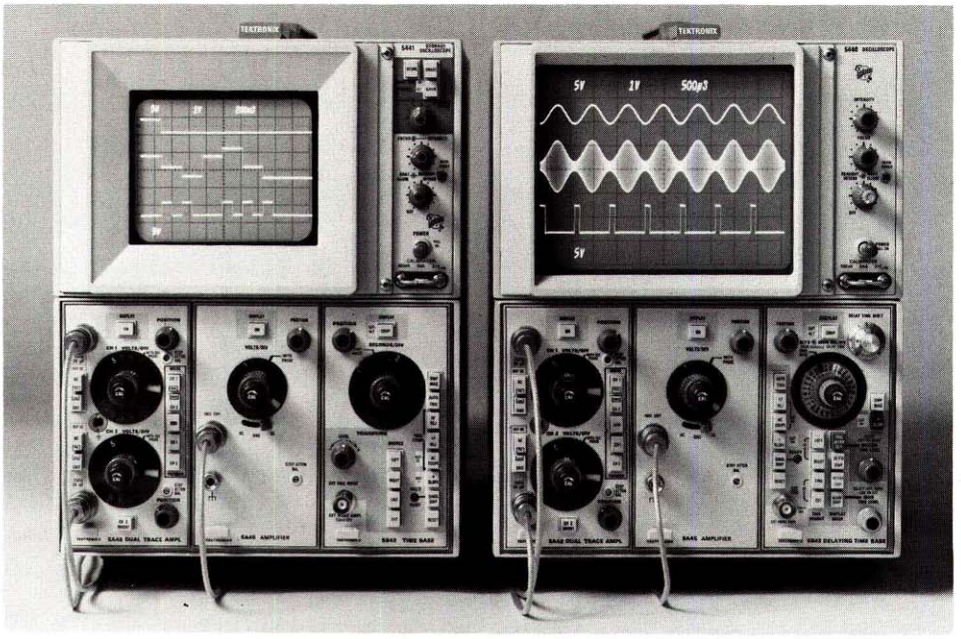
1 to 8 Trace Capability

Delayed-Sweep Time Bases

Y-T or X-Y Operation

Color-Coded Front Panels

Bench-to-Rack Convertibility



5400-Series

The 5000-Series Oscilloscope is designed to provide optimum versatility and performance at the lowest possible price.

5100-Series Oscilloscopes

Five 5100-Series Oscilloscopes are available. They include single-beam, dual-beam, and storage displays. The storage display units feature bistable, split-screen storage with burn-resistant phosphor. The dual-beam display units have two writing guns and two pairs of vertical deflection plates. One pair of horizontal deflection plates drive both beams.

The 5100 Series features 2 MHz mainframes with large 6½″ crts that accommodate two vertical deflection plug-ins and one horizontal deflection plug-in. It can be easily converted from bench to rackmount configuration.

To date, 17 plug-ins are available for use with the 5100 Series. Among these are the low-cost 5L4N Spectrum Analyzer for the 0 to 100 kHz frequency range and the 5S14N, a general-purpose, 1 GHz dual-trace sampling plug-in.

5100-Series Dimensions and Weights

	Cabinet		Rackmount	
Dimensions	in	cm	in	cm
Height	11.9	30.2	5.3	13.3
Width	8.4	21.3	19.0	48.3
Length	20.4	51.8	19.0	48.3
Weight (approx)	lb	kg	lb	kg
Net	23.0	10.4	24.0	10.9
Shipping	32.0	14.5	43.0	19.5

5400-Series Oscilloscopes

Two 5400-Series display units are presently available: a single-beam, non-storage display and a variable persistence storage display. Both feature crt readout of plug-in scale factors.

Like the 5100 Series, the 5400 Series features 3 plug-in compartments and bench-mount-to-rackmount convertibility.

The 5400 Series takes a giant step in performance; it offers 60 MHz bandwidth. The 5400 Series is capable of satisfying a wide range of measurement needs. It features readout of plug-in scale factors on the crt (except with plug-ins having a suffix N: 5A22N, 5B10N, etc). This feature, previously available only on more sophisticated oscilloscopes, allows you to make measurements more quickly and conveniently. The crt readout can also be externally accessed.

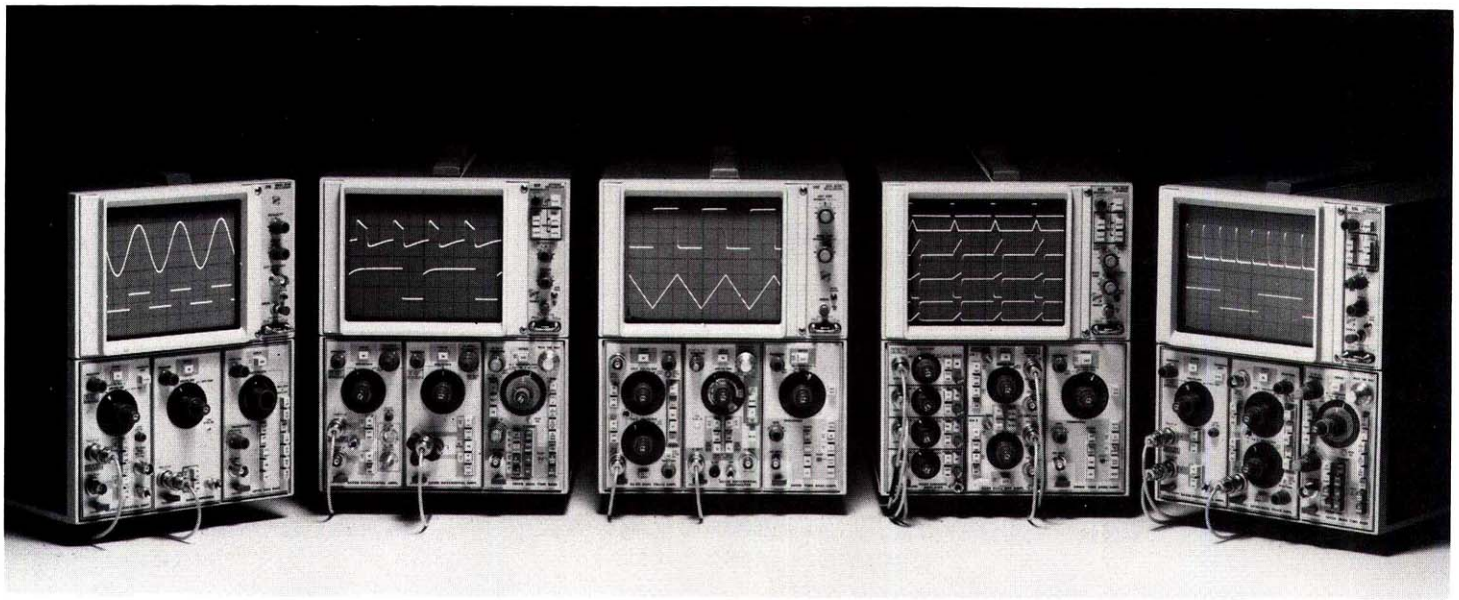
5400-Series Dimensions and Weights

	Cabinet		Rackmount	
Dimensions	in	cm	in	cm
Height	11.9	30.2	5.3	13.3
Width	8.4	21.3	19.0	48.3
Length	20.4	51.8	19.0	48.3
Weight (approx)	lb	kg	lb	kg
Net	25.0	11.3	26.0	11.8
Shipping	34.0	15.4	45.0	20.4

Whether you choose the 2 MHz 5100 Series or the 60 MHz 5400 Series, TEKTRONIX 5000-Series Oscilloscopes always give you the most versatility and performance for your dollar.

MAINFRAMES

Mainframe/ Display Unit	Page	Beams	Storage	Display Size
5110	**96**	Single		8 x 10 div (1.27 cm/div)
5111	**96**	Single	Bistable	8 x 10 div (1.27 cm/div)
5112	**96**	Dual		8 x 10 div (1.27 cm/div)
5113	**96**	Dual	Bistable	8 x 10 div (1.27 cm/div)
5115	**96**	Single	Bistable	8 x 10 div (1.27 cm/div)
5440	**91**	Single		8 x 10 div (1.22 cm/div)
5441	**92**	Single	Variable Persistence	8 x 10 div (0.9 cm/div)



5100-Series

PLUG-IN VERSATILITY

Twenty-four plug-ins are now available in the 5000 Series family. All these plug-ins are compatible with the 5400 Series, and all but 7 are compatible with 5100-Series Mainframes.

The amplifier plug-ins include single, dual, and four trace units, various differential amplifiers (including one with a current probe input), and a differential comparator amplifier. The time-base plug-ins include single, dual, delayed sweep units, and a digital delay time base.

Three special-purpose plug-ins are also available. The 5L4N is a spectrum analyzer for the 0-to-100 kHz frequency range. It has 10 Hz bandwidth resolution. The 5CT1N is a semiconductor curve-tracer plug-in. It allows characteristic curves of transistors, FETs, diodes, and other semiconductor devices to be displayed on the crt. The 5S14N, a general-purpose dual-trace, delayed sweep sampler, extends the bandwidth of either the 5100 or the 5400 Series to 1 GHz at 2 mV sensitivity.

More plug-ins are planned for the 5000 Series so that even greater measurement capability will be available to you.

Back-lighted knob skirts on the plug-ins provide scale-factor readout. The correct scale factor is automatically indicated when using the X10 magnifier and the recommended 1X and 10X probes. In addition, the 5400-Series automatically presents correct scale factors on the crt when used with non-N suffix plug-ins. This feature helps reduce human errors and enables photographic recording of measurement conditions.

AMPLIFIERS

Product	Page	Type	Minimum Deflection Factor	Bandwidth —3 dB	Cmrr
5A13N	99	Single	1 mV/div	2 MHz	10,000:1
5A14N	98	Four	1 mV/div	1 MHz	
5A15N	98	Single	1 mV/div	2 MHz	
5A18N	98	Dual	1 mV/div	2 MHz	
5A19N	99	Single	1 mV/div	2 MHz	1000:1
5A20N	99	Single	50 μV/div	1 MHz	100,000:1
5A21N	100	Single (voltage and current)	50 μV/div 0.5 mA/div	1 MHz	100,000:1
5A22N	100	Single	10 μV	1 MHz	100,000:1
5A23N	98	Single	10 mV/div	1.5 MHz	
5A24N	98	Single	50 mV/div	2 MHz	
5A26	100	Dual	50 μV/div	1 MHz	100,000:1
5A38	93	Dual	10 mV/div	35 MHz	
5A45	93	Single	1 mV/div*	60 MHz	
5A48	93	Dual	1 mV/div*	60 MHz	

**Bandwidth is dc to 25 MHz at 1 mV/div and 2 mV/div and 60 MHz at 5 mV/div through 10 V/div.*

Time-Base Plug-ins

Product	Page	Type	Sweep Rate	Mag	Single Sweep	Volts/Div Ext Mode
5B10N	101		1 μs to 5 s	X10	Yes	50 mV and 500 mV
5B12N	101	Dual Delaying	A 1 μs to 5 s B 2 μs to 0.5 s	X10 —	Yes —	50 mV and 500 mV
5B13N	101		1 μs to 100 ms			50 mV
5B31	94	Digital Delaying	0.2 μs to 5 s	X10	Yes	50 mV
5B40	94		0.1 μs to 5 s	X10	Yes	50 mV
5B42	94	Delaying	A 0.1 μs to 5 s B 0.1 μs to 0.5 s	X10 X10	Yes —	50 mV
5B44	94	Dual Delaying	50 ns to 2 s	X10	Yes	50 mV

Special-Purpose Plug-ins

Product	Page	Description
5CT1N	102	Semiconductor Curve Tracer
5L4N	102	Low-Cost Spectrum Analyzer
5S14N	102	Dual-Trace Delayed Sweep Sampler

5000-Series Plug-in Dimensions and Weights

Dimensions	Height		Width		Length	
	in	cm	in	cm	in	cm
Single Width	5.0	12.7	2.6	6.6	12.0	30.5
Double Width	5.0	12.7	5.2	13.2	12.0	30.5

Weight (approx)	Net		Shipping	
	lb	kg	lb	kg
Single Width	2.8	1.3	10.0	4.5
Double Width	5.8	2.6	10.8	4.9

Do you need rear-panel signal inputs or outputs, or other special features? If so, contact your Tektronix Field Engineer for details.

RECOMMENDED PROBES FOR 5000-SERIES AMPLIFIER PLUG-INS

The following probes are recommended for general use with the listed amplifier plug-ins. These probes automatically program the knob-skirt readout and the crt readout (available only in the 5400 Series) to indicate correct deflection factor. Probe packages include various tips, ground leads and accessories. Probes are also available in different lengths, attenuation ratios, input loading and bandwidths. Special purpose probes, such as high voltage, FET and current probes are available for use with 5000-Series amplifier plug-ins. See probe section for complete information.

Amplifier Plug-ins	Probe	Type	Attenuation	Standard Length	Features	Package Number
5A14N 5A15N 5A18N 5A23N	P6060	Voltage	10X	6′	Full bandwidth, low cost, (not compatible with crt readout).	010-6060-03
	P6062B	Voltage	1X/10X	6′	Full bandwidth, switchable attenuation, ground reference button.	010-6062-03
	P6101	Voltage	1X	2 m	Full bandwidth, miniature. Modular construction simplifies repair.	010-6101-03
5A13N 5A20N 5A21N* 5A22N 5A26	P6060	Voltage	10X	6′	Full bandwidth, low cost, (not compatible with crt readout).	010-6060-03
	P6062B	Voltage	1X/10X	6′	Full bandwidth, switchable attenuation, ground reference button.	010-6062-03
	P6101	Voltage	1X	2 m	Full bandwidth, miniature. Modular construction simplifies repair.	010-6101-03
	P6055	Voltage	Adjustable to 10X	3.5′ only	Adjustable attenuation. Will give up to 20,000:1 CMRR when used in pairs. (5A20N, 5A21N, 5A22N and 5A26).	010-6055-01
5A38 5A45 5A48	P6105	Voltage	10X	2 m	Full bandwidth, miniature. Modular construction simplifies repair.	010-6105-03
	P6062B	Voltage	1X/10X	6′	Switchable attenuation (full bandwidth in the 10X position) ground reference button.	010-6062-03
	P6101	Voltage	1X	2 m	Miniature, modular (reduced bandwidth).	010-6101-03

**The 5A21N also provides direct access to current probe P6021. Order 010-0237-02.*
See probe section for additional listings and complete information.

CARTS

SCOPE-MOBILE® Carts — For cabinet models, order Tek Lab Cart, Model 3; for rackmount models, order 205.

CAMERAS

All 5100 Series — C-5A, suitable for repetitive or stored traces.

5100 Storage Instruments, 5440 (with P or R back), 5441 (with G back) — C-59, general purpose.

For full details see Camera Section, page 225.

ACCESSORIES

Blank Panel — (016-0195-00)

Viewing Hoods — (016-0154-00, or 016-0260-00 folding)

Protective cover — (016-0544-00)

For full details see Accessories Section, page 225.

Low Cost

Dc to 60 MHz

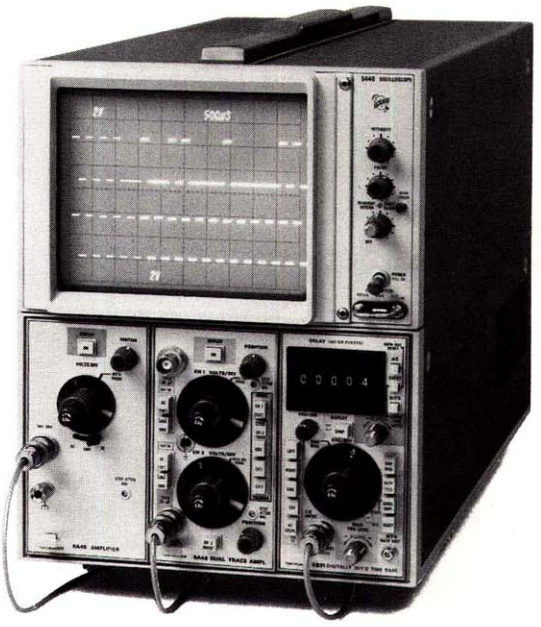
Sampling to 1 GHz

Crt Readout

3-Plug-in Flexibility

Choice of 24 Plug-ins

Bench to Rack Convertibility



The 5440 combines versatility and low cost in a 60 MHz general-purpose, plug-in oscilloscope. It features crt readout of plug-in scale factors, a 3-plug-in mainframe, a choice of 24 plug-ins*, and bench to rack convertibility.

Crt readout displays plug-in scale factors on the crt, so measurement time and operator errors are reduced by taking into account magnifiers and probe attenuators. It can also be accessed externally. This unique ability can be used to read out dates, picture numbers, digital clock times, etc.

All the plug-ins in the 5000 Series are compatible with the 5440.**

The wide variety of plug-ins available lets you configure your oscilloscope to meet your needs today as well as tomorrow: from a single-trace, single time-base configuration for production monitoring, to 4-trace, delayed sweep for logic work, to 4-trace differential amplifiers for transducer measurements, to dual-trace, delayed sweep for general purpose measurements.

If you're looking for a general-purpose oscilloscope, the 5440 gives you the most versatility and performance at the lowest price.

**Plug-ins with a suffix N (5A13N, 5B12N, etc) do not provide crt readout.*

***The 5B10N, 5B12N, and 5B13N Time Bases do not permit viewing the leading edge of a triggered waveform when used in the 5400 Series.*

VERTICAL SYSTEM

Channels—Left and center plug-in compartments are compatible with all 5000-Series Plug-ins. Crt readout is not available with plug-ins having a suffix N (5A13N, 5B10N, etc).

Deflection Factor—Determined by plug-in unit.

Bandwidth— 60 MHz max, determined by plug-in unit.

Chopped Mode—The 5440 will chop between channels at approx 25 to 100 kHz, depending on plug-ins and operating modes.

Alternate Mode—Each amplifier plug-in is swept twice before switching to the next. A single-trace amplifier is swept twice and each channel of a dual-trace amplifier is swept once before the 5440 switches to the second amplifier.

HORIZONTAL SYSTEM

Channel—Right-hand plug-in compartment compatible with all 5000-Series Plug-ins. Crt readout is not available for plug-ins with a suffix N.

Internal Trigger Mode—Left vertical, center vertical.

Fastest Calibrated Sweep Rate— 5 ns/div, determined by plug-in.

X-Y Mode—Phase shift within 2° from dc to 20 KHz.

CRT AND DISPLAY FEATURES

Crt—Internal parallax-free 8 x 10 div (1.22 cm/div) graticule with edge-lit illumination.

Phosphor—P31 Standard, P7 or P11 optional.

Accelerating Potential—15 kV.

External Intensity Input— +5 V turns beam on from off condition. −5 V turns beam off from on condition. Frequency range dc to 2 MHz. Input R and C is approx 10 kΩ paralleled by approx 40 pF. Max input is ± 50 V (dc + peak ac).

OTHER CHARACTERISTICS

Calibrator—Voltage amplitude is 400 mV within 1%. Current is 4 mA within 1%. Frequency is 2 times the line frequency.

Minimum Photographic Writing Speed—Using Polaroid film without film fogging. Writing speed can be increased with the TEKTRONIX Writing Speed Enhancer (see camera section for more information).

Writing Speed cm/μs				Camera	Lens
P31 Phosphor		P11 Phosphor			
10,000 ASA	3000 ASA	10,000 ASA	3000 ASA		
180	90	245	125	C-59R	f/2.8 0.67 mag
330	160	450	230	* ** C-50R	f/1.9 0.7 mag

**Slight cropping of the graticule corners.*

***Requires optional battery pack (016-0270-00) for operation with the 5440.*

Beam Finder—Intensifies trace and brings it into graticule areas.

Ambient Temperature—Performance characteristics valid from 0°C to + 50°C unless otherwise specified.

Line Voltage Range— 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selected with quick change jumpers. Line frequency range is 48 to 440 Hz.

Max Power Consumption— 100 W at 120 V ac, 60 Hz.

OPTIONS

Option 01 without Crt Readout—The 5440 may be ordered without crt readout. This feature can easily be added later with a conversion kit.

Option 03 User Addressable Crt Readout—An additional crt readout access is available for the operator to program two 10-digit characters such as time, operator name, or test number. The additional display is useful for photographic records and is programmed by external resistors and switches.

Option 04 Protective Panel Cover (Cabinet Model Only)—The 5440 may be ordered with a protective front-panel cover. The cover protects the front panel and knobs during transportation and storage.

For Recommended Cameras — See camera section, page 225.

ORDERING INFORMATION

The 5440 may be ordered as a cabinet-model oscilloscope equipped with a tilt bail, or as a 5¼ in rackmount oscilloscope with slide-out assembly.

5440 Oscilloscope **$1425**

R5440 Oscilloscope (Rackmount) **$1475**

OPTIONS

Option 01 without Crt Readout..... **Sub $325**

Option 03 User Addressable Crt Readout..... **Add $65**

Option 04 Protective Panel Cover (Cabinet Model Only) ..... **Add $20**

Option 76 P7 Phosphor ..... **No charge**

Option 78 P11 Phosphor ..... **No charge**

Conversion Kits

Cabinet-to-Rackmount, Order 040-0583-01..... **$65**

Rackmount-to-Cabinet, Order 040-0584-02..... **$65**

Crt Readout, Order 040-0691-00..... **$455**

5441 | 5000-Series 60-MHz Variable Persistence Storage Oscilloscopes

Low Cost

Variable Persistence Storage

Crt Readout

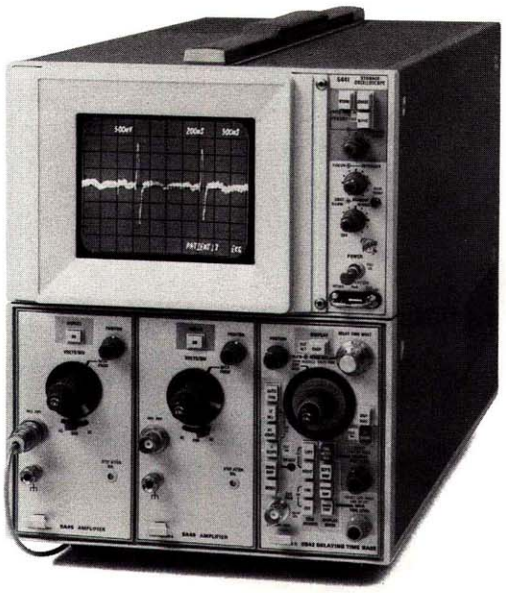
Dc to 60 Mz

3-Plug-in Flexibility

24 Versatile Plug-ins

Bench to Rack Convertibility

5 div/μs Stored Writing Speed



With the 5441 Variable Persistence Storage Oscilloscope, view time at normal intensity can be varied from a fraction of a second to more than 5 minutes. In the save mode, signals can be viewed at lower intensity for up to an hour.

High-speed events that occur only once or at very low repetition rates are easily observed. You can make low-frequency measurements more easily and accurately by eliminating flicker or transforming a slowly moving dot into a stable display. Repetitions of the same signal can be compared simultaneously to detect changes in amplitude or phase. The integrating effect of variable persistence can be used to suppress the random noise that obscures low signal-to-noise ratio waveforms.

The 5441 enhances the capabilities of the 5000-Series Sampler and Spectrum Analyzer Plug-ins. In sampling applications, discrete dot traces are converted into a continuous waveform by holding repeated sweeps on the crt.

In spectrum analysis, slow scan rates are used to maximize resolution. With the 5441, it is easy to display a full-scan pattern simultaneously even when the scan rate yields full-scale periods of more than a second.

Like other 5400-Series Oscilloscopes, the 5441 offers crt readout of deflection factors for convenient, error-free measurements and optional user-programmable crt readout of test information for ready identification and easy photographic recording. With the flexibility of a 3-plug-in mainframe and a choice of 24 plug-ins, you can make virtually any measurement from dc to 60 MHz.

VERTICAL SYSTEM

Channels—Left and center plug-in compartments compatible with all 5000-Series Plug-ins. Crt readout not available for plug-ins with suffix N.

Deflection Factor—Determined by plug-in.

Bandwidth— 60 MHz max, determined by plug-in.

Chopped Mode—The 5441 will chop between channels at approx 25 kHz to 100 kHz, depending on plug-ins and operating modes.

Alternate Mode—Each plug-in is swept twice before switching to the next. A single-trace amplifier is swept twice and each channel of a dual-trace amplifier is swept once before the 5441 switches to the second amplifier.

HORIZONTAL SYSTEM

Channel—Right-hand plug-in compartment compatible with all 5000-Series Plug-ins. Crt readout not available for plug-ins with suffix N.

Internal Trigger Mode—Left vertical, right vertical.

Fastest Calibrated Sweep Rate— 5 ns/div, determined by plug-in.

X-Y Mode—Phase shift within 2° from dc to 20 kHz.

CRT AND DISPLAY FEATURES

Crt—Internal, parallax-free, 8 x 10 div (0.9 cm/div) graticule with edge-lit illumination.

Persistence—Continuously variable. May be turned off when not needed, thus producing high-contrast stored displays without the characteristic fading of variable persistence.

Phosphor—P31.

Accelerating Potential— 8.5 kV.

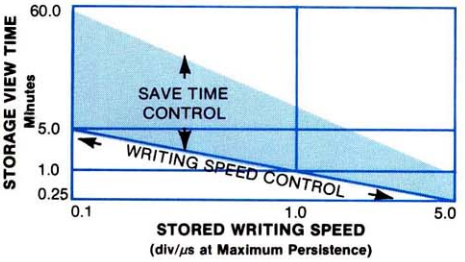
Max Stored Writing Speed—Writing speed greater than 5 div/μs for a view time of 15 s.

Storage View Time — The view time is the amount of time the stored signal can be viewed before it fades away.

At the max writing speed the view time is 15 seconds or 0.25 minutes with the writing speed control fully CW. Adjusting the stored intensity CCW will reduce the stored writing speed, but view time can be increased up to 5 minutes (see the chart above).

Save Mode—Extends view time of stored displays up to 1 hr; prevents erasure of stored display and storage of unwanted displays.

Erase Time—0.5 s ±10%.



External Intensity Input— +5 V turns beam on from off condition. −5 V turns beam off from on condition. Dc to 2 MHz usable frequency range. Input R and C approx 10 kΩ paralleled by approx 40 pF. Max input 50 V (dc + peak ac).

OTHER CHARACTERISTICS

Beam Finder—Intensifies trace and brings it into graticule area.

Calibrator—Voltage amplitude 400 mV ±1%. Current amplitude 4 mA ±1%. Frequency is 2 times line frequency.

Ambient Temperature—Performance characteristics valid from 0°C to +50°C unless otherwise specified.

Line Voltage Ranges— 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selected with quick-change jumpers. Line frequency range, 48-440 Hz.

Max Power Consumption—100 W at 120 V ac, 60 Hz.

OPTIONS

Option 01 without Crt Readout—The 5441 may be ordered without crt readout. This feature can easily be added later with a conversion kit.

Option 03 User Addressable Crt Readout—Crt readout access allows the operator to program up to two 10-digit words.

Option 04 Protective Panel Cover (Cabinet Model Only)—The 5441 may be ordered with a protective front-panel cover. The cover protects the front panel and knobs during transportation and storage.

Option 05—A 1 div/μs writing speed can be ordered (at a significantly lower price) when a writing speed of 5 div/μs is not required.

For Recommended Cameras — See camera section, page 225.

ORDERING INFORMATION

(Plug-ins not Included)

5441 Oscilloscope **$2595**

R5441 Oscilloscope (Rackmount) **$2645**

OPTIONS

Option 01 without Crt Readout..... **Sub $325**

Option 03 User Addressable Crt Readout..... **Add $65**

Option 04 Protective Panel Cover (Cabinet Model Only) ..... **Add $20**

Option 05 Reduce Writing Speed to 1 div/μs ..... **Sub $300**

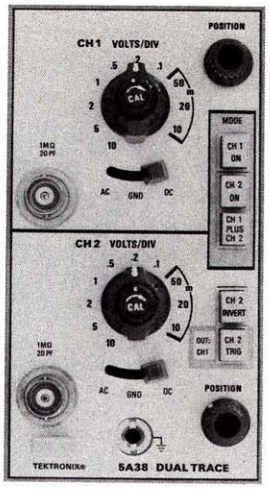
CONVERSION KITS

Cabinet-to-Rackmount, Order 040-0583-01.....**$65**

Rackmount-to-Cabinet, Order 040-0584-02.....**$65**

Crt Readout, Order 040-0691-00.....**$455**

5A38



Low Cost

Dc-to-35 MHz Bandwidth

10 mV/div to 10 V/div Calibrated Deflection Factors

The 5A38 is a dual-trace, 35 MHz plug-in amplifier for use only in 5400-Series Mainframes. It features 10 mV/div sensitivity and crt readout of deflection factor.

Bandwidth—Dc coupled, to ≥35 MHz. Lower end response, ac coupled, ≤ 10 Hz.

Display Modes—Channel 1 only, Channel 2 only (normal or inverted), Dual-trace, and Added. Alternated or chopped operation determined by time base plug-in. Internal trigger selectable from channel 1 or channel 2.

Rise Time— ≤10 ns.

Deflection Factors—Calibrated deflection factors from 10 mV/div to 10 V/div in a 1-2-5 sequence. Accuracy ≤ 3% from 15°C to 35°C, 4% from 0°C to 50°C. A continuously variable control provides ≥2.5X additional attenuation on each range.

Common-Mode Rejection Ratio— ≥50:1 up to 1 MHz.

Channel Isolation— ≥50:1 to 35 MHz with both traces displayed.

Input R and C— 1 MΩ shunted by approx 20 pF.

Max Input Voltage—Dc coupled, 250 V (dc + peak ac). Ac coupled, 500 V (dc + peak ac). Ac component 500 V p-p max at 1 kHz or less.

Stability— ≤0.3 mV vertical shift in any one minute after one hour warm-up, ambient temperature and line voltage held constant. ≤0.2 mV/°C vertical shift with line voltage held constant.

5A38 Dual-Trace Amplifier **$395**

5A48

Dc-to-60 MHz Bandwidth

1 mV/div to 10 V/div Calibrated Deflection Factors

The 5A48 is a dual-trace 60 MHz plug-in amplifier for use only with the 5400-Series Mainframe. The 5A48 features five operating modes and selectable trigger source.

Bandwidth—Dc coupled, dc to at least 60 MHz at 5 mV/div to 10 V/div, decreasing to dc to 25 MHz at 1 mV/div and 2 mV/div (3 dB down). Ac coupled, 10 Hz or less (1.0 Hz with a 10X probe) at all deflection factors (lower 3 dB point).

Display Modes— Channel 1 only, Channel 2 only (normal or inverted), Dual-trace, Added, Alternated, Chopped (determined by time-base plug-in horizontal compartment). Internal trigger source is selectable from channel one or channel two.

Rise Time— 5.8 ns or less (5 mV/div to 10 V/div), 14 ns or less (1 mV/div and 2 mV/div).

Deflection Factors — Calibrated deflection factors from 1 mV/div to 10 V/div in a 1-2-5 sequence. Accuracy ≤5% at 1 mV/div and 2 mV/div, ≤3% from 5 mV/div to 10 V/div from 15°C to 35°C, ≤4% from 5 mV/div to 10 V/div from 0°C to 50°C. A continuously variable control provides ≥2.5X additional attenuation on each range.

Common-Mode Rejection Ratio— ≥ 50:1 from 5 mV/div to 10 V/div, up to 1 MHz. ≥ 20:1 from 1 mV/div to 2 mV/div, up to 1 MHz.

Input R & C— 1 MΩ within 1%, approx 24 pF.

Max Input Voltage—Dc coupled, 250 V (dc + peak ac); ac coupled, 500 V (dc + peak ac). Ac component 500 V p-p max, 1 kHz or less.

Stability— ≤0.3 mV vertical shift in any one minute after one hour warm-up, ambient temperature and line voltage held constant. ≤0.2 mV/°C vertical shift with line voltage held constant.

5A48 Dual-Trace Amplifier **$495**

5A45

Low Cost

DC-to-60 MHz Bandwidth

1 mV/div to 10 V/div Calibrated Deflection Factors

The 5A45 is a single-trace, 60 MHz plug-in amplifier for use only in 5400-Series Mainframes. It features 5 mV/div sensitivity (1 mV/div at 25 MHz) and crt readout of deflection factor.

Bandwidth—Dc coupled, greater than 60 MHz for 5 mV/div through 10 V/div deflection factors, greater than 25 MHz for 1 mV/div and 2 mV/div deflection factors. Ac coupled, lower end response ≤10 Hz (≤1.0 Hz with 10X probe) for all deflection factors.

Rise Time— ≤14 ns, 1 mV/div and 2 mV/div. ≤5.8 ns, 5 mV/div through 10 V/div.

Deflection Factors—Calibrated deflection factors from 1 mV/div to 10 V/div in a 1-2-5 sequence. Accuracy ≤5% at 1 mV/div and 2 mV/div, ≤3% from 5 mV/div to 10 V/div from 15°C to 35°C, ≤4% from 5 mV/div to 10 V/div from 0°C to 50°C. A continuously variable control provides ≥2.5X additional attenuation on each range.

Input R and C— 1 MΩ, shunted by approx 20 pF.

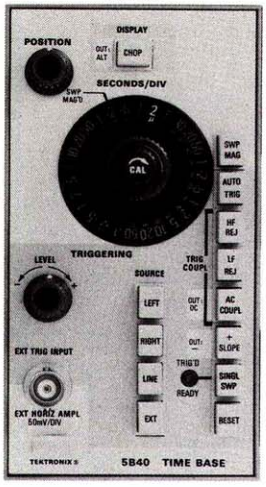
Max Safe Input Voltage—Dc coupled, 250 V (dc + peak ac). Ac coupled, 500 V (dc + peak ac). Ac component 500 V p-p max, 1 kHz or less.

Stability— ≤0.3 mV vertical shift in any one minute after one hour warm-up, ambient temperature and line voltage held constant. ≤0.2 mV/°C vertical shift with line voltage held constant.

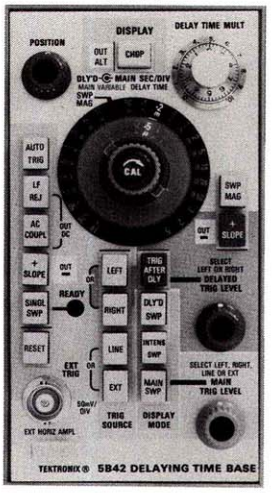
5A45 Single-Trace Amplifier **$280**

For recommended probes — refer to page 90.

5B40

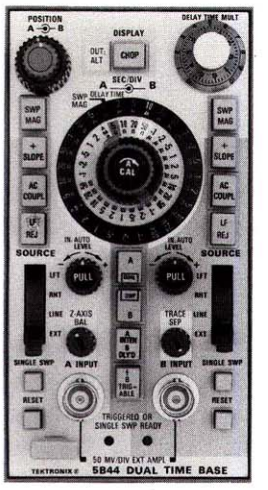


5B42



5B31

5B44



5B40

Low Cost

10 ns/div to 5 s/div Calibrated Time Base

Triggering to 60 MHz

The 5B40 Time Base is designed for use in 5400-Series Mainframes. It features sweep rates from 10 ns/div to 5 s/div and crt readout of the sweep rate selected.

Sweep Rate— 0.1 μs/div to 5 s/div in 24 calibrated steps (1-2-5 sequence). 10 ns/div is fastest sweep rate obtained with X10 magnifier. Uncalibrated, continuously variable between steps and up to 12.5 s/div.

Sweep Accuracy—Measured in 5400-Series Oscilloscope over center 8 graticule divisions. Valid for 100 div of magnified sweep after the first 30 ns.

Time/Div	Unmagnified		Magnified	
	+15°C to +35°C	0°C to +50°C	+15°C to +35°C	0°C to +50°C
1 s/div to 0.5 μs/div	3%	4%	4%	5.5%
5 s/div and 2 s/div, 0.2 μs/div and 0.1 μs/div	4%	5%	5%	6.5%

Triggering

Coupling	Frequency Range	Minimum Signal Required	
		Int	Ext
Dc	Dc to 10 MHz 10 MHz to 60MHz	0.4 div 1.0 div	60 mV 150 mV
Ac	Trigger requirements increase below 50 Hz.		
Lf Rej	Trigger requirements increase below 7.5 kHz.		
Hf Rej	Trigger requirements increase above 50 kHz.		

Single Sweep—Triggering requirements are the same as normal sweep. When triggered, sweep generator produces only one sweep.

External Trigger Input—Max input voltage is 350 V dc + peak ac, 350 V p-p ac at ≤ 1 kHz. Input R and C is 1 MΩ paralleled by approx 24 pF. Trigger level range is ≥ ± 1.5 V.

External Horizontal Input—Deflection factor is 50 mV/div ±3%. Input R and C is 1 MΩ paralleled by approx 24 pF. Dc coupled bandwidth is dc to ≤ 2 MHz. The ac coupled lower response is ≤ 50 Hz. Max input voltage is 350 V (dc + peak ac) or 350 V p-p ac at ≤ 1 kHz.

5B42

10 ns/div to 5 s/div Calibrated Time Base

Single-Sweep Operation

Triggering to 60 MHz

The 5B42 Delaying Time Base is designed specifically for use with 5400-Series Mainframes. The 5B42 is designed so that the user may easily operate the time base in the many applications where delayed sweep and sweep rates up to 10 ns/div are required.

Sweep Rate— 0.1 μs/div to 5 s/div in 24 calibrated steps (1-2-5 sequence). 10 ns/div is the fastest calibrated sweep rate obtained with the X10 magnifier. Uncalibrated, continuously variable between steps and to 12.5 s/div.

Sweep Accuracy—Measured over the center 8 div.

Time/Div	Unmagnified		Magnified	
	+15°C to +35°C	0°C to +50°C	+15°C to +35°C	0°C to +50°C
1 s/div to 0.5 μs/div	3%	4%	4%	5.5%
5 s/div and 2 s/div, 0.2 μs/div and 0.1 μs/div	4%	5%	5%	6.5%

TRIGGERING

Coupling	Frequency Range	Minimum Signal Required	
		Int	Ext
Dc 5400 ampl	Dc to 10 MHz	0.4 div	100 mV
5400 ampl	10 MHz to 60 MHz	1.0 div	400 mV
5100 ampl	Dc to 2 MHz	0.4 div	100 mV
Ac	Requirements increase below 50 Hz.		
Ac Lf Rejection	Requirements increase below 7.5 kHz.		

Single Sweep—Triggering requirements are the same as normal sweep. When triggered, sweep generator produces one sweep.

External Trigger Input—Max input voltage is 350 V (dc + peak ac), 350 V p-p ac at 1 kHz or less. Input R and C is 1 MΩ within 2%, approx 20 pF. Trigger level range is at least ± 2.5 V.

DELAYING SWEEP CHARACTERISTICS

Delay Time Multiplier Range— 0.2 to 10 times the TIME/DIV setting.

Differential Time Measurement Accuracy—Within 1% plus 0.2% of full scale from 1 μs to 0.5 s delay time. Within 2% plus 0.2% of full scale for 1 s to 5 s delay time.

Jitter—Less than 0.05% of the time represented by one div of delaying sweep selected.

DELAYED SWEEP

Sweep Rate— 0.1 μs/div to 0.5 s/div in 21 calibrated steps (1-2-5 sequence). 10 ns/div is the fastest calibrated sweep rate obtained with the X10 magnifier.

Sweep Accuracy—Measured over the center 8 div.

Time/Div	Unmagnified		Magnified	
	+15°C to +35°C	0°C to +50°C	+15°C to +35°C	0°C to +50°C
0.1 s/div to 0.5 μs/div	3%	4%	4%	5.5%
0.5 s/div to 0.2 s/div, 0.2 μs/div and 0.1 μs/div	4%	5%	5%	6.5%

TRIGGERING

Coupling	Frequency Range	Min Signal Required
		Int
Dc 5400 ampl	Dc to 10 MHz	0.4 div
5400 ampl	10 MHz to 60 MHz	1.0 div
5100	Dc to 2 MHz	0.4 div

EXTERNAL HORIZONTAL INPUT

Deflection Factor— 50 mV/div within 3%.

Bandwidth—Dc coupled, dc to at least 2 MHz. Ac coupled, 50 Hz or less to at least 2 MHz.

5B31

Jitter-Free Digital Delay

Delay by Time or Events

20 ns/div Sweep Rate

Crt Readout

The 5B31 Delaying Time Base with digital design features easy and accurate operation. It adds digital delay to the 5400-Series Oscilloscopes, and may be used only in a 5400-Series Mainframe.

The 5B31 can be used in many applications that call for accurate time delays and/or jitter-free displays, such as analyzing high-jitter digital data or machinery controls or production line testing. Its simple operation is helpful in production and education environments.

The 5B31 can delay by time or by events, and its digital delay system eliminates most in-

herent delay jitter. The delay mode is selected by pushbutton: the highly accurate delay time (from 1 μs to 99,999 μs) or the number of events (up to 99,999) is clearly displayed on thumbwheel dials.

CHARACTERISTICS

Sweep Rate— 0.2 μs/div to 5 s/div in 24 calibrated steps (1-2-5 sequence). 20 ns/div is the fastest calibrated sweep rate obtained with the X10 magnifier. Uncalibrated, continuously variable between steps and to 12.5 s/div.

Sweep Accuracy—Measured over the center 8 div.

Time/Div	Unmagnified		Magnified	
	+15°C to +35°C	0°C to +50°C	+15°C to +35°C	0°C to +50°C
1 s/div to 0.5 μs/div	3%	4%	4%	5.5%
5 s/div, 2 s/div, and 0.2 μs/div	4%	5%	5%	6.5%

Single Sweep—Triggering requirements are the same as normal sweep. When triggered, sweep generator produces one sweep.

TRIGGERING

Coupling	Amplifier Type	Frequency Range	Minimum Signal Required	
			Int	Ext
Dc	5400 Plug-ins	Dc to 10 MHz	0.4 div	100 mV
		10 MHz to 35 MHz	1.0 div	400 mV
		35 MHz to 60 MHz	2.0 div	600 mV
Ac	5100 Plug-ins	Dc to 2 MHz	0.4 div	
		Requirements increase below 50 Hz.		

External Trigger Input—Max input voltage is 350 V (dc + peak ac), 350 V p-p ac at 1 kHz or less. Input R and C is 1 MΩ within 2%, approx 24 pF. Trigger level range is at least ±2.0 V.

DELAY BY MICROSECOND

Delay Range— 0 to 99,999 μs in 1-μs steps.

Differential Time Measurement Accuracy—Within 2 parts in 10^5 plus 1 part in 10^5 per month.

Jitter—Less than 10 ns + 1 part in 10^7 of selected delay.

DELAY BY EVENTS

Delay Range— 1-event steps from 0 to 99,999.

Triggering—Dc coupled from left vert only. Separate slope and level controls provided.

Amplifier Type	Frequency Range	Minimum Signal Required
5400	Dc to 10 MHz	0.4 div
5400	10 MHz to 20 MHz	1.5 div
5100	Dc to 2 MHz	0.4 div

EXTERNAL HORIZONTAL INPUT

Deflection Factor— 50 mV/div within 3%.

Bandwidth—Dc coupled, dc to at least 2 MHz. Ac coupled, 50 Hz or less to at least 2 MHz.

DELAYED GATE OUT

Amplitude—Approx 2.5 V from 50-Ω source will drive one standard TTL load. Rises at end of delay, falls at end of sweep.

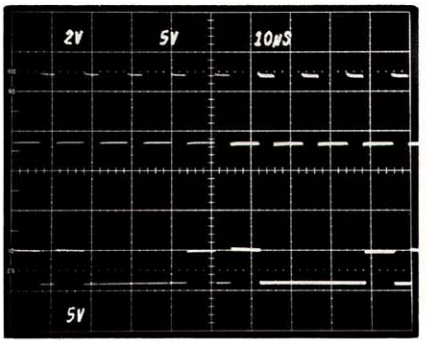


Figure 1. The above waveform shows a pre-set delay of 5 events such that the intensified zone starts on the 6th event.

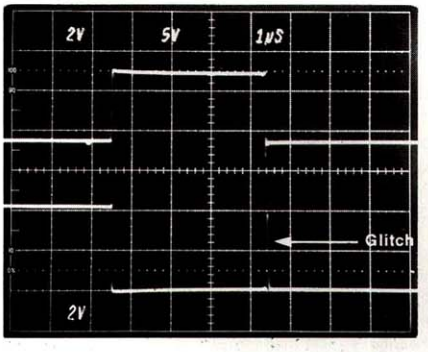


Figure 2. By triggering on a specific event, you can locate a glitch in a waveform. The above photo shows the same waveform as in Figure 1 triggered on the 5th event. Now you can locate the glitch that occurs on the falling edge of the above waveform.

5B44

Two Independent Sweeps

5 ns/div Sweep Rates

Dual Sweep by Sweep Switching Techniques

Crt Readout

The 5B44 Dual Time Base brings fast (5 ns/div) dual sweep display capability to 5400-Series mainframes.

Sweep switching techniques enable both sweeps to be viewed at the same time. For example, in the "A" intensified, "B" delayed mode, both the intensified and the delayed waveforms are presented at full screen width, with independent control of horizontal and vertical positioning.

Versatile and symmetrical triggering controls let you independently select A and B sweep trigger sources from either left hand or center compartments, or from external inputs. For example, this feature lets you display two asynchronous signals, giving you almost two scopes in one.

The 5B44 also features crt readout and an edge lighted seconds/div selector switch.

CHARACTERISTICS

The following applies to both A and B sweeps and triggering circuits, unless otherwise noted.

Sweep Accuracies—Measured over the center 8 div for A and B sweeps.

Time/Div	Unmagnified		Magnified	
	+15°C to +35°C	0°C to +50°C	+15°C to +35°C	0°C to +50°C
1 s/div to 0.5 μs/div	3%	4%	4%	5.5%
2 s/div and 0.2 μs/div to 100 ns/div	4%	5%	5%	6.5%
50 ns/div	4%	5%	6%	7%

Sweep Rate— 50 ns/div to 2 s/div in 25 calibrated steps (1-2-5 sequence). 5 ns/div, the fastest calibrated sweep rate, is obtained with the X10 magnifier. Uncalibrated, continuously variable between steps up to 5 s/div (A sweep only).

TRIGGERING

Coupling	Triggering Frequency Range	Minimum Signal Required	
		Int	Ext
Dc	Dc to 10 MHz 10 MHz to 60 MHz	0.4 div 1.0 div	100 mV 400 mV
Ac	Requirements increase below 50 Hz.		
Ac LF REJ	Requirements increase below 7.5 kHz.		

Single Sweep—Triggering requirements are the same as normal sweep. When triggering, sweep generator produces one sweep. Single sweep on both A and B sweep.

External Trigger Input—Max input voltage is 350 V (dc + peak ac), 350 V p-p ac at 1 kHz or less. Input R and C is 1 MΩ within 2%, paralleled by approx 26 pF. Trigger level range is at least ±2 V. External trigger inputs on both A and B sweep.

EXTERNAL HORIZONTAL INPUTS

Deflection Factor— 50 mV/div ±3%.

Input R and C — 1 MΩ ±2% paralleled by ≃ 26 pF.

Bandwidth—Dc coupled, dc to at least 2 MHz. Ac coupled, 50 Hz or less to at least 2 MHz.

DELAYING SWEEP CHARACTERISTICS

Delay Time Multiplier Range— X0.2 to X10 the A sweep TIME/DIV setting.

Differential Time Measurement Accuracy—Within 1% plus 0.2% of full scale from 1 μs to 1 s of A sweep rate setting. Within 2% plus 0.2% of full scale for 2 s/div.

Jitter—Less than 0.05% of the delaying sweep TIME/DIV.

ORDERING INFORMATION

5B40 Time Base **$340**

5B42 Delaying Time Base **$640**

5B31 Digitally Delayed Time Base **$625**

5B44 Dual Time Base **$895**

5000-Series 2 MHz Single-Beam, Dual-Beam, and Storage Oscilloscopes

Low Cost

Dc to 2 MHz

Sampling to 1 GHz

Choice of 17 Plug-ins

5110

The 5110 is a single-beam nonstorage oscilloscope featuring a large 6½″ diagonal (1.27 cm/div) crt.

Tailor your measurement needs with the appropriate plug-in units to obtain high-gain differential (10 μV/div), four-channel differential at 50 μV/div, eight-channel displays at 1 mV/div. Or choose from our extra low cost basic amplifier and time-base plug-ins to suit the special needs of education and industry.

When using two amplifiers and a dual time-base plug-in in the dual-sweep mode, the sweeps are slaved to the amplifiers.

CRT AND DISPLAY FEATURES

Crt — Internal 8 x 10 div (1.27 cm/div) parallax-free, non-illuminated graticule.*

Accelerating Potential — 3.5 kV.

Phosphor — P31 standard, P7 or P11 optional.

5111

The 5111 is a single-beam, split-screen, bistable oscilloscope with a large-screen, 6½″ diagonal (1.27 cm/div) display.

The 5111 extends measurement capability into areas requiring retention of single and multitrace displays for long-term examination and/or photography.

The 5111 is particularly useful for recording low and medium speed displays like those found in audio spectrum analysis, semiconductor curve tracing, sampling, vibration analysis, and the biophysical sciences.

When using two amplifiers and a dual time-base plug-in in the dual-sweep mode, the sweeps are slaved to the amplifiers.

CRT AND DISPLAY FEATURES

Crt — Internal 8 x 10 div (1.27 cm/div) parallax-free, non-illuminated graticule.*

Accelerating Potential — 3.5 kV.

Phosphor — Similar to P1.

Max Stored Writing Speed — At least 20 div/ms.

Storage View Time — At least 1 hr at normal intensity; up to 10 hr at reduced intensity, after which time it may be increased to original level.

Erase Time — Approx 250 ms.

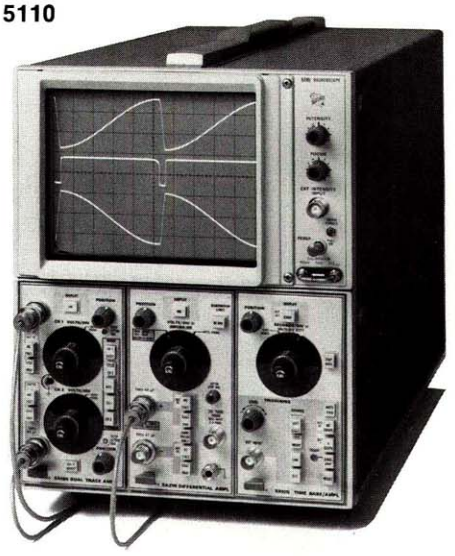
5112

The 5112 is a dual-beam nonstorage oscilloscope featuring two independent vertical systems referenced against a common horizontal deflection system.

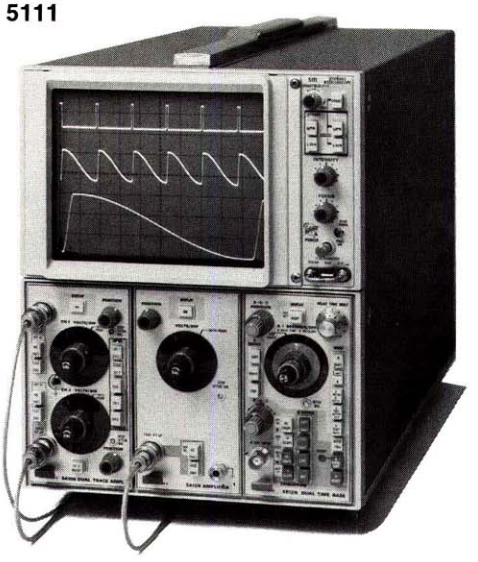
The 5112 can display two simultaneous events, either single-shot or repetitive, against a common time base within the bandwidth and writing rate limits of the system. *Both beams are driven by one set of horizontal deflection plates.*

**Illuminated graticule available at extra cost. Contact your local Tektronix Field Engineer.*

5110



5111



When teamed up with the appropriate differential amplifiers, the 5112 can display up to four channels of high-gain (50 μV) differential information for use in the biophysical, electromechanical, and component testing fields.

CRT AND DISPLAY FEATURES

Crt — Internal 8 x 10 div (1.27 cm/div) parallax-free, non-illuminated graticule.*

Accelerating Potential — 3.5 kV.

Phosphor — P31 standard, P7 or P11 optional.

5113

The 5113 is a dual-beam bistable storage oscilloscope featuring easy-to-use split-screen storage. Stored writing speed is at least 20 div/ms (Option 03 provides 200 div/ms for the center 6 x 8 div). View time is at least 1 hr at normal intensity and can be increased to 10 hr at reduced intensity.

The 5113 can display two simultaneous events, either single-shot or repetitive, against a common time base within the bandwidth and writing rate limits of the system. *Both beams are driven by one set of horizontal deflection plates.*

The 5113 is particularly useful in biomedical research where low-repetition-rate stimulus/response potentials need to be observed and recorded.

CRT AND DISPLAY FEATURES

Crt — Internal 8 x 10 div (1.27 cm/div) parallax-free, non-illuminated graticule.*

Accelerating Potential — 3.5 kV.

Phosphor — Similar to P1.

Max Stored Writing Speed — At least 20 div/ms. At least 200 div/ms at lower stored brightness (over center 6 x 8 div) with Option 03.

Storage View Time — At least 1 hr at normal intensity; up to 10 hr at reduced intensity, after which time it may be increased to original level.

Erase Time — Approx 250 ms.

Option 03 Fast Writing Speed Crt — Increases stored writing speed to 200 div/ms (center 6 x 8 div).

5115

The 5115 is a single-beam bistable storage oscilloscope with a writing speed of at least 200 div/ms in the normal mode and 800 div/ms (>1000 cm/ms) in the enhanced mode. Storage view time is at least 1 hr at normal intensity. A variable brightness control allows the storage time to be extended to at least 10 hrs at reduced intensity, after which time intensity may be increased to original level. Variable brightness also gives optimum photographic results and allows for the integration of multiple traces.

The 5115 is useful in a wide variety of fields, including education, biophysical engineering, component testing, and industrial electronics.

When using two amplifiers and a dual time-base plug-in in the dual-sweep mode, the sweeps are slaved to the amplifiers.

CRT AND DISPLAY FEATURES

Crt — Internal 8 x 10 div (1.27 cm/div) parallax-free, non-illuminated graticule.*

Accelerating Potential — 3.5 kV.

Phosphor — Similar to P1.

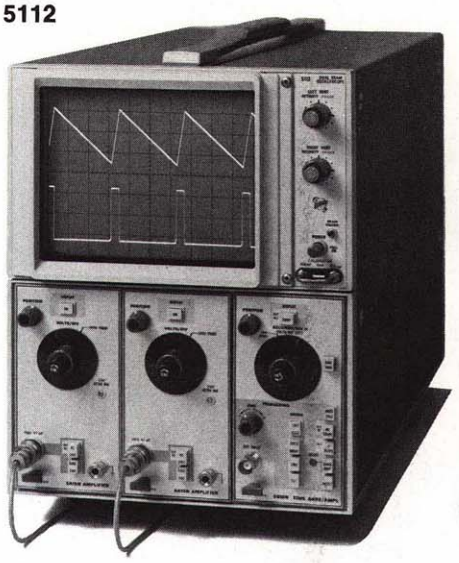
Max Stored Writing Speed — At least 200 div/ms in the normal mode and 800 div/ms in the enhanced mode.

Storage View Time — At least 1 hr at normal intensity; up to 10 hr at reduced intensity, after which time it may be increased to original level.

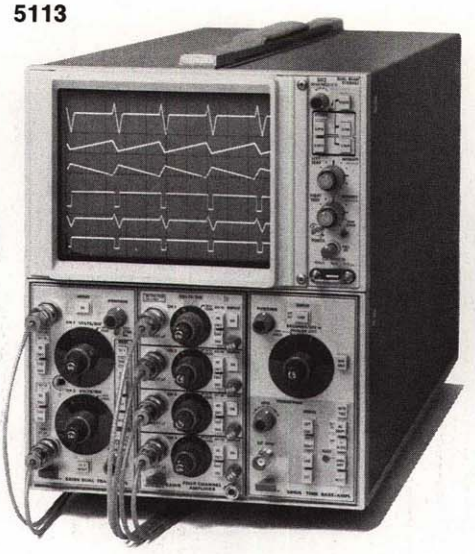
Erase Time — Approx 250 ms.

**Illuminated graticule available at extra cost. Contact your local Tektronix Field Engineer.*

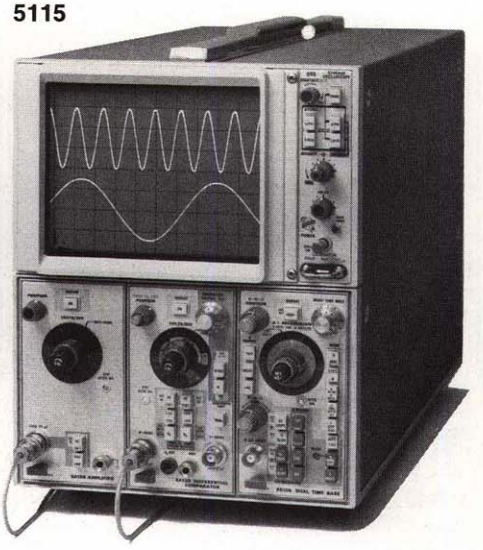
5112



5113



5115



COMMON CHARACTERISTICS
for 5110, 5111, 5112, 5113, 5115 unless otherwise specified

VERTICAL SYSTEM

Channels — Left and center plug-in compartments compatible with all 5100-Series Plug-ins.

Deflection Factor — Determined by plug-in.

Bandwidth — 2 MHz max.

Chopped Mode — (5110, 5111, 5115) The mainframe will chop between two amplifiers at approx 25 to 100 kHz, depending on plug-ins and operating modes. Chop or alternate mode is selected at the time base.

Chopped Mode — (5112, 5113) The mainframe will chop between amplifier channels at approx 25 to 100 kHz, depending on plug-ins and operating modes. Chop or alternate mode is selected at the time-base unit.

Alternate Mode — (5110, 5111, 5115) Each amplifier plug-in is swept twice before switching to the next. A single-trace amplifier is swept twice and each channel of a dual-trace amplifier is swept once before switching to the second amplifier.

Alternate Mode — (5112, 5113) Single-trace amplifiers are swept full time. Each channel of a multitrace amplifier is swept once before switching to the next channel. No channel switching is necessary between left and center plug-in compartments.

HORIZONTAL SYSTEM

Channel — Right-hand plug-in compartment compatible with all 5100-Series Plug-ins.

Fastest Calibrated Sweep Rate — 0.1 μs/div (X10 mag) with 5B10N or 5B12N.

X-Y Mode — Phase shift within 2° from dc to 100 kHz.

OTHER CHARACTERISTICS

Ambient Temperature — Performance characteristics valid from 0°C to +50°C.

Line Voltage Ranges — 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selected with quick change jumpers. Line frequency range, 48 to 440 Hz.

Typical Power Consumption — For 5110, 53 W. For 5111, 74 W. For 5112, 67 W. For 5113, 88 W. For 5115, 74 W.

External Intensity Input — +5 V turns beam on from off condition. −5 V turns beam off from on condition. Frequency range dc to 1 MHz. Input R and C is approx 10 kΩ paralleled by approx 40 pF. Max input ±50 V (dc + peak ac).

Calibrator — Voltage output 400 mV within 1%. Current output (loop) 4 mA within 1%. Frequency is 2 times line frequency.

Beam Finder — Positions beam on screen regardless of vertical and horizontal position control settings.

ORDERING INFORMATION
(Plug-ins not Included)

Cabinet Model

5110 Oscilloscope	**$700**
5111 Oscilloscope	**$1300**
5112 Oscilloscope	**$1225**
5113 Oscilloscope	**$1825**
5115 Oscilloscope	**$1375**

Rackmount Model

R5110 Oscilloscope	**$750**
R5111 Oscilloscope	**$1350**
R5112 Oscilloscope	**$1275**
R5113 Oscilloscope	**$1875**
R5115 Oscilloscope	**$1425**

OPTIONS

Option 02 Protective Panel Cover (Cabinet Models Only) — The cover protects the front panel and knobs during transportation and storage..... **Add $20**

Option 03 Fast Writing Speed Crt (5113, R5113 Only) ..... **Add $50**

Option 76 P7 Phosphor (5110, R5110, 5112, R5112 Only) ..... **No charge**

Option 78 P11 Phosphor (5110, R5110, 5112, R5112 Only) ..... **No charge**

CONVERSION KITS

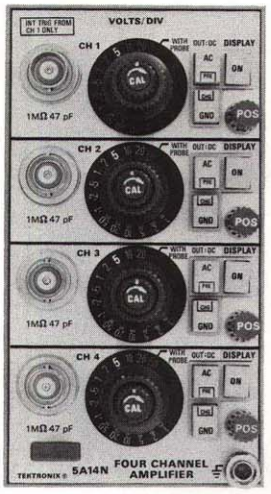
Cabinet-to-Rackmount Conversion Kit, Order 040-0583-01 ..... **$65**

Rackmount-to-Cabinet Conversion Kit, Order 040-0584-02 ..... **$65**

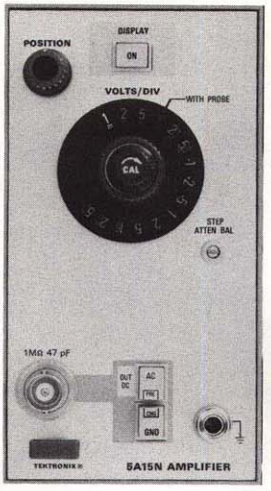
Protective Panel Cover Kit, Order 040-0620-00 ..... **$22**

For Recommended Cameras — See camera section, page 225.

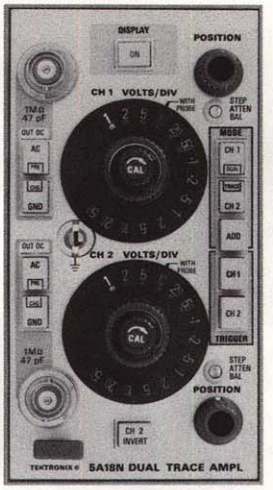
5A14N



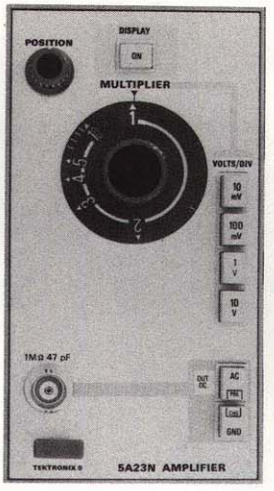
5A15N



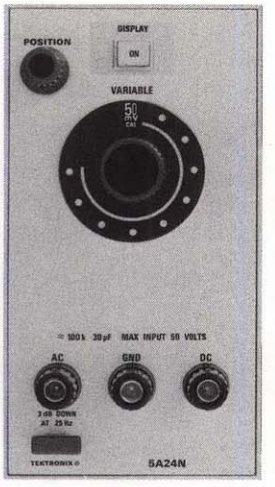
5A18N



5A23N



5A24N



5A14N

1 mV/div to 5 V/div

The 5A14N Four-Channel Amplifier features simplified front-panel controls and can be used in any 5000-Series Mainframe.

5A14N operating modes are: each channel separately, and alternated or chopped between any combination of channels. Internal trigger is available from channel one only.

CHARACTERISTICS

Bandwidth — Dc coupled, dc to at least 1 MHz at all deflection factors. Ac coupled, 2 Hz or less to at least 1 MHz at all deflection factors.

Deflection Factor — 1 mV/div to 5 V/div in 12 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5 V/div.

Input R and C — 1 MΩ within 1%, approx 47 pF.

Max Input — Dc coupled, 350 V (dc + peak ac). Ac-coupled, 350 V dc.

Chopping Rate — 25 kHz to 100 kHz depending upon plug-in combinations and number of traces displayed.

5A15N

1 mV/div to 5 V/div

The 5A15N Single-Channel Amplifier features easy to use front-panel controls and can be used in any 5000-Series Mainframe.

Two 5A15Ns (one must be located in the right-hand compartment) provide versatile X-Y operation when used in a 5100-Series Mainframe.

CHARACTERISTICS

Bandwidth — Dc coupled, dc to at least 2 MHz at all deflection factors. Ac coupled, 2 Hz or less to at least 2 MHz at all deflection factors.

Deflection Factor — 1 mV/div to 5 V/div in 12 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5 V/div.

Input R and C — 1 MΩ within 1%, approx 47 pF.

Max Input — Dc coupled, 350 V (dc + peak ac). Ac-coupled, 350 V dc.

5A18N

1 mV/div to 5 V/div

The 5A18N Dual-Trace Amplifier features easy to use front-panel controls and can be used in any 5000-Series Mainframe.

5A18N operating modes include channel one or two only, channels one and two added, channel two inverted and channel one alternated or chopped with channel two. Internal trigger source is selectable from channel one and channel two.

Two 5A18Ns (one must be located in the right-hand compartment) provide versatile, dual X-Y operation when used in a 5100-Series Mainframe.

CHARACTERISTICS

Bandwidth — Dc coupled, dc to at least 2 MHz at all deflection factors. Ac coupled, 2 Hz or less to at least 2 MHz at all deflection factors.

Deflection Factor — 1 mV/div to 5 V/div in 12 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5 V/div.

Input R and C — 1 MΩ within 1%, approx 47 pF.

Max Input — Dc coupled, 350 V (dc + peak ac). Ac-coupled, 350 V dc.

Chopping Rate — 25 kHz to 100 kHz depending upon plug-in combinations and number of traces displayed.

5A23N

10 mV/div to 10 V/div
Calibrated Deflection Factors

The 5A23N is a general-purpose amplifier for the 5000-Series Oscilloscopes. Featuring low cost and simplicity of controls, it is ideal for monitor and systems applications. It operates in the left or middle plug-in compartment of the 5000-Series Mainframes for Y-T displays, or in the right compartment for X-Y displays.

Bandwidth — Dc coupled, dc to at least 1.5 MHz at all deflection factors. Ac coupled, 2 Hz or less to at least 1.5 MHz at all deflection factors.

Deflection Factor — 10 mV/div to 10 V/div within 3% in 4 calibrated decade steps. A lighted multiplier control provides continuous variation between steps, and extends the deflection factor range to 100 V/div. Accuracy is within 5% at X2 and X5 multiplication.

Input R and C — 1 MΩ within 1%, approx 47 pF.

Max Input — 350 volts (dc + peak ac).

5A24N

50 mV/div to 1 V/div
Deflection Factors

Easy to Customize

The 5A24N is a low-cost utility plug-in providing direct access to either the vertical or horizontal deflection system of the 5000-Series Mainframes. It contains mode switching, crt beam positioning, trigger pickoff for basic measurements, and a built-in 3⅜ x 2¾ in soldering pad matrix for use by the customer who wishes to build his own input circuits for special applications. Customer-built circuits are powered through the circuit board which provides access to all mainframe power supplies.

Bandwidth — Dc coupled, dc to at least 2 MHz at 50 mV/div, decreasing to dc to 200 kHz at mid-attenuator range. Ac coupled, 25 Hz to at least 2 MHz at 50 mV/div, decreasing to 25 Hz to 200 kHz at mid-attenuator range. Uncompensated input.

Deflection Factor — 50 mV/div, accurate within 3%. Continuously variable, uncalibrated from 50 mV/div to at least 1 V/div.

Input R and C — Approx 100 kΩ, approx 30 pF.

Max Input — 50 volts (dc +peak ac).

ORDERING INFORMATION

5A14N Four-Trace Amplifier $750

5A15N Single Trace Amplifier $175

5A18N Dual-Trace Amplifier $365

5A23N Single-Trace Amplifier $135

5A24N Single-Trace Amplifier $95

For recommended probes — refer to page 90.

5A13N

Dc-to-2 MHz Bandwidth
1 mV/div to 5 V/div
10,000:1 Cmrr
10,000 Div Effective Screen Height

The 5A13N is a differential comparator plug-in amplifier for the 5000-Series. It incorporates a number of performance features that makes it particularly versatile, especially in multitrace combination with other 5000-Series Amplifier Plug-ins. The following operational areas describe the functions of the 5A13N.

Conventional Mode — As a conventional amplifier, the 5A13N has constant bandwidth over the 1 mV/div to 5 V/div deflection factor range. The bandwidth is selectable at 2 MHz or 10 kHz for best displayed noise conditions during low-frequency applications. The plus or minus inputs allow normal or inverted displays.

Differential Mode — As a differential amplifier, the 5A13N maintains its conventional features and provides a balanced input for applications requiring rejection of a common-mode signal. The cmrr is 10,000:1 from dc to 20 kHz, decreasing to 100:1 at 2 MHz. The unit rejects up to 15 V of common-mode signal at a deflection factor setting of 1 mV/div, increasing to 350 V rejection capability above 100 mV/div.

Comparator Mode — As a comparator amplifier, the 5A13N uses its differential capabilities, but provides an accurate positive or negative internal offsetting voltage. A signal of up to ±10 V may be applied to an input (plus or minus) at a deflection factor setting of 1 mV/div and viewed in 10,000 div by offsetting the signal with the opposing comparison voltage. A ±1 V comparison voltage is also available for applications requiring max resolution. The offset voltage may be externally monitored through a front-panel output.

CHARACTERISTICS

Bandwidth — Dc to 2 MHz. Bandwidth limit mode, dc to 10 kHz. Ac coupled, 2 Hz or less at the lower −3 dB point.

Deflection Factor — 1 mV/div to 5 V/div in a 1-2-5 sequence. Accuracy is within 3%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div.

Input R and C — 1 MΩ, approx 51 pF.

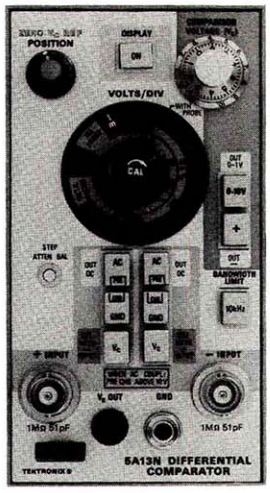
Signal Range

Deflection Factor Settings	1 mV to 50 mV/div	0.1 V to 5 V/div
Common-Mode Signal Range	±15 V	±350 V
Max Dc Coupled Input (Dc + Peak Ac at 1 kHz or Less)	±350 V	±350 V
Max Ac Coupled Input (Dc Voltage)	±350 V	

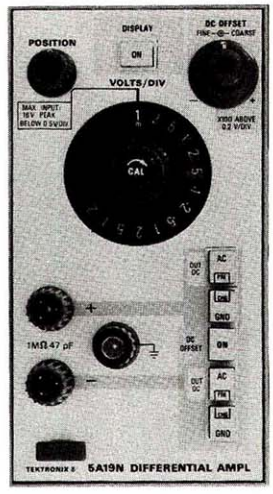
Max Input Gate Current — 0.1 nA or less (equivalent to 100 μV or less, depending on external loading) at 25°C.

Overdrive Recovery — 1 μs to recover to within 3.0 mV and 0.1 ms to recover to within 1.5 mV after removal of an overdrive signal between +15 V and −15 V, regardless of overdrive signal duration.

5A13N



5A19N



5A20N

Internal Comparison Voltage — Ranges, 0 V to ±10 V and 0 V to ±1 V. Accuracy, within 0.2% of dial setting plus 5 mV from ±1 V to ±10 V; within 0.2% of dial setting plus 1 mV from ±25 mV to ±1 V on the 0 V to ±1 V range. From 0 V to ±25 mV, use the on-screen display for greater resolution. Vc output R, approx 15 kΩ.

Common-Mode Rejection Ratio — At least 10,000:1, dc to 10 kHz at 1 mV/div to 50 mV/div dc coupled, with up to 20 V p-p sine wave, decreasing to 100:1 at 1 MHz. At least 400:1, dc to 10 kHz at 0.1 V/div to 5 V/div dc coupled, with up to 100 V p-p sine wave, decreasing to 40:1 at 1 MHz. For frequencies above 5 kHz ac coupled, cmrr is the same as stated for dc coupled. Below 5 kHz ac coupled, cmrr decreases to 400:1 at 10 Hz. Cmrr with two P6060 probes is at least 400:1 at any deflection factor.

5A19N

Dc-to-2 MHz Bandwidth
1 mV/div to 20 V/div
Dc Offset

The 5A19N is a low-cost differential amplifier featuring variable dc offset and simplicity of controls. It is ideal for monitor and systems applications. It operates in the left or middle plug-in compartment of the 5000-Series Mainframe for Y-T displays, or in the right compartment for X-Y displays.

Bandwidth — Dc coupled, dc to at least 2 MHz at all deflection factors. Ac coupled, 2 Hz or less to at least 2 MHz at all deflection factors.

Deflection Factor — 1 mV/div to 20 V/div in a 1-2-5 sequence. Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 50 V/div.

Input R and C — 1 MΩ within 0.3%, approx 47 pF.

Signal and Offset Range

Deflection Factor Settings	1 mV/div to 200 mV/div	500 mV/div to 20 V/div
Common-Mode Signal Range	±16 V	±350 V
Max Dc Coupled Input (Dc + Peak Ac at 1 kHz or Less)	±350 V	
Max Ac Coupled Input (Ac Voltage)	±350 V	
Dc Offset Range	+15 V to −15 V	+350 V to −350 V

Common-Mode Rejection Ratio — Dc coupled, 1 mV/div to 200 mV/div, at least 1000:1 from dc to 10 kHz; decreasing to 100:1 at 500 mV/div to 20 V/div.

5A20N

Dc-to-1 MHz Bandwidth
10 kHz Bandwidth Limiter
50 μV/div to 5 V/div
100,000:1 Cmrr

The 5A20N is a 50 μV/div, dc coupled differential amplifier for the 5000-Series.

VOLTAGE CHARACTERISTICS

Bandwidth — Dc coupled, dc to at least 1 MHz. Ac-coupled, 2 Hz or less to at least 1 MHz. Bandwidth may be limited to 10 kHz.

Deflection Factor — 50 μV/div to 5 V/div in 16 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5 V/div.

Input R and C — Voltage mode, 1 MΩ within 0.15%, approx 47 pF.

Max Input Voltage

	Dc Coupled	Ac Coupled
50 μV/div to 50 mV/div	10 V (dc + peak ac)	350 V dc (coupling cap pre-charged), 10 V peak ac
100 mV/div to 5 V/div	350 V (dc + peak ac)	350 V (dc + peak ac)

Input Gate Current — 100 pA or less (equivalent to 100 μV or less, depending on external loading at 25°C.

Displayed Noise — 30 μV or less, tangentially measured.

Common-Mode Rejection Ratio — Ac coupled, 50 μV/div to 0.5 mV/div, at least 20,000:1 at 5 kHz and above, decreasing to 400:1 at 10 Hz. Dc coupled, at least 100,000:1, dc to 30 kHz at 50 μV/div and 100 μV/div with up to 20 V p-p sine wave, decreasing by less than 20 dB/decade on sensitivity ranges up to 50 mV/div. From 100 mV/div to 5 V/div, cmrr is at least 400:1 with up to 100 V p-p sine wave. Cmrr with two P6060 probes is at least 400:1 at any deflection factor.

ORDERING INFORMATION

5A13N Differential Comparator Amplifier **$685**

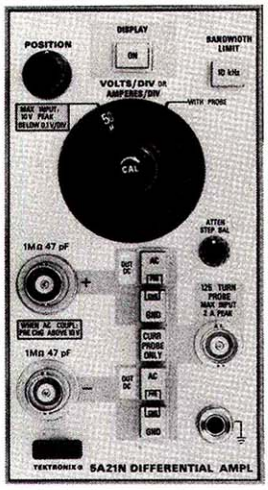
5A19N Differential Amplifier **$210**

5A20N Differential Amplifier **$275**

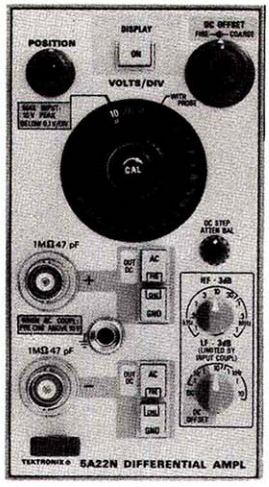
The 5A20N, 5A21N and 5A22N Differential Amplifiers are available with crt readout at additional cost (crt readout functional in 5400-Series mainframes only). Contact your local Tektronix Field Engineer for details.

For recommended probes — refer to page 90.

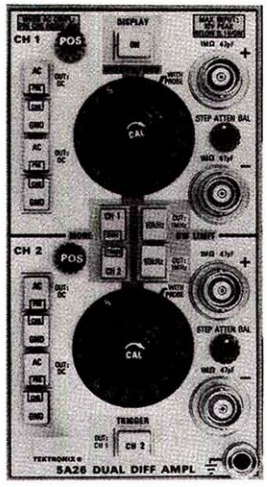
5A21N



5A22N



5A26



5A21N

Dc-to-1 MHz Bandwidth
10 kHz Bandwidth Limiter
50 μV/div to 5 V/div
100,000:1 Cmrr
Voltage and Current Probe Inputs

The 5A21N is a 50 μV/div, dc coupled differential amplifier for the 5000-Series. The 5A21N has a current probe input.

VOLTAGE CHARACTERISTICS

Bandwidth — Dc coupled, dc to at least 1 MHz. Ac coupled, 2 Hz or less to at least 1 MHz. Bandwidth may be limited to 10 kHz.

Deflection Factor — 50 μV/div to 5 V/div in 16 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5 V/div.

Input R and C — Voltage mode, 1 MΩ within 0.15%, approx 47 pF.

Max Input Voltage

	Dc Coupled	Ac Coupled
50 μV/div to 50 mV/div	10 V (dc + peak ac)	350 V dc (coupling cap pre-charged), 10 V peak ac
100 mV/div to 5 V/div	350 V (dc + peak ac)	350 V (dc + peak ac)

Input Gate Current — 100 pA or less (equivalent to 100 μV or less, depending on external loading) at 25°C.

Displayed Noise — 30 μV or less, tangentially measured.

Common-Mode Rejection Ratio — Ac coupled, 50 μV/div to 0.5 mV/div, at least 20,000:1 at 5 kHz and above decreasing to 400:1 at 10 Hz. Dc coupled, at least 100,000:1, dc to 30 kHz at 50 μV/div and 100 μV/div with up to 20 V p-p sine wave, decreasing by less than 20 dB/decade on sensitivity ranges up to 50 mV/div. From 100 mV/div to 5 V/div, cmrr is at least 400:1 with up to 100 V p-p sine wave. Cmrr with two P6060 probes is at least 400:1 at any deflection factor.

CURRENT PROBE INPUT CHARACTERISTICS (with P6021 CURRENT PROBE)

Bandwidth — 15 Hz or less, to at least 1 MHz. Bandwidth may be limited to 10 kHz.

Deflection Factor — 0.5 mA/div to 0.5 A/div in 10 calibrated steps (1-2-5 sequence). Accurate within 3%. Uncalibrated, continuously variable between steps and to 1.25 A/div.

Max Input Current — 4 A p-p (at probe loop) with 125-turn P6021 Current Probe.

Displayed Noise — 300 μA or less, tangentially measured. Performance characteristics are valid for the 5A21N from 0°C to +50°C.

5A22N

Dc-to-1 MHz Bandwidth
10 μV/div to 5 V/div
100,000:1 Cmrr
Selectable Upper and Lower −3 dB Points
Dc Offset

The 5A22N is the most versatile of the 5000-Series differential amplifiers. It features front panel selectable filtering which enables reduction of undesirable displayed noise; both upper and lower 3 dB points are selectable. Dc offset at full bandwidth is available for viewing signals riding on a dc component such as low-level ripple and noise on a power supply.

These features, together with its high common mode rejection, make the 5A22N well suited for measurements in difficult low-amplitude, low-frequency areas.

CHARACTERISTICS

Bandwidth — HF −3 dB point: selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz. 100 Hz to 0.3 MHz, accurate to within 20% of selected frequency; at 1 MHz, bandwidth is down 3-dB or less. LF −3 dB point: selectable in 6 steps (1-10 sequence) from 0.1 Hz to 10 kHz accurate to within 20% of selected frequency. Ac coupled, 2 Hz or less.

Deflection Factor — 10 μV/div to 5 V/div in a 1-2-5 sequence. Accuracy is within 3%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div.

Common-Mode Rejection Ratio — Ac coupled, 10 μV/div to 0.5 mV/div, at least 20,000:1 at 5 kHz and above, decreasing to 400:1 at 10 Hz. Dc coupled, at least 100,000:1, dc to 30 kHz from 10 μV/div to 100 μV/div with up to 20 V p-p sine wave, decreasing by less than 20 dB/decade on sensitivity ranges up to 50 mV/div. From 100 mV/div to 5 V/div, cmrr is at least 400:1 with up to 100 V p-p sine wave. Cmrr with two P6060 probes is at least 400:1 at any deflection factor.

Signal and Offset Range

Deflection Factor Settings	10 μV to 50 mV/div	0.1 V to 5 V/div
Common-Mode Signal Range	±10 V	±350 V
Max Dc Coupled Input (Dc + Peak Ac at 1 kHz or Less)	±12 V	±350 V
Max Ac Coupled Input (Dc Voltage)	±350 V Dc rejection, at least 4 x 10^5:1	
Dc Offset Range	+0.5 V to −0.5 V	+50 V to −50 V

Input R and C — 1 MΩ within 0.15%, approx 47 pF.

Overdrive Recovery — 10 μs or less to recover within 99.5% of reference level after removal of a test signal applied for 1 s. Signal amplitude not to exceed common-mode signal range.
Max Input Gate Current — 200 pA or less.
Displayed Noise — 20 μV at max bandwidth, source resistance 25 Ω or less, measured tangentially.
Drift with Temperature — 100 μV/°C or less.

5A26

Two Differential Amplifiers in One Plug-In
50 μV/div Sensitivity at 1 MHz
100,000: 1 Cmrr
Crt Readout

The 5A26 Dual Differential Amplifier combines two independent differential amplifiers in one plug-in. It adds no-compromise differential measurement capability to the line of low-cost, high-performance 5000-Series Laboratory Oscilloscopes. It may be used in any 5000-Series Mainframe.

The 5A26 provides 50 μV/div sensitivity at 1 MHz, high common-mode rejection ratio, *crt readout in any standard 5400-Series Mainframe,* trigger-source selection, and bandwidth limit on each channel. With two 5A26s, it is possible to observe up to four differential channels at one time in the chop or alternate mode.

The 5A26 has many applications in areas that require dual differential performance, especially in biomedical and electromechanical fields, education, and component manufacturing.

CHARACTERISTICS

Number of Differential Channels — Two.
Bandwidth — Dc coupled, dc to at least 1 MHz. Ac coupled, 2 Hz or less to at least 1 MHz. Bandwidth may be limited to 10 kHz.
Deflection Factor — 50 μV/div to 5 V/div in 16 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5 V/div.
Crt Readout — Crt readout of deflection factors. Functional in crt readout-equipped 5400-Series Oscilloscopes, nonfunctional in 5100-Series Oscilloscopes.
Input R and C — 1 MΩ within 0.15% paralleled by approx 47 pF.

Max Input Voltage

	Dc Coupled	Ac Coupled
50 μV/div to 50 mV/div	10 V (dc + peak ac)	350 V dc (coupling cap precharged), 10 V peak ac
100 mV/div to 5 V/div	350 V (dc + peak ac)	350 V (dc + peak ac)

Input Gate Current — 100 pA or less (equivalent to 100 μV or less, depending on external loading) at 25°C.

Display Noise — 30 μV or less, tangentially measured.

Common-Mode Rejection Ratio

Dc Coupled 50 μV/div to 50 mV/div	At least 100,000:1 from dc to 30 kHz with up to 20 V p-p sine wave
100 mV/div to 5 V/div	At least 300:1 from dc to 30 kHz with up to 100 V p-p sine wave
Ac Coupled 50 μV/div to 50 mV/div	At least 20,000:1 at 5 kHz to 30 kHz, decreasing to not less than 2000:1 at 60 Hz
With 2 P6062A Probes	400:1 at 10X probe attenuation

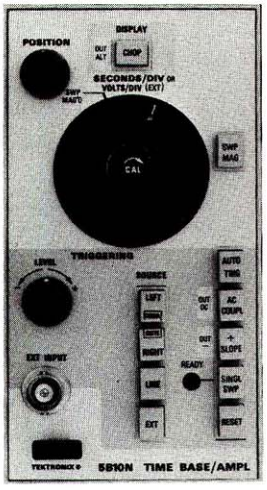
ORDERING INFORMATION

P6021 5-Ft Current Probe, Order 010-0237-02 . . . $130
P6021 9-Ft Current Probe, Order 010-0244-02 . . . $130
5A21N Differential Amplifier $310
5A22N Differential Amplifier $575
5A26 Dual Differential Amplifier $585

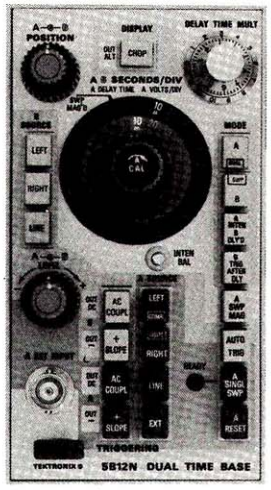
The 5A20N, 5A21N and 5A22N Differential Amplifiers are available with crt readout at additional cost (crt readout functional in 5400-Series mainframes only). Contact your local Tektronix Field Engineer for details.

For recommended probes — refer to page 90.

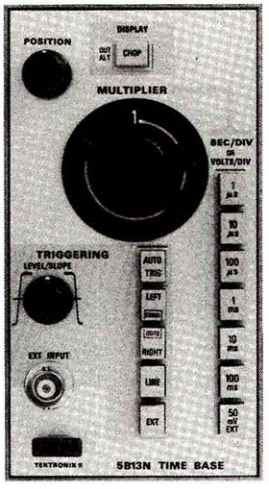
5B10N



5B12N



5B13N



5B10N

100 ns/div to 5 s/div Calibrated Time Base
Single Sweep
Direct Readout X10 Mag
Provides Alternate and Chopped Displays
50 mV/div and 500 mV/div External Input

The 5B10N is a time base/amplifier plug-in unit for generating a sweep in the 5000-Series Oscilloscopes. An external input allows use of the 5B10N as a voltage amplifier with calibrated deflection factors of 50 mV/div and 500 mV/div.

Triggering the 5B10N is straightforward even with the many triggering modes which are pushbutton selected. Source positions include left or right plug-in, composite (from the mainframe vertical amplifier), line, and external.

CHARACTERISTICS

Sweep Rates — 1 μs/div to 5 s/div in 21 calibrated steps (1-2-5 sequence). X10 magnifier extends displayed sweep time/div to 100 ns. Uncalibrated, continuously variable between steps and to 12.5 s/div.

Sweep Accuracy — Unmagnified, within 3% from 1 μs/div to 1 s/div, and within 4% at 2 s/div and 5 s/div. Magnified displays accurate within 1% in addition to specified time base sweep accuracy.

TRIGGERING

	Coupling	To 1 MHz	At 2 MHz
Dc	Internal	0.4 div	0.6 div
	External	200 mV	200 mV
Ac	Requirements increase below 50 Hz		

Auto Trig — Same as above except signal rate requirements are 15 Hz and above.

Single Sweep — Same as for ac and dc coupled.

External Trigger Input — Max input is 350 V (dc + peak ac). Input R and C is 1 MΩ within 2% paralleled by ≈70 pF. Trigger level voltage range is +5 V to −5 V.

EXTERNAL HORIZONTAL MODE

Deflection Factor — 50 mV/div and 500 mV/div, accurate within 3%. 10X variable extends range to at least 5 V/div.

Bandwidth — Dc coupled, dc to at least 1 MHz. Ac coupled, 50 Hz or less to at least 1 MHz.

Input R and C — 1 MΩ within 2%, approx 70 pF.

Max Input Voltage — 350 V (dc + peak ac).

ORDERING INFORMATION

5B10N Time Base/Amplifier **$275**
5B12N Dual Time Base **$575**
5B13N Time Base **$140**

5B12N

100 ns/div to 5 s/div Calibrated Time Base
Dual and Delayed Sweep
Direct Readout X10 Mag

The 5B12N is a time base for generating single, dual, or delayed sweeps in 5000-Series Oscilloscopes. The 5B12N is normally used in the right plug-in compartment but is compatible with the vertical deflection compartments as well.

The display modes are A sweep, B sweep, A intensified — B delayed and dual sweep. Each mode is selectable by pushbutton switches. Triggering sources for A and B sweep include left and right plug-in, line, and display composite. In the display composite mode the sweep is triggered from the composite signal being displayed. Auto and external trigger and single sweep are provided for the A sweep. The B sweep is triggerable after the delay time.

When operated in the dual-sweep mode in a dual-beam oscilloscope with two amplifier plug-ins, first the A sweep and then the B sweep displays the signals from both amplifiers; four traces will be displayed. Both sweeps are displayed simultaneously in chop mode.

When operated in the dual-sweep mode in a single-beam oscilloscope with two amplifier plug-ins, the A sweep is slaved to the left plug-in and the B sweep is slaved to the right plug-in.

The display mode pushbutton selects chop or alternate time-share switching between vertical plug-ins and amplifier channels. Chop rate is 25 kHz to 100 kHz depending on plug-in combinations and number of traces displayed.

CHARACTERISTICS

A Sweep Rates — 1 μs/div to 5 s/div in 21 calibrated steps (1-2-5 sequence). X10 magnifier extends displayed sweep time/div to 100 ns. Uncalibrated, continuously variable between steps and to 12.5 s/div.

A Sweep Accuracy — Unmagnified, within 3% from 1 μs/div to 1 s/div and within 4% at 2 s/div and 5 s/div. Magnified, displays accurate to within 1% in addition to specified time-base sweep accuracy.

B Sweep Rates — 0.2 μs/div to 0.5 s/div in 20 calibrated steps.

B Sweep Accuracy — Within 3% from 1 μs/div to 0.1 s/div. Within 4% at 0.2 μs/div, 0.5 μs/div, 0.2 s/div, and 0.5 s/div.

TRIGGERING

The following applies to the A and B trigger except as noted.

	Coupling	To 1 MHz	At 2 MHz
Dc	Internal	0.4 div	0.6 div
	External*	200 mV	200 mV
Ac	Requirements increase below 50 Hz		

*A Trigger only.

B sweep operates in triggered or free-run mode after delay time.

Auto Trig — Same as above on signal rates of 15 Hz and above.

The following characteristics apply to the A trigger only.

Single Sweep — Same as for ac and dc coupled.

External Trigger Input — Max input voltage is 350 V (dc + peak ac). Input R and C is 1 MΩ within 2% paralleled by approx 70 pF. Trigger level voltage range is +5 V to −5 V.

DELAYING SWEEP CHARACTERISTICS

Delay Time Accuracy — 1 μs/div to 0.5 s/div, within 1%. 1 s/div to 5 s/div, within 2%.

Delay Time Multiplier Range — 0.2 to 10.2 times the time/div setting.

Delay Time Multiplier Incremental Linearity — Within 0.2%.

Differential Time Measurement Accuracy — Within 1% plus 2 minor dial div for 1 μs to 0.5 s delay times. Within 2% plus 2 minor dial div for 1 s to 5 s delay times.

Jitter — Less than 0.05% of the time represented by one div of the delaying sweep selected.

EXTERNAL HORIZONTAL MODE

Deflection Factor — 50 mV/div and 500 mV/div accurate to within 3%. 10X variable extends range to at least 5 V/div.

Bandwidth — Dc coupled, dc to at least 1 MHz. Ac coupled, 50 Hz or less to at least 1 MHz.

Input R and C — 1 MΩ within 2%, approx 70 pF.

Max Input Voltage — 350 V (dc + peak ac).

5B13N

1 μs/div to 100 ms/div Calibrated Time Base
External Horizontal Input

The 5B13N is a low-cost, general-purpose time base for 5000-Series Oscilloscopes. The 5B13N suits applications such as basic laboratory use by students, production testing, scientific research, and others.

CHARACTERISTICS

Sweep Rates — 1 μs/div to 100 ms/div within 5% in 6 calibrated decade steps. A lighted multiplier control provides continuous, uncalibrated variation between steps and extends the pushbutton-selected rate to at least 1 s/div.

TRIGGERING

Coupling		Sensitivity and Frequency Range
Ac	Int	0.4 div from 50 Hz to 100 kHz, increasing to 1 div at 1 MHz
	Ext	200 mV from 50 Hz to 1 MHz

External Trigger Input — Max input voltage is 200 V (dc + peak ac). Input R and C is approx 100 kΩ paralleled by approx 1000 pF. Trigger-level voltage range is +1.5 V to −1.5 V.

EXTERNAL HORIZONTAL INPUT

Deflection Factor — 50 mV/div, accurate to within 5%. A continuously variable deflection factor multiplier provides variation between 50 mV/div and 0.5 V/div.

Bandwidth — Dc to at least 100 kHz.

Input R and C — Approx 50 kΩ paralleled by 1000 pF.

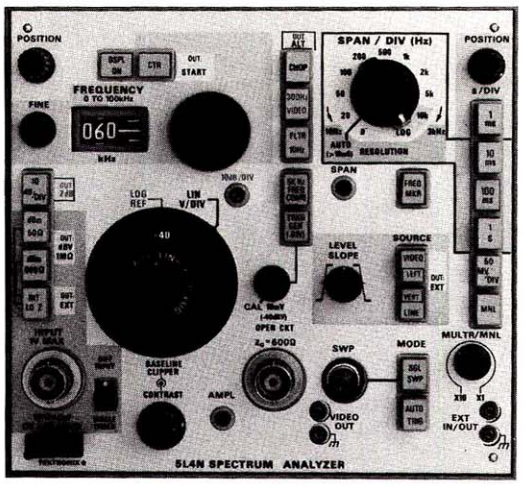
Max Input Voltage — 200 V (dc + peak ac).

5CT1N
5L4N
5S14N

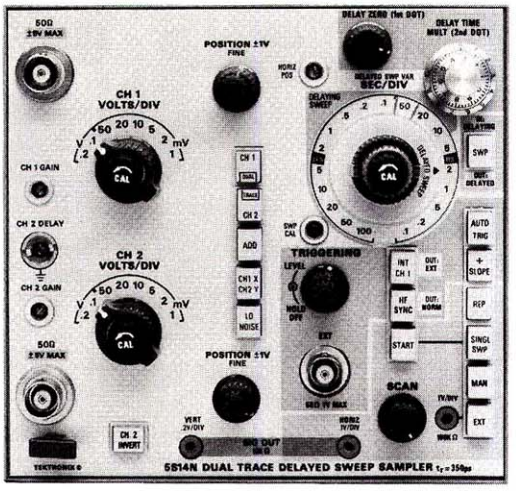
5000-Series Curve Tracer, Spectrum Analyzer, and Dual-Trace Sampler

5CTIN

5L4N



5S14N



5CTIN Curve Tracer

• Test Semiconductor Devices to 0.5 W • 10 nA/div to 20 mA/div Vertical Deflection Factors • 0.5 V/div to 20 V/div Horizontal Deflection Factors • For a complete description see page 214.

5L4N Spectrum Analyzer

• Low Cost • 0-100 KHz Frequency Range • Resolution Bandwidth 10 Hz to 3 kHz • Log and Linear-Span Modes • Auto Resolution • For a complete description see page 195.

5S14N Sampler

Dc-to-1 GHz Bandwidth
Dual Trace, 2 mV/div Sensitivity
Calibrated Delayed Sweep
Simplified Triggering
Operational Ease of Conventional Oscilloscope
Two-Dot Time Measurements

The 5S14N Sampling Unit combines amplifier and time-base functions in one double-width plug-in unit designed to operate in all 5000-Series Mainframes. Combining the sampling amplifier and time-base functions in one plug-in enables the 5S14N to provide new economy and ease of operation.

Two identical amplifier channels provide dual-trace sampling. A two-ramp time base introduces calibrated delayed sweep operation to sampling in an inexpensive package.

A unique feature is a system for making two-dot time-interval measurements. This feature provides an easy and accurate means for measuring the time between two points on a waveform. One bright dot on the trace is positioned with the Delay Zero control to the start of an event to be measured. Next a second bright dot is positioned by the Delay Time Multiplier Control to the end of the event. The time-interval between the selected points is then determined by multiplying the number read directly from the Delay Time Mult Dial by the selected time per division.

AMPLIFIER CHARACTERISTICS

Modes — Channel 1 only; Channel 2 only; Dual Trace; Channel 1 added to Channel 2; Channel 2 subtracted from Channel 1 (CH 2 INVERT); Channel 1 vertical (Y), Channel 2 horizontal (X).

Input Impedance — Nominally 50 Ω.

Bandwidth — Equivalent to dc to 1 GHz.

Rise Time — 350 ps or less.

Step Aberrations — +2%, −3%, total of 5% p-p within first 5 ns, ±1% thereafter, tested with 284 Pulse Generator.

Deflection Factor — 2 mV/div to 0.5 V/div in 8 calibrated steps (1-2-5 sequence). Variable between steps by at least 2.5 to 1.

Accuracy — Within ±3%.

Max Input Voltage — ±5 V.

Input Signal Range — 2 V p-p max within a +2 V to −2 V window at any sensitivity.

Dc Offset Range — At least +2 V to −2 V.

Displayed Noise — 2 mV or less unsmoothed (tangentially measured). Low noise pushbutton reduces random noise by factor of 4 to 1 or more.

Vertical Signal Output — 0.2 V/div of vertical deflection; 10-kΩ source resistance.

Channel Delay Difference — Adjustable to zero or for any time difference up to at least 1 ns.

TIME BASE CHARACTERISTICS

Scan Modes — Repetitive, Single, Manual, or External.

Delaying Sweep — May be used as crt time base or as a delay generator for the Delayed Sweep. The sweep starts with minimum delay from the instant of trigger recognition. When the Delaying Sweep mode is selected for the time base, two bright dots in the trace are generated which may be positioned anywhere on the displayed waveform. The time between dots is equal to the reading on the Delay Time Multiplier dial multiplied by the time/div.

Delayed Sweep — This mode is used when the signal to be displayed occurs considerably later than the instant of trigger recognition or when the time must be 5 ns or less per div. The Delayed Sweep may be started with zero delay time with respect to the start of the Delaying Sweep. Or the start may be delayed by any time interval up to that represented by ten div of the Delaying Sweep selected.

Horizontal Signal Output — 1.0 V per div of horizontal deflection; 10-kΩ source resistance.

DELAYING SWEEP CHARACTERISTICS

Range — 10 ns/div to 100 μs/div in 13 steps (1-2-5 sequence).

Accuracy — Within ±3% excluding first ½ div of displayed sweep.

Delay Zero (1st Dot) — Adjustable to correspond to any instant within the time interval represented by the first 9 div of the Delaying Sweep selected.

Delay Time (2nd Dot) — Adjustable to any portion of the time interval represented by ten div of the Delaying Sweep selected.

Delay Accuracy — Within ±1% of ten div when measurement is made within the last 9.5 div.

DELAYED SWEEP CHARACTERISTICS

Range — 100 ps/div to 100 μs/div in 19 calibrated steps (1-2-5 sequence). Variable between steps by at least 2.5 to 1.

Accuracy — Within ±3% excluding first ½ div of displayed sweep.

Start Delay — Depends on the Delaying Sweep time selected and the setting of the Delay Time Mult dial. Adjustable from Zero to any time interval up to that represented by 10 div of the Delaying Sweep selected. The Delaying Sweep start point corresponds to the second bright dot position.

Delay Jitter — Less than 0.05% of the time represented by 1 div of the Delaying Sweep selected.

TRIGGERING AND SYNC CHARACTERISTICS

Signal Source — Interval from channel 1 vertical input or external through front-panel connector.

External Triggering — Nominal 50 Ω input, ac coupled, 2 V p-p, 50 V dc max. Trigger pulse amplitude 10 mV p-p or more with rise time of 1 μs or less. 10 Hz to 100 MHz. Sine-wave amplitude 10 mV p-p or more from 150 kHz to 100 MHz.

Internal Triggering — Pulse amplitude 50 mV p-p or more with rise time of 1 μs or less. Sine-wave amplitude 50 mV p-p or more from 150 kHz to 100 MHz.

Triggered Mode — Trigger recognition may be made to occur at any selected voltage level between +0.5 V and −0.5 V at instants when either a + slope or a − slope of the triggering signal crosses that level.

Auto Triggered Mode — For small signals or when there may be no triggering signal. Sampling pulses are automatically generated at a low rate in the absence of a triggering signal so a trace may always be generated and displayed. The trigger level range automatically adjusts to approx the p-p voltage of the signal.

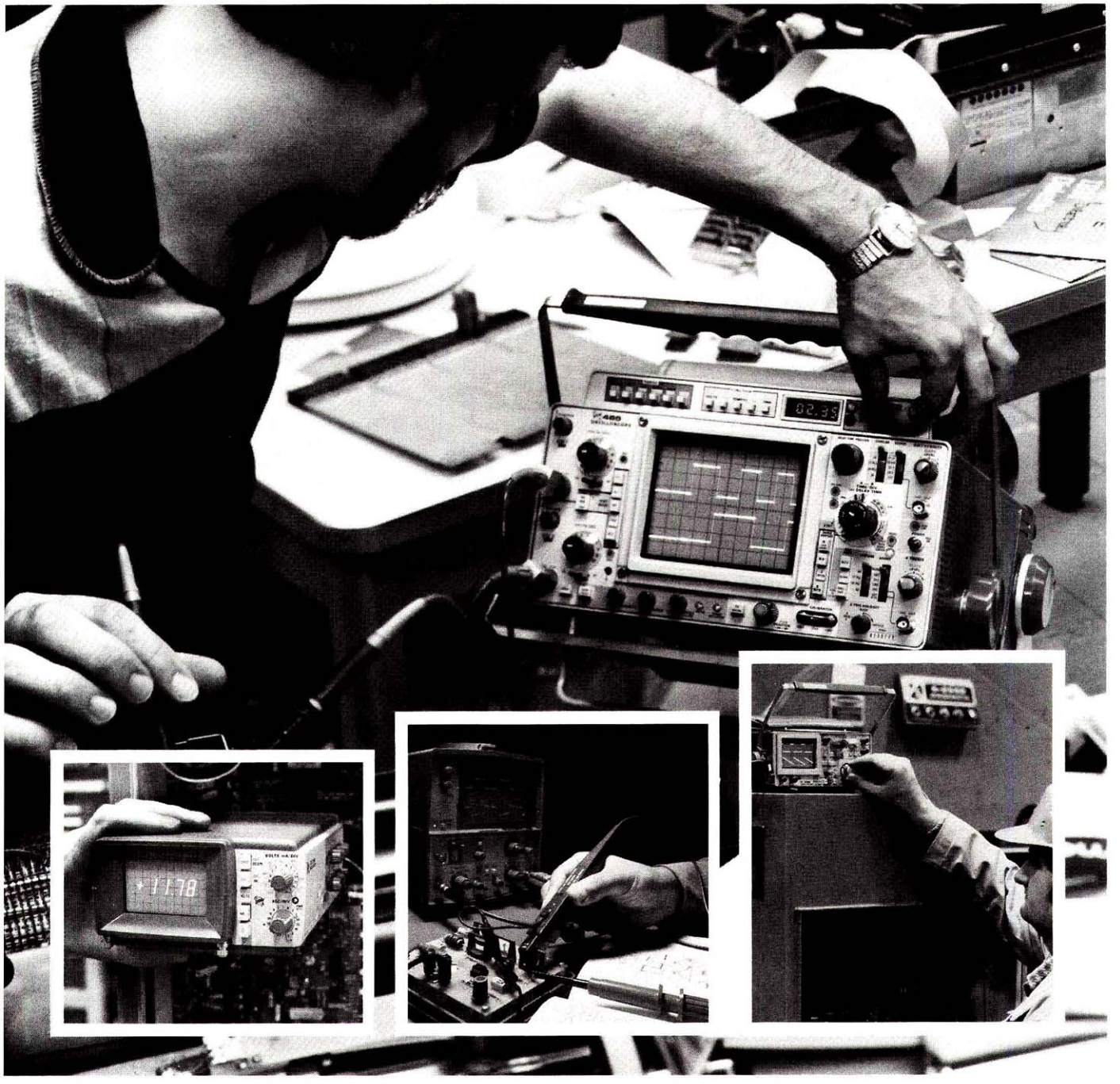
Holdoff — Varies the length of the time interval during which recognition is inhibited. Variation is at least 5 to 1. The control is particularly useful for displaying digital words when triggering on binary pulses.

HF SYNC Mode — For sine waves from 100 MHz to 1 GHz, 10 mV p-p or more from external source, 50 mV p-p or more from internal pickoff.

5S14N Sampler **$2275**

Portable Oscilloscopes

7



Portable Oscilloscopes From Tektronix...

Model Number	Page	Special Capabilities	
		DMM	Storage
485	108		
475A	110	W/Opt. DM 44	
475	110	W/Opt. DM 44	
466	114	W/Opt. DM 44	X
465	110	W/Opt. DM 44	
465M	113		
464	114	W/Opt. DM 44	X
455	112		
434	116		X
335	118		
326	120		
323	121		
314	122		X
221	123		
214	126		X
213	124	Built-in DMM	
212	126		
T912	131		X
T921	132		
T922	132		
T932	135		
T935	135		

Because electronic servicing requirements in the field, laboratory, and factory vary, selection of the appropriate test equipment, such as portable oscilloscopes, can be crucial. Your application can guide you in making the best decisions about performance, price, size, and weight. And other factors such as ease of operation and support from the manufacturer are also important. In this section you'll find the description and specifications for 22 TEKTRONIX Portables. (TEL-EQUIPMENT Portables are also described in this catalog, beginning on page 137). For cost effective solutions, compare their capabilities to your measurement needs.

You can carry these portables wherever you need to make a measurement. Each weighs less than 30 pounds and has a convenient handle. When you're in the field and there is no ac or dc power available, you can use either the internal battery power available on some models or portable battery packs.

If you need to make differential time measurements, the DM44 can be included on your choice of five 400-Series Portable Oscilloscopes (100 MHz to 250 MHz, two with storage). It can help you make these measurements faster, easier, and more accurately. With a built-in digital multimeter, the DM44 adds capabilities of dc voltage, and resistance measurements as well as temperature measurements to the scope.

You will find TEKTRONIX Portables used for aircraft avionics checkout, communication system maintenance and computer and peripheral servicing. They are even found in locations ranging from space research centers, drilling rigs, and reaching all the way down to submarines and coal mines.

Tektronix, the industry leader in portables, backs every instrument with experienced design engineers, complete documentation, trained sales engineers, and factory-trained service technicians . . . plus a reputation for product improvement and innovation.

In addition to a complete set of specifications, data sheets, and product literature, the TEKTRONIX Portables product line is supported by sales offices, distributors and representatives located strategically throughout the world. Sales offices are staffed with trained field engineers to help you solve any of your servicing needs with a portable, or any other TEKTRONIX Product.

Factory-trained technicians staff a world wide network of TEKTRONIX Service Centers, providing prompt and thorough service support. Emergency repairs, calibration, pick up/delivery, and reconditioning are examples of the support available from these service centers.

Accessories including cameras, probes, and carts complement the measurement capabilities of the TEKTRONIX Portable you choose.

Several cameras are available to record single events and document the results. One is best for your application and budget. They are designed specifically to match TEKTRONIX Oscilloscopes, from shutter speed to the hinges that support them.

Probes to extend measurement capabilities are included on some portable instruments and are available as options on all portables. A wide range is available, from standard voltage probes to special current and temperature probes.

A selection of SCOPE-MOBILE® CARTS can extend the portability of your oscilloscope. The Model 200C complements 400-Series units, while the Model 3 accommodates the 400-Series and several other TEKTRONIX Instruments.

Choose from the comprehensive line of TEKTRONIX Portables for the cost/performance combination that is best for your needs. Your selection begins with a high-performance, 350-MHz bandwidth model in the 400-Series to the low-cost T900-Series and handheld portables of the 200-Series product line.

High Performance — For measurements in the field which must be made to laboratory standards, the 400-Series features: wide bandwidth, to 350 MHz in one model, probe coding, light weight — all wrapped into a portable package. Backed by special IC technology and unique crt display technology, the TEKTRONIX 400-Series has set the performance standards for portable oscilloscopes.

Model	Page	BW	Maximum Sensitivity	Dual Trace	Delayed Sweep	Fastest Sweep Rate	Price
485	108	350 MHz	5 mV/div @ BW	Yes	Yes	1 ns/div	$4900
475A	110	250 MHz	5 mV/div @ BW	Yes	Yes	1 ns/div	$3300
475	110	200 MHz	2 mV/div @ BW	Yes	Yes	1 ns/div	$3000
465	110	100 MHz	5 mV/div @ BW	Yes	Yes	5 ns/div	$2145
465M	113	100 MHz	5 mV/div @ BW	Yes	Yes	5 ns/div	$2195
455	112	50 MHz	5 mV/div @ BW	Yes	Yes	5 ns/div	$1745

Storage Scopes — Because applications differ, Tektronix builds six storage portables with a variety of storage capabilities: fast transfer, variable persistence, and bistable. The fast transfer mode on the TEKTRONIX 466 makes it the fastest writing portable storage oscilloscope available—3000 div/μs.

A detailed discussion of storage techniques can be found in the Reference Section of this catalog.

Model	Page	BW	Max. Stored Writing Speed	Maximum Sensitivity	Dual Trace	Delayed Sweep	Fastest Sweep	Price
466	114	100 MHz	3000 div/μs (at reduced scan .45 cm/div)	5 mV/div @ BW	Yes	Yes	5 ns/div	$4600
464	114	100 MHz	110 div/μs (.9 cm/div)	5 mV/div @ BW	Yes	Yes	5 ns/div	$3950
434	116	25 MHz	400 div/ms* (.97 cm/div)	1 mV/div (10 mV/div @ BW)	Yes		20 ns/div	$3150
314	122	10 MHz	400 div/ms* (.6 cm/div)	1 mV/div @ BW	Yes		100 ns/div	$2385
214	126	500 MHz	500 div/ms* (.52 cm/div)	1 mV/div (10 mV/div @ BW)	Yes		1 μs/div	$1425
T912	131	10 MHz	250 div/ms* (1 cm/div) *Enhanced mode	2 mV/div @ BW	Yes		50 ns/div	$1300

300-Series — Unique performance/size/weight combinations are available in the SONY/TEKTRONIX 300-Series. All models weigh less than 11 pounds, yet you get bandwidth to 35 MHz plus ac, dc, or battery operation. Other capabilities include dual trace, delayed sweep, and long-term storage.

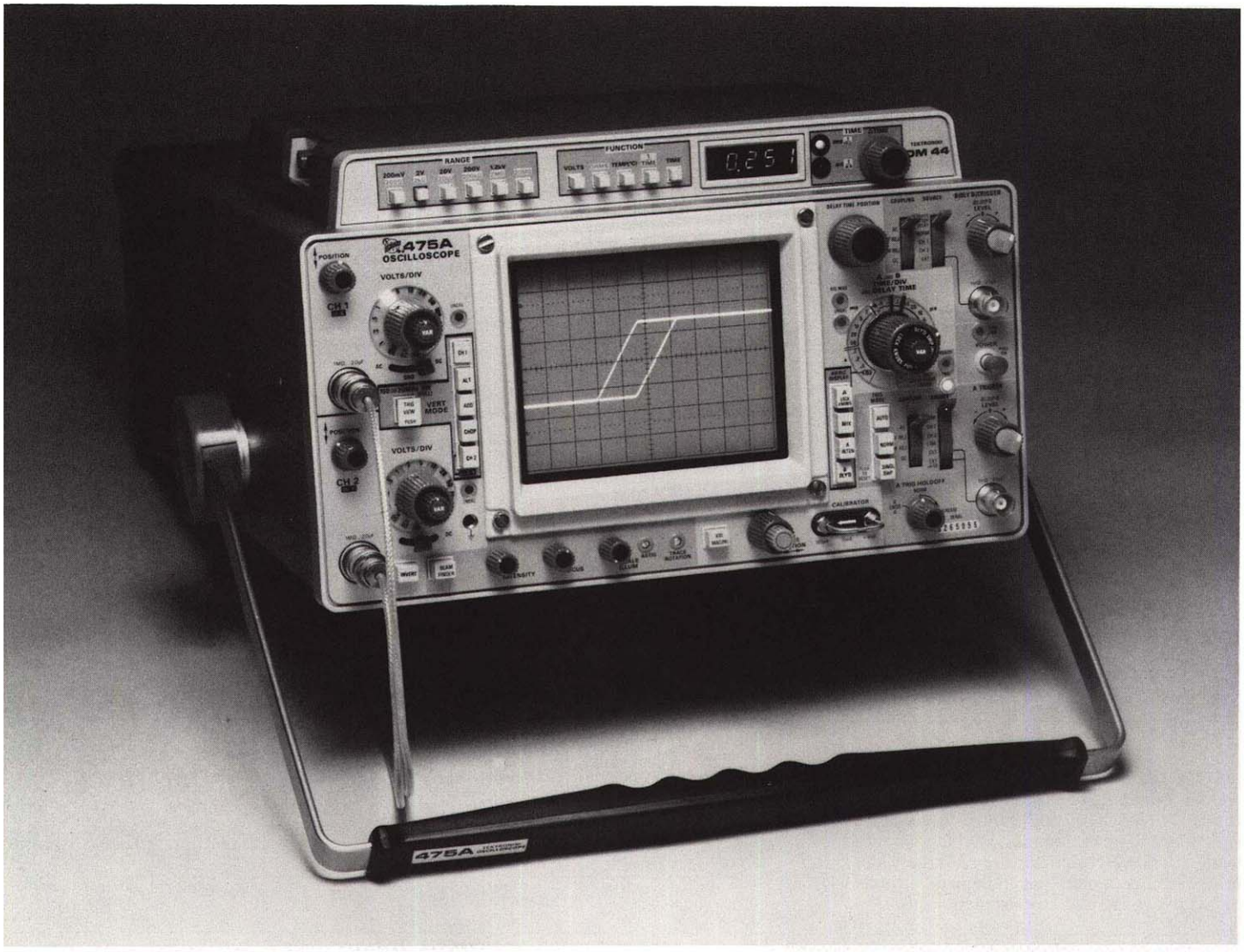
Model	Page	BW	Maximum Sensitivity	Dual Trace	Delayed Sweep	Fastest Sweep Rate	Other Special Features	Price
335	118	35 MHz	1 mV/div (10 mV/div @ BW)	Yes	Yes	20 ns/div		$1875
326	120	10 MHz	1 mV/div (10 mV/div @ BW)	Yes		100 ns/div	Internal Battery	$1975
323	121	4 MHz	1 mV/div (10 mV/div @ BW)			500 ns/div	Internal Battery	$1400

Miniscopes — The TEKTRONIX 200-Series Miniscopes are fully self-contained, double insulated, packaged in compact resistant plastic cases, and can be used to make "floating" measurements. All 200-Series Miniscopes can be battery operated. For added performance, one model contains a digital multimeter. The ultra small size and light weight of these miniscopes makes them ideal for almost any on-site service application that can arise.

Model	Page	BW	Maximum Sensitivity	Dual Trace	Fastest Sweep Rate	Other Special Features	Price
221	123	5 MHz	5 mV/div @ BW		100 ns/div	Internal Battery	$975
213	124	1 MHz	5 mV/div (20 mV/div @ BW)		400 ns/div	DMM/ Oscilloscope & Internal Battery	$1425
212	126	500 kHz	1 mV/div (10 mV/div @ BW)	Yes	1 μs/div	Internal Battery	$1000

Low Cost — For basic oscilloscope performance — plus light weight for portability — a low cost T900-Series Oscilloscope is an excellent choice. These portables are designed to be easy-to-operate as well as easy-to-calibrate and service. Though low cost of ownership has been stressed in designing and manufacturing the T900-Series Oscilloscopes, they represent outstanding performance values. Features include: bandwidth to 35 MHz, built-in delay line, automatic trigger mode and specially designed T900 Accessories.

Model	Page	BW	Maximum Sensitivity	Dual Trace	Delayed Sweep	Fastest Sweep Rate	Price
T935	135	35 MHz	2 mV/div @ BW	Yes	Yes	10 ns/div	$1395
T932	135	35 MHz	2 mV/div @ BW	Yes		10 ns/div	$1195
T922	132	15 MHz	2 mV/div @ BW	Yes		20 ns/div	$850
T921	132	15 MHz	2 mV/div @ BW			20 ns/div	$695



Available with Five TEKTRONIX Portables

The DM 44's **built-in digital multimeter** adds dc voltage measurements with 0.1% accuracy, resistance measurements with 0.3% accuracy, and temperature measurements from —55°C to 150°C . . . to any of five TEKTRONIX Oscilloscopes.

Since the **DMM inputs are independent of the oscilloscope,** waveforms can be observed while simultaneously monitoring related dc voltage or component temperatures.

With Delta Delayed Sweep, direct numerical readout and DMM capabilities, the DM 44 speeds differential time measurements. At the same time, **measurement repeatability is improved,** the chance for computational errors is reduced, and **1% accuracy is consistently achieved.**

Delta Delayed Sweep is a second delayed sweep (Δ Time control) which can be independently positioned on the oscilloscope screen over a range of ±10 divisions with respect to the main sweep.

Faster delay measurements can be made by using the Delay Time Control and Δ Time dial to position intensified spots at the beginning and end of the time interval.

Then, by switching to delayed sweep mode and using Δ Time dial to superimpose the end of the interval on the beginning, the **desired time interval is immediately read out with 1% accuracy.**

Frequency of periodic waveforms is read out with 2% accuracy by measuring one period and pushing the 1/Time button.

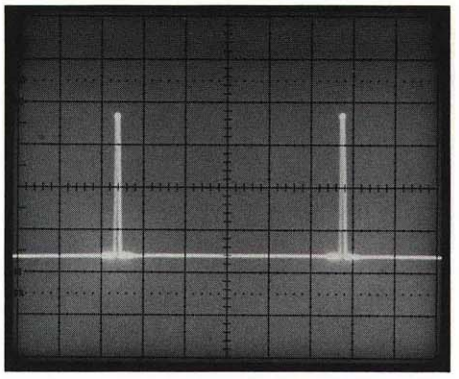
Numerical readout of time intervals is derived directly from the oscilloscope's sweep circuitry. The 3½ digit LED display provides resolution needed for timing measurement accuracy to 1%.

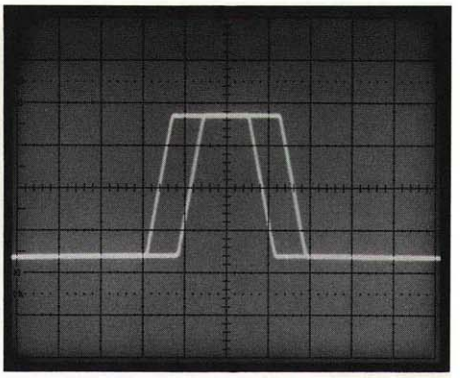
Conventional procedures for timing measurements require approximately four times the number of steps, versus the DM 44 procedure. But more important, if you allow for conventional time-consuming vernier readings and possible calculation errors, the DM 44 can do the same job in perhaps **one-tenth** the time.

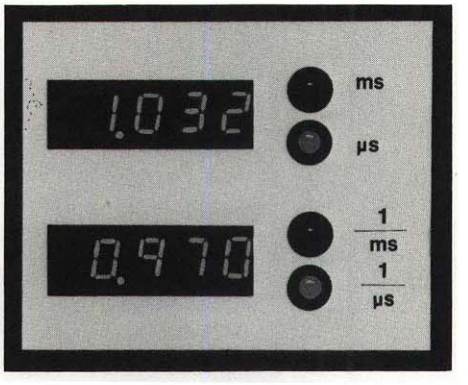
The DM 44 is offered as a factory-installed option. And because you can add it to any of the five portables, you can match bandwidth, sensitivity, storage, and price requirements to your needs.

Consider the DM 44 an integral part of your next oscilloscope. By ordering the TEKTRONIX 465 DM 44, you get 100 MHz bandwidth at 5 mV/div sensitivity plus the DM 44 capabilities. The DM 44 can be installed on the TEKTRONIX 475 which provides 200 MHz at 2 mV/div sensitivity and the new 475A with 250 MHz at 5 mV/div.

Two TEKTRONIX Portables accommodating the DM 44 offer storage. The medium-speed storage 464 can be equipped with the DM 44. And the extremely fast-storage 466, with high stored writing speed, 3000 div/μs is available with the DM 44.







DM 44 Procedure

In intensified mode, use Delay Time Position and Δ Time dials to position intensified spots to beginning and end of interval.

Switch to delayed sweep mode, and use Δ Time dial to superimpose end of interval on beginning.

RESULT: Desired time interval *read out* with 1% accuracy. For frequency readout (for one period of a periodic waveform) simply push 1/Time button.

DM 44 CHARACTERISTICS

Timing Measurements

Differential Time Delay Accuracy —

+15°C to +35°C	−15°C to +55°C	
used with 464, 465, 466, 475, and 475A	used with 464, 465, and 466	used with 475 and 475A
within 1% of reading ±1 count	within 2.5% of reading ±1 count	within 1.5% of reading ±1 count

1/Time Accuracy —

+15°C to +35°C	−15°C to +55°C	
used with 464, 465, 466, 475, and 475A	used with 464, 465, and 466	used with 475 and 475A
within 2% of reading ±1 count	within 3.5% of reading ±1 count	within 3% of reading ±1 count

Dc Voltage

Ranges — 0-200 mV, 0-2 V, 0-20 V, 0-200 V, 0-1.2 kV.

Resolution — 100 µV.

Accuracy — Within 0.1% of reading ±1 count.

Input Resistance — 10 MΩ for all ranges. Removal of an internal strap increases resistance to approximately 1000 MΩ on 200 mV and 2 V ranges.

Normal Mode Rejection Ratio — At least 60 dB at 50 Hz and 60 Hz.

Common Mode Rejection Ratio — At least 100 dB at dc, 80 dB at 50 Hz and 60 Hz.

Recycle Rate — Approximately 3.3 measurements/s.

Response Time — Within 0.5 s.

Maximum Safe Input Voltage — ±1200 V dc + peak ac between + and common inputs or between + and chassis. ±500 V (dc + peak ac) common floating voltage between common and chassis.

Resistance

Ranges — 0-200 Ω, 0-2 kΩ, 0-20 kΩ, 0-200 kΩ, 0-2 MΩ and 0-20 MΩ.

Resolution — 0.1 Ω.

Accuracy —

Range	Accuracy
200 Ω	within 0.25% ±1 count + probe resistance
2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ	within 0.25% ±1 count
20 MΩ	within 0.3% ±1 count

Recycle Rate — Approximately 3.3 measurements/s.

Response Time —

200 Ω through 200 kΩ ranges	within 1 s
2 MΩ ranges 20 MΩ ranges	within 5 s

Maximum Safe Input Voltage — 120 V rms between + and common inputs.

Temperature Using P6430 Probe

Range — −55°C to +150°C

Accuracy —

DM 44 Temp	P6430 Tip Temp	Accuracy: probe calibrated to DM 44	Accuracy: probe not calibrated to DM 44
+15°C to +35°C	−55°C to +150°C	±2°C	±6°C
−15°C to +55°C	−55°C to +125°C	±3°C	±8°C
	+125°C to +150°C	±4°C	±8°C

ORDERING INFORMATION

465 DM 44 ..... **$2555**

475 DM 44 ..... **$3410**

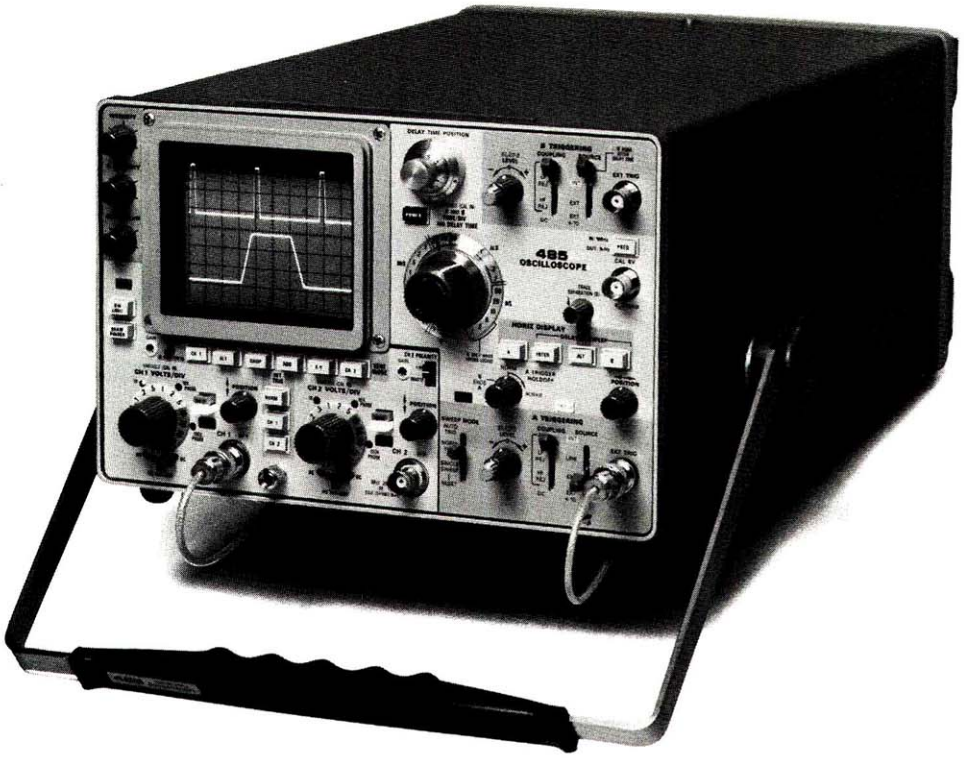
475A DM 44 (Order 475A Option 44) .. **$3710**

466 DM 44 ..... **$5010**

464 DM 44 ..... **$4360**

Option 01, delete temperature probe (for 475A order Option 45) ..... **Subtract $85**

485 | 350-MHz Lightweight Dual-Trace Portable Oscilloscope



350 MHz at 5 mV/div

1 ns/div Sweep Rate

3.0 div/ns Writing Speed

1 MΩ and 50 Ω Input Impedances

Input Protection 50 Ω Internal

Automatic Deflection Factor Readout

Pushbutton Ext Trigger View

Weighs Only 21 Lb

At just 21 pounds, the 1 ns/div dual-trace 485 is the lightest weight 350-MHz portable oscilloscope on the market. This wide bandwidth is one reason why the 485 is highly compatible with today's increasing technology.

Many features contribute to the 485's extraordinary overall performance. Fast **3.0 div/ns writing speed** is one, making it especially attractive for use in field research environments.

The 485 vertical system provides wide bandwidth at full sensitivity with selectable input impedances. At 5 mV/div sensitivity (350 MHz at 50 Ω and 250 MHz at 1 MΩ), the 485 offers more gain bandwidth than any other portable oscilloscope. **Selectable input impedance** provides the capability to measure low and high impedance points with the same scope and without active probes.

Internal detection circuitry protects the 50 Ω input by automatically disconnecting when the signal exceeds 5 V rms.

You no longer have to mentally compensate for attenuating probes. **Automatic vertical scale-factor readout** is provided by three light-emitting diodes located around the edge of each input attenuator knob. A quick glance at the readout tells the operator the correct on-screen V/div when the recommended 10X or 100X probes are used.

And you always know exactly where you are in a pulse train when making a delayed sweep measurement. An **alternate sweep mode** allows the delayed sweep to appear alternately with the intensified main sweep. In this mode, you can view the intensified zone and the delayed display simultaneously.

The **external trigger signal** can be easily viewed on the 485. A front-panel pushbutton automatically routes the external signal used to trigger Time Base A to the vertical deflection amplifier. This feature can also be used to quickly make time comparisons between the signal of interest and the external trigger signal.

On the 485, focus is always correct in single-shot photography. An **autofocus** circuit eliminates the need to readjust the focus each time the intensity is changed.

When commercial power is not available, use the **1105 Battery Power Supply.** It weighs only 19.5 pounds, and lets you take the high-performance 485 virtually anywhere.

Often chosen as a general-purpose scope for computer and electronic servicing environments because of its fast writing speed and wide bandwidth, the 485 can also be found in specialized and unusual applications. For example, to maintain a ground-based laser/radar acquisition system, the 485's alternate sweep switching mode proved an important factor.

VERTICAL DEFLECTION
(2 Identical Channels)

Bandwidth* and Rise Time — (at all deflection factors from 50 Ω terminated source).

	−15°C to +35°C	+35°C to +55°C
50 Ω	Dc to 350 MHz, 1 ns	Dc to 300 MHz, 1.2 ns
1 MΩ	Dc to 250 MHz, 1.4 ns	Dc to 200 MHz, 1.8 ns

*Measured at −3 dB. Bandwidth may be limited to approx 20 MHz by bandwidth limit switch.

Lower −3 dB point, ac coupling 1X probe: 1 kHz or less for 50 Ω, and 10 Hz or less for 1 MΩ. 10X probe: 100 Hz or less for 50 Ω, and 1 Hz or less for 1 MΩ.

Deflection Factor — 5 mV/div to 5 V/div (1-2-5 sequence), accurate ±2%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div. Gain can be recalibrated at the front panel.

Display Modes — Ch 1, Ch 2 (normal and inverted), X-Y (Ch 1-Y and Ch 2-X).

CMRR — Common mode rejection ratio at least 20 dB at 50 MHz for common mode signals of 6 div or less.

Automatic Scale Factor — Probe tip deflection factors for 1X, 10X, and 100X coded probes are automatically indicated by three readout lights at the edge of the knob skirts. All lights are off when the channel is not selected for display or when the trace identification control on the probe is depressed.

Selectable Input Impedance — 50 Ω and 1 MΩ impedances are available at a single BNC connector by pushbutton selection.

50 Ω ±0.5%; vswr 1.25:1 or less at 5 mV/div to 10 mV/div, 1.15:1 or less from 20 mV/div to 5 V/div to 350 MHz.

Input R and C — 1 MΩ ±1% paralleled by approx 20 pF.

50 Ω Protection — Internal detection circuitry provides protection by automatically disconnecting excessive signals of up to 50 V. The "disconnected" condition is indicated, and has manual reset.

Max Input Voltage

50 Ω	Protection disconnect occurs for voltages that exceed approx: 5 V rms continuous 0.1 watt-second for instantaneous voltages of 5 V to 50 V.	
	Ac Coupled	250 V (dc + peak ac), 500 V p-p to 1 kHz.
1 MΩ	Dc Coupled	250 V (dc + peak ac), 500 V p-p to 1 kHz.
	Ac Coupled	500 V (dc + peak ac). 500 V p-p to 1 kHz.

Selectable Input Coupling — Ac; dc; GND (provides zero reference, precharges coupling capacitor, disconnects 50 Ω load in 50 Ω mode).

Delay Line — Permits viewing leading edge of displayed waveform.

Probe Power — Connectors provide correct voltages for two optional P6201 FET probes.

HORIZONTAL DEFLECTION

Time Base A and B — Calibrated sweep range; 1 ns/div to 0.5 s/div (1-2-5 sequence).

Variable Time Control — Time Base A provides continuously variable uncalibrated sweep rates between steps and to at least 1.25 s/div.

Time Base A and B Accuracy, center 8 div

Sweep Rate	+15°C to +35°C	−15°C to +55°C
1 ns/div to 20 ns/div	±3%	±5%
50 ns/div to 0.1 s/div	±2%	±4%
0.2 s/div and 0.5 s/div	±3%	±5%

Horizontal Display Modes — A, intensified, alternate, and B (delayed sweep). A only is displayed for A sweep rates of 1, 2, and 5 ns/div. B ends A for increased intensity in the delayed mode.

Alternate Display Modes — Allows the B delayed sweep to appear alternately with the intensified A sweep. Trace separation control positions B (delayed sweep approx 4 div from the A sweep).

CALIBRATED SWEEP DELAY

Delay Time Range — 0 to X10 delay time/div setting of 10 ns/div to 0.5 s/div.

Differential Delay Time Measurement Accuracy

Delay Time Setting	+15°C to +35°C
10 ns/div and 20 ns/div	± (1% of measurement +0.2% of full scale)
50 ns/div to 1 ms/div	± (0.5% of measurement +0.1% of full scale)
2 ms/div to 0.5 s/div	± (1% of measurement +0.1% of full scale)

Full scale is 10 times the delay time/div setting.

Jitter — 1 part or less in 20,000 of 10X the time/div setting.

TRIGGERING A and B

A Trigger Modes — Normal (sweep runs when triggered). Automatic (sweep free-runs in the absence of a triggering signal and for signals below 20 Hz). Single sweep (sweep runs one time on the first triggering event after the reset selector is pressed). Lights indicate when sweep is triggered and when single sweep is ready.

A Trigger Holdoff — Adjustable control permits a stable presentation of repetitive complex waveforms. The control covers at least the time of one full sweep for faster than 0.2 s/div.

B Trigger Modes — B runs after delay time (starts automatically at the end of the delay time) and B triggerable after delay time (runs when triggered). The B (delayed) sweep runs once, in each of these modes, following the A sweep delay time.

Time Base A and B Trigger Sensitivity

Coupling		To 50 MHz	To 350 MHz
Dc	Internal	0.3 div deflection	1.5 div deflection
	External	20 mV	100 mV
Ac		Signals below 16 Hz are attenuated	
Ac	Lf Reject	Signals below 16 kHz are attenuated	
Ac	Hf Reject	Signals below 16 Hz and above 50 kHz are attenuated	

Jitter — 0.1 ns or less at 350 MHz at 1 ns/div.

A Trigger View — A spring-loaded pushbutton overrides other vertical controls and displays the external signal used for A sweep triggering. This provides quick verification of the external signal and time comparison between a vertical signal and the external trigger signal. The deflection factor is approx 50 mV/div (0.5 V/div with external ÷ 10 source).

Level and Slope — Internal, permits selection of triggering at any point on the positive or negative slope of the displayed waveform. External, level is adjustable through at least ±0.5 V for either polarity; ±5 V for Ext ÷ 10.

A Sources — Internal, line, external, external ÷ 10.

B Sources — B runs after delay time, internal, external, external ÷ 10.

External Inputs — R and C approx 1 MΩ paralleled by approx 20 pF. Max input voltage; 500 V (dc + peak ac), 500 V p-p to 1 kHz.

X-Y OPERATION

Full Sensitivity X-Y (Ch 1 Vert, Ch 2 Horiz) — 5 mV/div to 5 V/div, accurate ±2%. Y-axis bandwidth identical Channel 1. X-axis bandwidth is dc to at least 4 MHz (−3 dB). Phase difference between amplifiers is 3° or less to 4 MHz.

DISPLAY

Crt — 8 x 10 div display, each div is 0.8 cm. Horizontal and vertical centerlines further marked in 0.2 div increments. P31 phosphor standard; P11 optional without extra charge. 21 kV accelerating potential.

Photographic Writing Speed — At least 1.5 div/ns with standard P31 phosphor and at least 3 div/ns with optional P11 phosphor using the TEKTRONIX C-31R Camera and 3000 speed film.

Auto Focus — Automatically maintains beam focus for all intensity settings.

Graticule — Internal, nonparallax; variable edge lighting; markings for measurement of rise time.

Beam Finder — Compresses trace to within graticule area for ease in determining the location of an off-screen signal.

Z-Axis Input — Rise time ≃15 ns. Input R ≃500 Ω. +0.2 V (dc to 20 MHz) decreases intensity. + 2 V (dc to 2 MHz) blanks max intensity trace.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Nonoperating: −35°C to +75°C. Filtered forced air ventilation is provided.

Altitude — Operating: to 15,000 ft; max allowable ambient temperature decreased by 1°C/1000 ft from 5000 to 15,000 ft. Nonoperating to 50,000 ft.

Vibration — Operating: 15 minutes along each of the three axes. .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Operating and nonoperating: 5 cycles (120 hours) to 95% relative humidity referenced to MIL-E-16400F (par 4.5.9 through 4.5.9.5.1, class 4).

Shock — Operating and nonoperating: 30 g's, ½ sine, 11-ms duration, 2 shocks per axis in each direction for a total of 12 shocks.

OTHER CHARACTERISTICS

Two-Frequency, Fast-Rise Calibrator — Output resistance is 450 Ω with a rise time (positive slope) into 50 Ω of 1 ns or less. 1 kHz, duty cycle 49.8% to 50.2%. Amplitude is 5 V ±0.5% into 1 MΩ and 0.5 V ±1% into 50 Ω (±0.5%). Optional BNC accessory current loop provides 50 mA ±1%. Selectable repetition rates are 1 kHz and 1 MHz ±0.25%. Specifications apply over +15°C to +35°C range.

A Sweep Output — Open circuit, approx 10 V positive-going sawtooth; into 50 Ω, approx 0.5 V.

A and B Gate Outputs — Open circuit, approx 4 V positive-going rectangular pulse; into 50 Ω approx 0.5 V.

Power Requirements — Recessed slide switch selects nominal operating line range. Line voltage range is 90 V to 136 V and 180 V to 272 V. 60 W max power consumption at 115 V. Line frequency 48 to 440 Hz.

	Cabinet		Rackmount	
Dimensions	**in**	**cm**	**in**	**cm**
Height	6.6	16.8	7.0	17.7
Width	12.0	30.5	19.0	48.3
Depth			18.0	45.7
(handle extended)	20.6	52.3		
(handle not extended)	18.5	47.0		
Weights (Approx)	**lb**	**kg**	**lb**	**kg**
Net (with accessories)	24	10.9		
Net (without accessories)	21	9.5	26.2	11.9
Shipping	33	15	54	24.5

INCLUDED ACCESSORIES

50-Ω, 18-inch BNC cable (012-0076-00), two BNC jack posts (012-0092-00), two 50-Ω terminators (011-0049-01), clear filter (386-0118-00), four 3-amp fuses (159-0015-00), accessory pouch (016-0535-00) or (016-0537-00). Rack models also include mounting hardware and slide out assemblies.

ORDERING INFORMATION

485 Oscilloscope **$4900**

R485 Oscilloscope, 7 in rack model ... **$5025**

485-1 or R485-1 Oscilloscope, without A Ext Trig Display ..... **Sub $100**

485-2 or R485-2 Oscilloscope, without A Ext Trigger Display and with 50 Ω input only instead of selectable input impedance ..... **Sub $350**

INSTRUMENT OPTIONS

Option 04 **Emc Modification** ..... **Add $40**

Option 78 **P11 Phosphor** ..... **No Charge**

OPTIONAL ACCESSORIES

Probes —

Input Terminal	Probe Type	Attenuation	Input Impedance	Bandwidth* with 485
50 Ω Input	P6056 6 ft	10X	500 Ω 1 pF	350 MHz
	P6057 6 ft	100X	5000 Ω 1 pF	350 MHz
	P6201 FET 2 Meter	1X	100 kΩ 3 pF	330 MHz
		10X Head	1 MΩ 1.5 pF	
		100X Head	1 MΩ 1.5 pF	
50 Ω or 1 MΩ	P6202 2 Meter	10X 10X Head (optional)	10 MΩ 2 pF	285 MHz
	P6106 2 Meter	10X	10 MΩ 13 pF	250 MHz
1 MΩ Input	P6063B 6 ft	1X Switchable 10X	1 MΩ 12 pF	6 MHz
			10 MΩ 14 pF	200 MHz
Current Probe	**Probe Type**	**Calibration**	**Insertion Impedance**	**Bandwidth* with 485**
	P6022	1 mA/mV 10 mA/mV (Selectable)	.03 Ω @ 1 MHz Increasing to .2 Ω @ 120 MHz	130 MHz

*Bandwidths are measured at the upper −3 dB, and apply only to the cable length shown. Generally, shorter cable lengths increase bandwidth, longer ones decrease bandwidth.

Current Loop Adapter — The adapter provides an accurate 50 mA square-wave calibrator when connected to the 485 voltage calibrator. The rise time is approx 25 ns.

Order 012-0341-00 ..... **$26**

50 Ω 5X Pad — Provides reverse termination for the calibrator.

Order 011-0060-02 ..... **$28**

Folding Viewing Hoods — Folds to 7/16 x 4½ x 7½ in.

Order 016-0274-00 ..... **$10**

Folds to 9/16 x 6¾ x 13¾ in.

Order 016-0082-00 ..... **$14.75**

SCOPE-MOBILE® Cart — Occupies less than 18 inches aisle space, has storage area in base.

Order 200C **$160**

1105 Battery Power Supply — Provides 2.3 hours of battery operation.

Order 1105 Battery Power Supply **$795**

RECOMMENDED CAMERAS

C-30AP General Purpose Camera — Includes 016-0306-00 mounting adapter.

Order C-30AP **$690**

C-31R High Speed Camera — Includes 016-0306-00 mounting adapter.

Order C-31R **$870**

For further information see camera section.

475A
475
465

250-MHz, 200-MHz, and 100-MHz Dual-Trace Portable Oscilloscopes

Except for the TIME/DIV and VOLTS/DIV controls, the 465 pictured above is identical in appearance to the 475 and 475A.

1 ns/div Sweep Rate (475) (475A)

5 ns/div Sweep Rate (465)

8 x 10 cm Calibrated Display

Trigger View

Automatic V/div Readout

Versatile Trigger Selection

Battery Operation

All three of these TEKTRONIX Portables feature **high performance and light weight** for making complex measurements in the field.

1) The **475A** is a new portable with 250 MHz at 5 mV/div. It features wider bandwidth than the 475, plus a more concise spot size and trace for particular applications.

2) With 200 MHz at 2 mV/div, the **475** features better sensitivity than the 475A. This bandwidth/sensitivity combination is useful in a wide variety of measurements.

3) The **465,** long considered the industry standard, features 100 MHz at 5 mV/div.

Both the 475 and 475A offer **1% (1 ns/div) timing accuracy,** which can be critical in servicing computers. The 465 can be found in numerous service applications, and has proved to be one of the most popular oscilloscopes available.

All three oscilloscopes are light, compact, and rugged for portability and durability, yet each contains a big, bright 8 x 10 cm crt. Operation has been simplified by single-function pushbuttons, control knob design, layout, and color-coordinated front panels.

Determining deflection factors used to be error-prone and costly. Now, it's a problem of the past... readout lights behind knob skirts automatically indicate the proper probe tip deflection factors for recommended 1X and 10X probes.

Measuring with respect to ground is important in many applications. This is controlled at the probe when dc-coupled by simply pressing the small ground reference button on recommended probes.

You can choose from **two types of battery packs.** Both are small and light weight, and provide a ready solution for making accurate measurements in difficult environments such as conducted emc, ground loops, power line fluctuations, or where line power is nonexistent.

Applications for these three instruments are widespread. The 475 performs tests and measurements aboard flight test aircraft, in both stationary and portable modes. The 465 troubleshoots radio/remote-controlled cranes. The 465 is also used to maintain mini-computers for one of the nation's largest department store chains. And a leading computer hardware manufacturer uses the 465 because of its wide bandwidth.

CHARACTERISTICS

All characteristics are common to the 465, 475 and 475A except where indicated.

VERTICAL DEFLECTION

(2 Identical Channels)

Bandwidth* and Rise Time — (at all deflection factors from 50 Ω terminated source)

	−15°C to +40°C	+40°C to +55°C
465	Dc to 100 MHz, 3.5 ns	85 MHz, 4.1 ns
475	Dc to 200 MHz, 1.8 ns	175 MHz, 2.0 ns
475A	Dc to 250 MHz, 1.4 ns	250 MHz, 1.4 ns

*Measured at −3 dB, Bandwidth may be limited to approx 20 MHz by bandwidth limit switch.

Lower −3 dB point, ac coupling 1X probe: 10 Hz or less. 10X probe: 1 Hz or less.

Deflection Factor at BW
465 — 5 mV/div to 5 V/div
475 — 2 mV/div to 5 V/div
475A — 5 mV/div to 10 V/div

1-2-5 sequence, accurate ±3%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div (465/475) to at least 25 V/div (475A). In cascade mode sensitivity is approx 1 mV/div (465); approx 400 μV/div (475); and approx 2.5 mV/div (475A). Cascaded bandwidth is at least 50 MHz (465/475/475A) when signal out is terminated in 50 Ω.

Display Modes — Ch 1; Ch 2 (normal and inverted), alternate, chopped (465 — approx 250 kHz rate, 475/475A — approx 1 MHz rate), added; X-Y (selected by time/div, Ch 1-X, Ch 2-Y)

CMRR — Common-mode rejection ratio at least 20 dB at 20 MHz (50 MHz for 475/475A) for common mode signals of 6 div or less.

Automatic Scale Factor — Probe tip deflection factors for 1X or 10X coded probes are automatically indicated by two readout lights behind the knob skirts. All lights are off when the channel is not displayed. Ground reference display selectable at probe (when dc coupled).

Input R and C — 1 MΩ ±2% paralleled by approx 20 pF.

Max Input Voltage

Dc Coupled	250 V (dc + peak ac) 500 V (p-p ac at 1 kHz or less)
Ac Coupled	500 V (dc + peak ac) 500 V (p-p ac at 1 kHz or less)

Delay Line — Permits viewing leading edge of displayed waveform.

Probe Power (475/475A only) — Connectors provide correct voltages for two optional P6201 FET Probes.

HORIZONTAL DEFLECTION

465

Time Base A — 0.05 μs/div to 0.5 s/div (1-2-5 sequence). X10 mag extends max sweep rate to 5 ns/div.

Time Base B — 0.05 μs/div to 50 ms/div (1-2-5 sequence). X10 mag extends max sweep rate to 5 ns/div.

475/475A

Time Base A and B — 0.01 μs/div to 0.5 s/div (1-2-5 sequence). X10 mag extends max sweep rate to 1 ns/div.

Variable Time Control — Time Base A (465/475/475A) provides continuously variable uncalibrated sweep rates between steps and to at least 1.25 s/div. Warning lights indicates uncalibrated setting.

Time Base A and B Accuracy, full 10 cm

	+20°C to +30°C		−15°C to +55°C	
	465	475/475A	465	475/475A
Unmagnified	±2%	±1%	±3%	±2%
Magnified	±3%	±2%	±4%	±3%

Horizontal Display Modes — A, mixed sweep, A intensified, B delayed. B ends A for increased intensity in the delayed mode.

Calibrated Mixed Sweep — Displays A sweep for period determined by delay-time position control, then displays B sweep for remainder of horizontal sweep.

CALIBRATED SWEEP DELAY

Delay Time Range

465 — 0.2 to X10 delay time/div settings of 200/ns to 0.5 s (minimum delay time is 200 ns).

475/475A — 0 to X10 delay time/div settings of 50 ns to 0.5 s (minimum delay time is 50 ns).

Differential Time Measurement Accuracy

Delay Time Setting	+15°C to +35°C
over one or more major dial divisions	±1%
less than one major dial division	±0.01 major dial divisions

Jitter — 1 part or less in 50,000 (0.002%) of 10X the A sweep time/div setting. 1 part in 20,000 when operating from 50 Hz line.

TRIGGERING A and B

A Trigger Modes — Normal (sweep runs when triggered). Automatic (sweep free-runs in the absence of a triggering signal and for signals below 30 Hz). Single Sweep (sweep runs one time on the first triggering event after the reset selector is pressed). Lights indicate when sweep is triggered and when single sweep is ready.

A Trigger Holdoff — Adjustable control permits a stable presentation of repetitive complex waveforms.

B Trigger Modes — B runs after delay time (starts automatically at the end of the delay time) and B triggerable after delay time (runs when triggered). The B (delayed) sweep runs once, in each of these modes, following the A sweep delay time.

Time Base A and B Trigger Sensitivity and Coupling —

Coupling		465		475		475A	
		To 25 MHz	At 100 MHz	To 40 MHz	At 200 MHz	to 40 MHz	At 250 MHz
Dc	Internal	0.3 div deflection	1.5 div deflection	0.3 div deflection	1.5 div deflection	0.3 div deflection	2.0 div deflection
	External	50 mV	150 mV	50 mV	250 mV	50 mV	250 mV
	External ÷ 10	500 mV	1.5 V	500 mV	2.5 V	500 mV	2.5 V
Ac		Requirements increase below 60 Hz					
Ac Lf Reject		Requirements increase below 50 kHz					
Ac Hf Reject		Requirements increase below 60 Hz and above 50 kHz					

465 Jitter — 0.5 ns or less at 100 MHz and 5 ns/div.

475 Jitter — 0.2 ns or less at 200 MHz and 1 ns/div.

475A Jitter — 0.2 ns or less at 250 MHz and 1 ns/div.

A Trigger View — A spring-loaded pushbutton overrides other vertical controls and displays the external signal used for A sweep triggering. This provides quick verification of the signal and time comparison between a vertical signal and the trigger signal. The deflection factor is approx 50 mV/div (0.5 V/div with external ÷ 10 source).

Level and Slope — Internal, permits selection of triggering at any point on the positive or negative slope of the displayed waveform. Level adjustment through at least ±2 V in external, through at least ±20 V in external ÷ 10.

A Sources — Norm, Ch 1, Ch 2, line, external, and external ÷ 10.

B Sources — Starts after delay, norm, Ch 1, Ch 2, and external.

External Inputs — R and C approx 1 MΩ paralleled by approx 20 pF. 250 V (dc + peak ac) max input.

X-Y OPERATION

465

Full-sensitivity X-Y (CH 1 Horiz, CH 2 Vert) — 5 mV/div to 5 V/div, accurate ±4%. Bandwidth is dc to at least 4 MHz. Phase difference between amplifiers is 3° or less from dc to 50 kHz.

475, 475A

Full-sensitivity X-Y (CH 1 Horiz, CH 2 Vert) — 2 mV/div to 5 V/div (475), 5 mV to 10 V/div (475A) accurate ±3%. Bandwidth is dc to at least 3 MHz. Phase difference between amplifiers is 1° or less from dc to 1 MHz.

DISPLAY

Crt — 8 x 10 cm display. Horizontal and vertical centerlines further marked in 0.2 cm increments. P31 phosphor standard; P11 optional without extra charge. 18 kV accelerating potential.

Graticule — Internal, nonparallax; variable edge lighting; markings for measurement of rise time.

Beam Finder — Compresses trace to within graticule area for ease in determining the location of an off-screen signal. A pre-set intensity level provides a constant brightness.

Z-Axis Input — Dc coupled, positive-going signal decreases intensity; 5 V p-p signal causes noticeable modulation at normal intensity; dc to 50 MHz.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Nonoperating: −55°C to +75°C. Filtered forced air ventilation is provided.

Altitude — Operating: to 15,000 ft; max allowable ambient temperature decreased by 1°C/1000 ft from 5000 to 15,000 ft. Nonoperating to 50,000 ft.

Vibration — Operating: 15 minutes along each of the three axes. .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Operating and nonoperating: 5 cycles (120 hours) to 95% relative humidity referenced to MIL-E-16400F (par 4.5.9 through 4.5.9.5.1, class 4).

Shock — Operating and nonoperating; 30 g's ½ sine, 11 ms duration, 2 shocks per axis in each direction for a total of 12 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator

Output Voltage	0.3 V	1% 0°C to +40°C
Output Current	30 mA	2% +20°C to +30°C
Frequency	Approx 1 kHz	

Vertical Signal Output — (465) Ch 1 vertical signal is dc to at least 50 MHz (−3 dB), and approx 25 mV/div terminated into 50 Ω, and approx 50 mV/div terminated into 1 MΩ. (475/475A) Ch 2 vertical signal is dc to at least 50 MHz (−3 dB), and approx 10 mV/div terminated into 50 Ω, and approx 20 mV/div terminated into 1 MΩ.

Gate Outputs — Positive gates from both time bases (approx 5 V).

Power Requirements — Quick-change line voltage selector provides six ranges; 110 V, 115 V, 120 V. 220 V, 230 V, and 240 V, each ±10%. 48 to 440 Hz, 75 watts (465) or 100 watts (475, 475A) max at 115 V and 60 Hz. Operation from 12 or 24 V dc is available with Option 07.

	Cabinet		Rackmount	
Dimensions	**in**	**cm**	**in**	**cm**
Height	6.2	15.7	7.0	17.7
Width (with handle)	12.9	32.8	19.0	48.3
Depth (with panel cover)	18.1	46.0	18.0	45.7
Depth (handle extended)	20.3	51.6		
Weights (approx)	**lb**	**kg**	**lb**	**kg**
Net (without panel cover)	22.8	10.3	29.4	13.3
Net (with panel cover and accessories)	25.3	11.5		
Shipping	37.0	16.7	58.0	26.3

INCLUDED ACCESSORIES

Two P6105 10X probes (010-6105-03) (465 only), two P6106 10X probes (010-6106-03) (475/475A only), blue accessory pouch (016-0535-02), clear pouch (016-0537-00), blue crt light filter (337-1674-00), clear crt light filter (337-1674-01), ground wire (134-0016-01), two 1½-amp fuses (159-0016-00), one ¾-amp fuse (159-0042-00). Rack models also include mounting hardware and slide out assemblies, do not include accessory pouches.

ORDERING INFORMATION

465 Oscilloscope **$2145**
475 Oscilloscope **$3000**
475A Oscilloscope **$3300**
R465 Oscilloscope **$2270**
R475 Oscilloscope **$3125**
R475A Oscilloscope **$3425**
465 DM 44 ..... **$2555**
475 DM 44 ..... **$3410**
475A DM 44 (order 475A Option 44, see below)

INSTRUMENT OPTIONS

Option 01, delete temperature probe on DM 44. (for 475A order Option 45) ..... **Sub $85**
Option 04, Emc Environmental ..... **Add $125**
Option 05, Tv Sync Separator (465 only) ..... **Add $185**
Option 07, Ext Dc Operation ..... **Add $125**
Option 07 cannot be ordered with DM 44.
1106 Battery Pack (used with Option 07) ..... **Add $525**
Option 44, Built-in DMM (475A only) ..... **Add $410**
Option 45, Built-in DMM without temperature probe (475A only) ..... **Add $325**
Option 78, P11 Phosphor ..... **No charge**

OPTIONAL ACCESSORIES

Probes —

Probe Type	Attenuation	Input Impedance	Bandwidth* with 465	475	475A
P6063B 6 ft	1X	1 MΩ 105 pF	6 MHz	6 MHz	6 MHz
	Switchable 10X	10 MΩ 14 pF	90 MHz	145 MHz	160 MHz
P6202 FET Probe 2 Meter	10X	10 MΩ 2 pF	100 MHz	185 MHz	220 MHz
	100X Head	10 MΩ 2 pF	100 MHz	185 MHz	220 MHz
	Ac Head	10 MΩ 4 pF	100 MHz	185 MHz	220 MHz
Current Probe	**Calibration**	**Insertion Impedance**	**Bandwidth with 465**	**475**	**475A**
P6022 5 ft	1 mA/mV 10 mA/mV (Selectable)	.03 Ω @ 1 MHz Increasing to 0.2 Ω @ 120 MHz	85 MHz	125 MHz	160 MHz

*Bandwidths are measured at the upper −3 dB and apply only to the cable length shown. Generally shorter cable lengths increase bandwidth, longer ones decrease bandwidth.

Folding Polarized Viewing Hood —
Order 016-0180-00 ..... **$17**

Collapsible Viewing Hood —
Order 016-0566-00 ..... **$13**

Option 07 Modification Kit — Converts existing 465 or 475s to the Option 07 version. For 465s with serial No below B042244
Order 040-0650-06 ..... **$205**

For 475s with serial No below B061174
Order 040-0665-08 ..... **$170**

For 465s or 475s with serial No above those listed
Order 040-0666-07 ..... **$300**

Protective Cover — Waterproof, blue vinyl
Order 016-0554-00 ..... **$15**

Mesh Filter — Improves contrast and emc filtering
Order 378-0726-01 ..... **$28**

SCOPE-MOBILE® Cart — Occupies less than 18 in aisle space, has storage area in base
Order 200C **$160**

1106 Battery Pack (for use with Option 07) **$525**

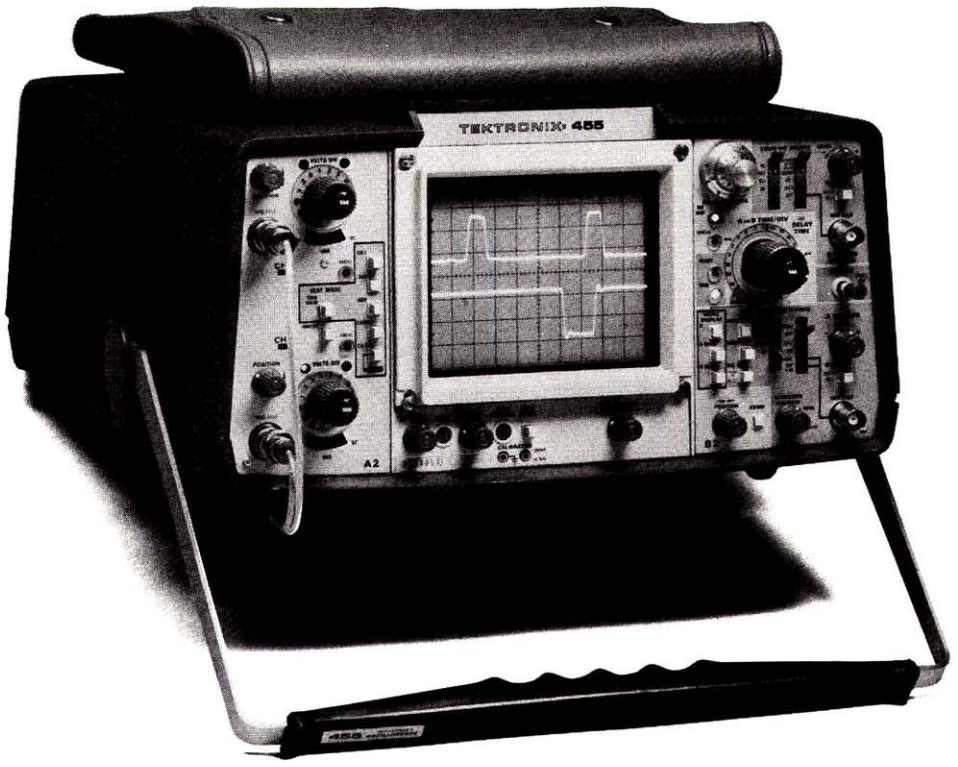
1105 Battery Power Supply **$795**

RECOMMENDED CAMERA

C-30AP Option 01 General Purpose Compact Camera
Includes 016-0301-00 mounting adapter/corrector lens.
Order C-30AP Option 01 ..... **$705**

For further information see camera section.

455 | 50-MHz Dual-Trace Portable Oscilloscope



50 MHz at 5 mV/div

5 ns/div Sweep Rate

Trigger View

Dual-Trace, Delayed Sweep

The 455, **the 400-Series value leader,** is a rugged and economical portable that retains the high performance of the 400-Series.

Special features of the 455 let you **check trigger signal presence and timing at the push of a button,** without moving the probes. Errors in amplitude readings are minimized through lighted vertical deflection factor readout. 1X and 10X probes are automatically accounted for by the readout. If the 455's **modular probes** should become damaged, the probe tip, cable, or compensation unit can be quickly and inexpensively replaced. A **large 8 x 10 cm display** permits easy viewing, yet the control area remains uncrowded.

An important 455 option, adding to versatility, is the snap-on 1106 Battery Pack.

Modular design means easy serviceability. Vertical amplifier and time-base modules can be quickly removed for ready access to all components, making repairs faster and less costly.

Calibration time is reduced with the 455. A minimum number of adjustments, made possible by actively trimmed networks, simplifies procedures and saves calibration time.

The 455 is extremely **easy to operate,** thanks to well-laid-out, color-coded controls. This translates into minimum operator training time, plus easier, faster, more error-free measurements.

The value leading 455 is an economy/performance, general-purpose oscilloscope. Though its price is moderate, it accommodates most measurements required in digital service.

VERTICAL DEFLECTION
(2 Identical Channels)

Bandwidth* and Rise Time — Bandwidth dc to at least 50 MHz and rise time 7.0 ns or less, at all deflection factors from 50-Ω terminated source. Lower −3 dB point, ac coupling 1X probe: 10 Hz or less. 10X probe: 1 Hz or less.

*Measured at −3 dB.

Deflection Factor — 5 mV/div to 5 V/div (1-2-5 sequence), accurate ±3%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div. In cascade mode sensitivity is approx 1 mV/div. Cascaded bandwidth is at least 20 MHz, when signal out is terminated in 50 Ω.

Display Modes — Ch 1, Ch 2 (normal or inverted), alternate, chopped (250 kHz rate), added, X Y.

CMRR — Common-mode rejection ratio at least 20 dB at 10 MHz for common mode signals of 6 div or less.

Automatic Scale Factor — Probe tip deflection factors for 1X or 10X coded probes are automatically indicated by two lighted indicators beside the knob skirts. All lights are off when the channel is not displayed. Ground reference display selectable at probe (when dc coupled).

Input R and C — 1 MΩ ±2%, approx 20 pF.

Max Input Voltage —

Dc Coupled	250 V (dc + peak ac) 500 V (p-p ac at 1 kHz or less)
Ac Coupled	500 V (dc + peak ac) 500 V (p-p ac at 1 kHz or less)

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL DEFLECTION

Time Base A — 0.05 μs/div to 0.5 s/div (1-2-5 sequence). X10 mag extends fastest sweep rate to 5 ns/div.

Time Base B — 0.05 μs/div to 50 ms/div (1-2-5 sequence). X10 mag extends fastest sweep rate to 5 ns/div.

Variable Time Control — Time Base A, provides continuously variable uncalibrated sweep rates between steps and to at least 1.25 s/div. Warning light indicated uncalibrated setting.

Time Base A and B Accuracy, Full 10 Cm —

	+20°C to +30°C	−15°C to +55°C
Unmagnified	±2%	±3%
Magnified	±3%	±4%

Horizontal Display Modes — A, A intensified by B, B delayed. B ends A for increased intensity in the delayed mode.

CALIBRATED SWEEP DELAY

Delay Time Range — 0.2 to X10 delay time/div settings of 200/ns to 0.5 s (minimum delay time is 200 ns).

Differential Time Measurement Accuracy —

Delay Time Settings	+15°C to +35°C
Over one or more major dial divisions	1.5%
Less than one major dial division	±0.015 major dial division

Jitter — 1 part or less in 20,000 (0.005%) of 10X the A sweep time/div setting.

TRIGGERING A AND B

A Trigger Modes — Normal Sweep (runs when triggered), single sweep (runs one time on the first triggering event after the single sweep pushbutton is pressed). Automatic (sweep free-runs in the absence of a trigger and for signals below 20 Hz). Lights indicate when signal sweep is ready.

A Trigger Hold-off — Adjustable control permits a stable presentation of repetitive complex waveforms.

B Trigger Modes — B runs after delay time (starts automatically at the end of the delay time) and B triggerable after delay time (runs when triggered). The B (delayed) sweep runs once, following the A sweep delay time, in each of these modes.

Time Base A and B Trigger Sensitivity and Coupling—

Coupling		To 10 MHz	At 50 MHz
Dc	Internal	0.4 div deflection	1.5 div deflection
	External	50 mV	250 mV
	External ÷ 10	500 mV	2.5 V
Ac	Requirements increase below 60 Hz		
Ac Lf Reject	Requirements increasing below 50 kHz		
Ac Hf Reject	Requirements increasing below 60 Hz and above 50 kHz		

Jitter — 0.5 ns or less at 50 MHz and 5 ns/div (X10 MAG on).

A Trigger View — A spring-loaded pushbutton overrides other vertical controls and displays the external signal used for A sweep triggering. Provides quick verification of external trigger and time comparison between external trigger and the displayed signal. Deflection factor approx 50 mV/div (0.5 V/div in external ÷ 10 mode).

Level and Slope — Internal, permits triggering at any point on the positive or negative slopes of the displayed waveform. External, permits triggering on any level between −2 V and +2 V (−20 V to +20 V for external ÷ 10).

A Sources — Norm, Ch 1, Ch 2, line, external, and external ÷ 10.

B Sources — Starts after delay, norm, Ch 1, Ch 2 and external.

External Inputs — R and C approx 1 MΩ paralleled by approx 20 pF. 250 V (dc + peak ac) max input.

X-Y OPERATION

Full-sensitivity X-Y (Ch 1 Horiz, Ch 2 Vert) — 5 mV/div to 5 V/div, accurate ±4%. Bandwidth is dc to at least 3 MHz. Phase difference between amplifiers is 3° or less from dc to 50 kHz.

DISPLAY

Crt — 8 x 10 cm display, horizontal and vertical center lines further marked in 0.2 cm increments: P31 phosphor standard, P11 phosphor optional without extra charge. 12 kV accelerating potential.

Graticule — Internal, nonparallax; variable edge lighting; markings for measurement of rise time.

Beam Finder — Compresses the display to within the graticule area and provides a visible display when pushed.

Z-axis Input — Dc coupled, positive-going signal decreases intensity: 5 V p-p signal causes noticeable modulation at normal intensity: dc to 20 MHz.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Nonoperating: −55°C to +75°C.

Altitude — Operating: to 15,000 ft; max allowable ambient temperature decreased by 1°C/1000 ft from 5000 to 15,000 ft. Nonoperating to 50,000 ft.

Vibration — Operating: 15 minutes along each of the three axes. .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Operating and nonoperating: 5 cycles (120 hours) to 95% relative humidity referenced to MIL-E-16400F (par 4.5.9 through 4.5.9.5.1, class 4).

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 ms duration, 2 shocks per axis each direction for a total of 12 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator — 0.3 V ±1%. Frequency approx 1 kHz.

Vertical Signal Output — Ch 2 vertical signal is dc to at least 20 MHz and approx 25 mV/div terminated into 50 Ω, and approx 50 mV/div terminated into 1 MΩ.

Gate Outputs — (approx 5 V) internally selectable from either A or B time base.

Power Requirements — Quick change line voltage selector provides two ranges: 100 V to 132 V, 200 V to 264 V. 48 Hz to 440 Hz. Power consumption 35 watts at 115 V, 60 Hz. Operation from 12 V or 24 V dc is available with Option 07.

Dimensions	in	cm
Height	9.0	22.9
Width (with handle)	13.7	34.7
Depth (with handle cover)	19.5	49.5
Depth (handle extended)	21.7	55.2
Weight (approx)	**lb**	**kg**
Net (without panel cover)	24.0	10.9
Net (with panel cover and accessories)	27.0	12.2
Shipping	34.2	15.5

INCLUDED ACCESSORIES

Two P6105 probes (010-6105-03), blue accessory pouch (016-0339-00), clear pouch (016-0537-00), clear crt filter (337-2122-01), adapter (134 0016-01), ½-A fuses (159-0025-00), two 2A-fuses (159-0021-00), one 1A-fuse (159-0022-00).

ORDERING INFORMATION

455/A2/B2 Portable Oscilloscope . . . $1745

INSTRUMENT OPTIONS

Option 04 Emc Modification . . . . . **Add $125**
Option 05 Tv Sync Separator . . . . . **Add $185**
Option 07 External Dc Operation . . . . . **Add $125**
Option 78 P11 Phosphor . . . . . **No charge**

OPTIONAL ACCESSORIES

Probes —

Probe Type	Attenuation	Input Impedance	Bandwidth* with 455
P6062B 6 ft	1X Switchable	1 MΩ 105 pF	6.7 MHz
	10X	10 MΩ 14 pF	50 MHz
P6202	10X	10 MΩ 2 pF	50 MHz
FET probe	100X Head	10 MΩ 2 pF	
2 meter	Ac Head	10 MΩ 4 pF	
Current Probe	**Calibration**	**Insertion Impedance**	**Bandwidth with 455**
P6022	10 mA/mV 1 mA/mV	.03 Ω @ 1 MHz increasing to 0.2 Ω @ 120 MHz	47 MHz

*Bandwidths are measured at the upper −3 dB point, and apply only to the cable length shown. Generally, shorter cable lengths increase bandwidth, longer ones decrease bandwidth.

Rack Adapter (Cradle Mount) Kit — Includes hardware for converting standard 455 to 19 in rack installation. Cradle mount consists of a shelf and a mask to fit over regular instrument panel. Instrument can be slid out from rack. Rack height 7 in, depth 18¾ in, width 19 in.
Order 040-0825-00 . . . . . **$200**

Protective Cover — Waterproof, blue vinyl.
Order 016-0554-00 . . . . . **$15**

Folding Polarized Viewing Hood —
Order 016-0180-00 . . . . . **$17**

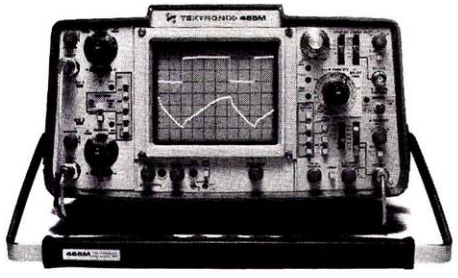
SCOPE-MOBILE® Cart — Occupies less than 18 inches of aisle space.
Order 200 C **$160**

RECOMMENDED CAMERA

C-30AP Option 01 General Purpose Camera — Includes 016-0301 00 mounting adapter/corrector lens.
Order C-30AP Option 01 . . . . . **$705**

For further information see camera section.

Triservice 100-MHz Dual-Trace Oscilloscope | 465M



465M

Military Designator AN/USM 425

Meets Mil-T-28800A, Type II, Class 4, Style C

Triservice Standard 100 MHz Oscilloscope

Full Military Provisioning

The 465M Oscilloscope is the commercially available AN/USM 425, the tri-service 100 MHz standard oscilloscope. Both the 465M and the AN/USM 425 are designed and manufactured to meet the Mil-T-28800A, Type II, Class 4, Style C requirements.

The 465M dual-trace Oscilloscope features 100 MHz bandwidth, 5 mV/div vertical sensitivity and delayed sweep . . . all in a rugged portable. And there's more to the value leading 465M. Trigger signal presence and timing can be checked by pushing a button without moving the probes. Variable trigger holdoff provides stable displays of complex digital signals.

With clearly labeled controls, color coding and functional group arrangements, operator training time is minimized in addition to easier, faster, more error-free measurements. All this translates into savings in time and money.

Modular design means easy serviceability. Vertical amplifier and time-base modules can be quickly removed for ready access to all components, making repairs faster and less costly. Lower parts count means a less expensive spare parts inventory. Since the military catalogs all parts for the military version (AN/USM 425), parts provisioning and logistics support is not a problem when specifying the 465M as test equipment in military applications.

Calibration time is reduced with the 465M. A minimum number of adjustments, made possible by actively trimmed networks, saves the time and money associated with elaborate calibration procedures.

For protection against adverse environmental and operating conditions, the unit is housed in a rugged, attractive, reinforced plastic case and comes complete with a drip proof front cover. An important option, adding to versatility, is the 1106 clip-on Battery Pack.

Detailed specifications are available on request. Contact the nearest Tektronix Field Office or use reply card in this catalog.

ORDERING INFORMATION

465M Oscilloscope **$2195**

OPTIONAL ACCESSORIES

Rack Adapter (Cradle Mount) Kit — Includes hardware for converting standard 465M to 19 in rack installation. Cradle mount consists of a shelf and a mask to fit over regular instrument panel. Instrument can be slid out from rack. Rack height 7 in, depth 18¾ in, width 19 in.
Order 040-0825-00 . . . . . **$200**

The Fastest Storage . . . The Most Versatile Package

Dc to at Least 100 MHz Bandwidth

5 mV/div Vertical Sensitivity at Full Bandwidth

5 ns/div Sweep Speed

Variable Persistence and Fast Mesh Transfer Storage Modes

3000 div/μs Stored Writing Speed (466)

The 466 and 464 Portable Storage Oscilloscopes are both designed to display nonrepetitive or slow moving signals. And with the exception of stored writing speed, on the 466, both instruments offer similar performance.

Operating in a reduced scan mode, the stored writing speed of the 466 is 3000 div/μs (1350 cm/μs) making it the fastest portable storage oscilloscope available. The lower cost 464 doesn't offer a reduced scan mode and stores at 110 div/μs. Both instruments feature two modes of storage — variable persistence and fast transfer.

The bright 8 x 10 cm crt on both instruments comprises 0.90 cm/divisions. In the 466, **reduced scan graticule** is superimposed over the center of the main graticule, measuring 8 x 10 divisions with 0.45 cm/division. All graticules are etched onto the inner face of the crt to eliminate parallax problems. Of time-saving importance, you can easily view the **trigger signal** without disconnecting leads and re-setting controls.

TEKTRONIX P6062B Probes provide operator convenience of 1X or 10X input attenuation at the probe tip. The correct deflection factor is automatically indicated on the 464 or 466 front panel when the probe attenuation factor is switched.

Light weight plus the ability to use optional, external dc power makes both the 464 and 466 sufficiently portable for virtually all field measurement applications. The snap-on 1106 Battery Pack is also useful in isolating these oscilloscopes from noisy or intermittent power sources.

CHARACTERISTICS

All characteristics apply to both the 466 and 464, except where indicated.

VERTICAL DEFLECTION
(2 Identical Channels)

Bandwidth* and Rise Time — at all deflection factors from 50 Ω terminated source.

−15°C to +40°C	+40°C to +55°C
Dc to 100 MHz, ≤3.5 ns	Dc to 85 MHz, ≤4.15 ns

*Measured at −3 dB down. Bandwidth may be limited to approx 20 MHz by bandwidth limit switch. Lower −3 dB point, ac coupling 1X probe; 10 Hz or less. 10X probe; 1 Hz or less.

Deflection Factor — 5 mV/div to 5 V/div (1-2-5 sequence); accurate ±3%. Uncalibrated, continuously variable between steps and to approx 12.5 V/div. In cascade mode sensitivity is approx 1 mV/div. Cascaded bandwidth is at least 50 MHz when signal out is terminated in 50 Ω.

Display Modes — Ch 1, Ch 2 (normal or inverted), alternate, chopped (approx 250 kHz), added, X-Y.

CMRR — Common mode rejection ratio at least 20 dB at 20 MHz for common mode signals of 6 div or less.

Automatic Scale Factor — Probe tip deflection factors for 1X or 10X coded probes are automatically indicated by two readout lights behind the knob skirts. All lights are off when the channel is not displayed. Ground reference display selectable at probe (when dc coupled).

Input R and C — 1 MΩ ±2% paralleled by approx 20 pF.

Max Input Voltage —

Dc Coupled	250 V (dc + peak ac) 500 V (p-p ac at 1 kHz or less)
Ac Coupled	500 V (dc + peak ac) 500 V (p-p ac at 1 kHz or less)

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL DEFLECTION

Time Base A — 0.05 μs/div to 0.5 s/div (1-2-5 sequence). X10 mag extends sweep rate to 5 ns/div.

Time Base B — 0.05 μs/div to 50 ms/div (1-2-5 sequence). X10 mag extends sweep rate to 5 ns/div.

Variable Time Control — Time Base A — Provides continuously variable uncalibrated sweep rates between steps and to at least 1.25 s/div. Warning light indicates uncalibrated setting.

Time Base A and B Accuracy — full 10 cm

	+20°C to +30°C	−15°C to +55°C
Unmagnified	±2%	±3%
Magnified	±3%	±4%

Horizontal Display Modes — A, mixed sweep, A intensified, B delayed. B ends A for increased intensity in the delayed mode.

Calibrated Mixed Sweep — Displays A sweep for period determined by DELAY-TIME POSITION control, then displays B sweep for remainder of horizontal sweep.

CALIBRATED SWEEP DELAY

Delay Time Range — 0.2 to X10 delay time/div settings of 200/ns to 0.5 s (minimum delay time is 200 ns).

Differential Time Measurement Accuracy —

Delay Time Setting	+15°C to +35°C	−15°C to +55°C
over one or more major dial div	±1%	±2.5%
less than one major dial div	±0.01 major dial div	±0.025 major dial div

Jitter — 1 part or less in 50,000 (0.002%) of X10 the A sweep time/div setting.

TRIGGERING A and B

A Trigger Modes — Normal (sweep runs when triggered), automatic (sweep free-runs in the absence of a triggering signal and for signals below 30 Hz). Single sweep (sweep runs one time on the first triggering event after the reset selector is pressed). Lights indicate when sweep is triggered and when single sweep is ready.

A Trigger Holdoff — Adjustable control permits a stable presentation of repetitive complex waveforms. At least 10:1 variation.

B Trigger Modes — B starts after delay time (starts automatically at the end of the delay time), B triggerable after delay time (runs when triggered). The B (delayed) sweep runs once, in each of these modes, following the A sweep delay time.

Time Base A and B Trigger Sensitivity and Coupling —

Coupling		To 25 MHz	At 100 MHz
Dc	Int	0.3 div deflection	1.5 div deflection
	Ext	50 mV	150 mV
	Ext ÷ 10	500 mV	1.5 V
Ac	Ac Lf Reject	Requirements increase below 60 Hz	
		Requirements increase below 50 kHz	
	Ac Hf Reject	Requirements increase below 30 Hz and above 50 kHz	

Jitter — 0.5 ns or less at 100 MHz and 5 ns/div (X10 mag).

A Trigger View — A spring-loaded pushbutton overrides other vertical controls and displays the external signal used for A sweep triggering. This provides quick verification of the signal and time comparison between a vertical signal and the trigger signal. The deflection factor is approx 50 mV/div (0.5 V/div with external ÷ 10 source).

Level and Slope — Internal, permits selection of triggering at any point on the positive or negative slope of the displayed waveform. Level adjustment through at least ±2 V in external, through at least ±20 V in external ÷ 10.

A Sources — Norm, Ch 1, Ch 2, line, external and external ÷ 10.

B Sources — Starts after delay, norm, Ch 1, Ch 2, and external.

External Inputs — R and C approx 1 MΩ paralleled by approx 20 pF. 250 V (dc + peak ac) max input.

X-Y OPERATION

Full Sensitivity X-Y (Ch 1 Horiz, Ch 2 Vert) — 5 mV/div to 5 V/div accurate ±4%. Bandwidth is dc to at least 4 MHz. Phase difference between amplifiers in 3° or less from dc to 50 kHz.

DISPLAY

Crt — 8 x 10 div display, each div is 0.9 cm (normal); 0.45 cm/div (reduced, scan). 8.5 kV accelerating potential, normal mode, 10 kV reduced scan. P31 phosphor.

Graticule — Internal, nonparallax; variable edge lighting; markings for measurement of rise time.

Beam Finder — Compresses trace to within graticule area for ease in determining the location of an off-screen signal. A preset intensity level provides a constant brightness.

Z-Axis Input — Dc coupled, positive-going signal decreases intensity; 5 V p-p signal causes noticeable modulation at normal intensity; dc to 50 MHz.

STORED WRITING SPEEDS

	466	464	Storage* View Time
Full Scan (Center 6 x 8 div; 0.9 cm/div)			
FAST	150 div/μs	110 div/μs	>15s
VARIABLE PERSISTANCE	0.5 div/μs	0.5 div/μs	>15s
Reduced Scan (Center 8 x 10 div; 0.45 cm/div) FAST	3,000 div/μs	Reduced Scan not available on 464	>15s
VARIABLE PERSISTANCE	3 div/μs		>15s

*These times are at full-stored display intensity; they can be extended at least 25 times using reduced intensity in SAVE Display Mode.

ENVIRONMENTAL CAPABILITIES

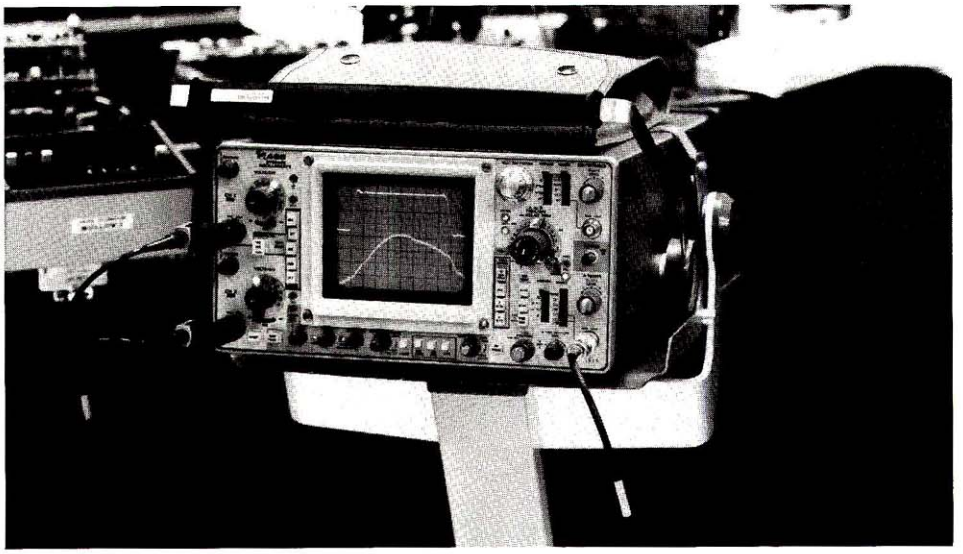
Ambient Temperature — Operating: −15°C to +55°C. Nonoperating: −55°C to +75°C. Forced air ventilation is provided.

Altitude — Operating: to 15,000 ft; max allowable ambient temperature decreased by 1°C/1000 ft from 5000 to 15,000 ft. Nonoperating to 50,000 ft.

Vibration — Operating: 15 minutes along each of the three axes. .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Operating and nonoperating: 5 cycles (120 hours) to 95% relative humidity referenced to MIL-E-16400F (par 4.5.9 through 4.5.9.5.1, class 4).

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 ms duration, 2 shocks per axis in each direction for a total of 12 shocks.



OTHER CHARACTERISTICS

Amplitude Calibrator —

Output Voltage	0.3 V	1% 0°C to +40°C
Output Current	30 mA	2% +20°C to +30°C
Frequency	Approx 1 kHz	

Vertical Signal Output — Ch 1 vertical signal is dc to at least 50 MHz and approx 25 mV/div terminated into 50 Ω, and approx 50 mV/div terminated into 1 MΩ.

Gate Outputs — Positive gates from both time bases (approx 5 V).

Power Requirements — Quick-change line voltage selector provides six ranges: 110 V, 115 V, 120 V, 220 V, 230 V, and 240 V, each ±10%. 48 to 440 Hz, 100 W max at 115 V and 60 Hz. Operation from 12 or 24 V dc is available with Option 07.

Dimensions	in	cm
Height	6.2	15.9
Width (with handle)	13.0	33.0
Depth (with panel cover)	21.7	55.0
Depth (handle extended)	23.5	59.7
Weights (approx)	**lb**	**kg**
Net (without panel cover or accessories)	26.0	11.8
Net (with panel cover and accessories)	29.8	13.5
Shipping	41.5	18.8

INCLUDED ACCESSORIES

Two P6062B probes (010-6062-03), blue accessory pouch (016-0535-02), clear pouch (016-0537-00), crt light filter (337-1674-01), two 1½ amp fuses (159-0016-00)/¾ amp fuse (159-0042-00), adapter, ground wire (134-0016-01), view hood (016-0592-00).

ORDERING INFORMATION

466 Storage Oscilloscope **$4600**

466 DM 44 Storage Oscilloscope/ Multimeter **$5010**

464 Storage Oscilloscope **$3950**

464 DM 44 Storage Oscilloscope/ Multimeter **$4360**

INSTRUMENT OPTIONS

Option 01, delete DM 44 temperature probe (466 DM 44, 464 DM 44 only) . . . . . **Sub $85**

Option 04, Emc Environmental . . . . . **Add $125**

Option 05, Tv Sync Separator . . . . . **Add $185**

Option 07, Ext Dc Operation (Option 07 cannot be ordered with DM 44) . . . **Add $125**

OPTIONAL ACCESSORIES

Probes —

Probe Type	Attenuation	Input Impedance	Bandwidth* with 464/466
P6063B 6 ft	1X Switchable 10X	1 MΩ 105 pF 10 MΩ 14 pF	6 MHz 90 MHz
P6202 FET Probe 2 Meter	10X 100X Head Ac Head	10 MΩ 2 pF 10 MΩ 2 pF 10 MΩ 4 pF	100 MHz
Current Probe	**Calibration**	**Insertion Impedance**	**Bandwidth with 464/466**
P6022	1 mA/mV 10 mA/mV (Selectable)	0.03 Ω @ 1 MHz Increasing to 0.2 Ω @ 120 MHz	85 MHz

*Bandwidths are measured at the upper −3 dB point, and apply only to the cable length shown. Generally, shorter cable lengths increase bandwidth, longer ones decrease bandwidth.

OPTIONAL ACCESSORIES

1106 Battery Pack (used with Option 07) **$525**

1105 Battery Power Supply **$795**

Mesh Filter — Improves display contrast in high ambient light. Order 378-0726-01 . . . . . **$28**

Protective Cover — Waterproof vinyl. For 464/466 Order 016-0365-00 . . . . . **$15.75**

Folding Viewing Hood — Order 016-0592-00 . . . **$11.50**

Folding Binocular Hood — Order 016-0566-00 . . . . . **$13**

Polarized Collapsible Viewing Hood — Order 016-0180-00 . . . . . **$17**

SCOPE-MOBILE® CART — Occupies less than 18 inches aisle space, has storage area in base. **Order 200C** **$160**

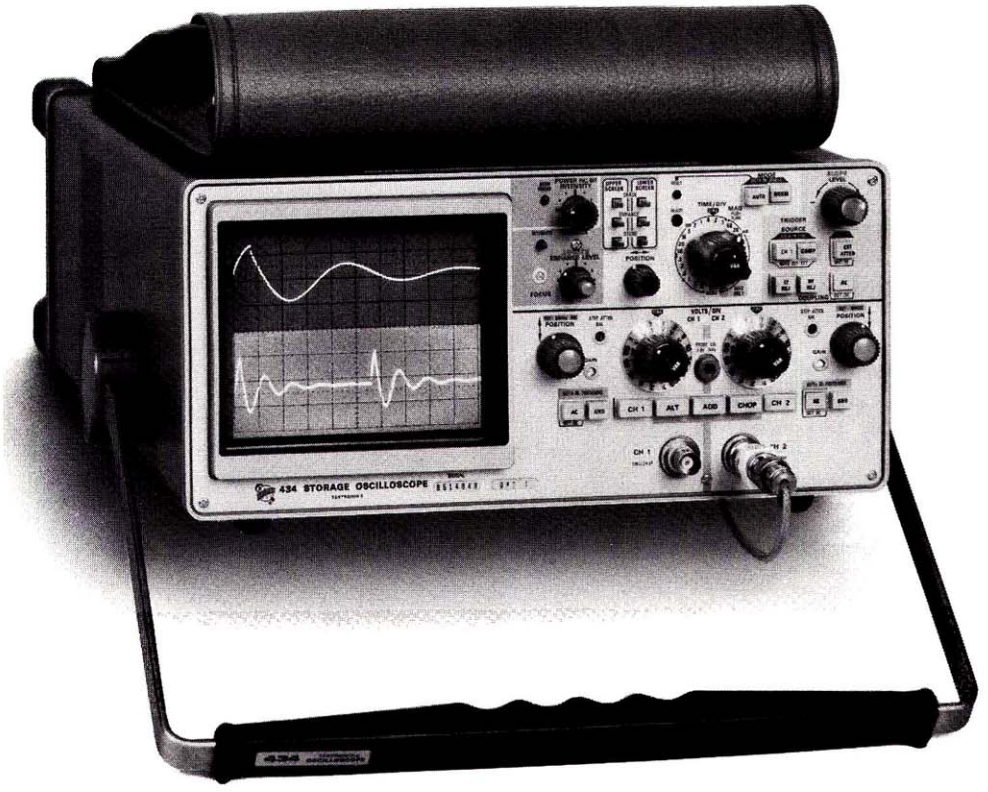
RECOMMENDED CAMERA

C-30AP Option 01 General Purpose Camera — Includes 016-0301-00 mounting adapter/corrector lens. **Order C-30AP Option 01** **$705**

Camera Adapter — Mounts C-30A Series Camera to 464/466 Oscilloscopes. **Order 016-0301-00** **$60**

For further information see Camera section.

434 | 25-MHz Dual-Trace Bistable Storage Oscilloscope



Deflection Factors to 1 mV/div

Automatic Volts/div Readout

Direct-Reading Wide-Range Magnifier

Weighs 20¾ Lb

A bistable, split-screen storage oscilloscope with a **25 MHz bandwidth,** the compact 434 fills many needs in the field as well as on a bench.

The 434's split screen operates in three modes: full-screen storage, or upper or lower screen storage, with the other half in a conventional mode.

Vertical scale-factor readout is provided by lighted knob skirts. You save time by not having to calculate the scale factor each time a measurement is made.

The 1105 Battery Power Supply powers the 434 for up to 1.8 hours. Take the 1105 along when required. Or forget it when line power is available.

TEKTRONIX 434's have been used for: maintaining display boards, video monitors, and automatic baggage handling systems for an airline; maintenance of X-ray systems in a hospital; monitoring air-conditioning and heating systems that are hooked into an alarm system in large buildings.

VERTICAL DEFLECTION
(2 Identical Channels)

Bandwidth and Rise Time — (from 50-Ω terminated source, with or without 10X probe) Dc to at least 25 MHz at 3 dB down*, 14 ns from 10 mV/div to 10 V/div, decreasing to 15 MHz, 22 ns at 1 mV/div. Low frequency 3 dB down point with ac coupling is 14 Hz or less (less than 1 Hz with 10X probe).

Deflection Factor — 1 mV/div to 10 V/div, accurate ±3%. Lighted knob skirts indicate correct deflection factor for either 1X or 10X probes. Uncalibrated, continuously variable between steps and to approx 25 V/div.

Display Modes — Ch 1 only, Ch 2 only (normal or inverted), alternate, chopped (approx 100 kHz), added.

CMRR — Common mode rejection ratio at least 20 db at 10 MHz for common mode signals of 6 div or less.

Automatic Scale Factor — Probe tip deflection factors for 1X or 10X coded probes are automatically indicated by two lighted indicators beside the knob skirts. All lights are off when the channel is not displayed. Ground reference display selectable at probe (when dc coupled).

Input R and C — 1 MΩ ±2% paralleled by approx 24 pF.

Max Input Voltage — Dc coupled: 250 V (dc + peak ac); ac coupled: 500 V (dc + peak ac). In either mode the max ac is 500 V p-p at 1 kHz or less.

Delay Line — Permits viewing of leading edge of displayed waveform.

*Bandwidth derating to 22 MHz at temperatures above +30°C.

HORIZONTAL DEFLECTION

Time Base — 0.2 μs/div to 5 s/div (1-2-5 sequence). X50 mag extends fastest sweep rate to 20 ns/div.

Variable Time Control — Uncalibrated, continuously variable between steps and to 12.5 s/div.

Time Base Accuracy, Full 10 div —

	+20°C to +30°C	−15°C to +55°C
Unmagnified	±3%	±4%
Magnified	±4%	±5%

External Horizontal Input — Deflection factor is approx 0.5 V/div. Input resistance is approx 50 kΩ.

TRIGGER

Modes — Auto trigger (sweep free-runs in absence of triggering signal and provides bright baseline at all sweep rates), normal trigger, single sweep.

Trigger Sensitivity and Coupling —

Coupling		To 5 MHz	At 25 MHz
Dc	Internal	0.3 div deflection	1 div deflection
	External	50 mV	125 mV
Ac	Requirements increase below 20 Hz		
Ac Lf Reject	Requirements increase below 50 kHz		
Ac Hf Reject	Requirements increase above 50 kHz		

Sources — Ch 1 only, composite line, external and external ÷ 10. External trigger level range is at least +2 V to −2 V or +20 V to −20 V.

Level and Slope — External trigger level range is at least ±2 V or ±20 V in external ÷ 10.

External Inputs — Input R approx 1 MΩ paralleled by 100 pF ÷ 1 or 70 pF ÷ 10. 250 V (dc + peak ac).

DISPLAY

Crt — 8 x 10 div (1 div = 0.975 cm) horizontal and vertical divisions further marked in 0.2 div increments. P1 phosphor. 4 kV accelerating potential.

Graticule — Internal, non parallax; nonilluminated.

Beam Finder — Compresses trace to within graticule area for ease in determining the location of an off-screen signal.

Z-axis Input — Dc coupled, positive going signal decreases intensity, 5 V p-p signal causes noticeable modulation; dc to 20 MHz usable frequency range.

STORAGE FEATURES

Display Modes — Split-screen storage with 3 display modes: storage on either upper or lower half of screen with conventional display on other half. Storage on entire screen or conventional display on entire screen. Independent operation of both halves.

Stored Writing Speed (Center 8 Div) — Normal, 100 div/ms. Enhanced, increases single-sweep storage writing speed to at least 400 div/ms. (Option 01, 500 div/ms, normal; to 5000 div/ms, enhanced).

Erase Time — 300 ms or less.

Locate — When the 434 is operated in the stored mode, the beam can be positioned to the left of the graticule area to determine the vertical position of the next sweep without disturbing a stored display.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Nonoperating: −55°C to +75°C.

Altitude — Operating: to 15,000 ft; max allowable ambient temperature decreased by 1°C/1000 ft from 5000 to 15,000 ft. Nonoperating: to 50,000 ft.

Vibration — Operating: 15 minutes along each of the three axes. .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Operating and nonoperating: 5 cycles (120 hours) to 95% relative humidity referenced to MIL-E-16400F (par 4.5.9 through 4.5.9.1, class 4).

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 ms duration, 2 shocks per axis in each direction for a total of 12 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator — 0.6 V ±1.0%, 1 kHz ±1.0% (+20°C to +30°C). Output resistance is 575 Ω.

Power Requirements — Operates on all voltages from 90 V to 136 V and 180 V to 272 V, 50 to 400 Hz, 75 W max. Also operates from 105 V dc to 250 V dc.

	Cabinet		Rackmount	
Dimensions	**in**	**cm**	**in**	**cm**
Height	5.6	14.2	5.3	13.3
Width (with handle)	13.0	33.0	19.0	48.3
Depth	18.7	47.5	18.0	45.7
Weights (approx)	**lb**	**kg**	**lb**	**kg**
Net	20.8	9.4	23.1	10.5
Shipping	30.0	13.6	49.0	22.2

INCLUDED ACCESSORIES

Two P6105 probes (010-6105-03), accessory pouch (016-0165-00). Rack models also include mounting hardware and slide out assemblies, do not include accessory pouch.

ORDERING INFORMATION

434 Storage Oscilloscope $3150

R434 Storage Oscilloscope Rackmount Model $3200

INSTRUMENT OPTIONS

Option 01 Increased Writing Speed . . . . . Add $30

OPTIONAL ACCESSORIES

Probes —

Probe Type	Attenuation	Input Impedance	Bandwidth* with 434
P6062A 6 ft	Switch- able 1X	1 MΩ 5 pF	6.7 MHz
	10X	10 MΩ 14 pF	25 MHz

Current Probe	Calibration	Insertion Impedance	Bandwidth with 434
P6022	1 mA/mV 10 mA/mV (Selectable)	0.03 Ω @ 1 MHz increasing to 0.2 Ω @ 120 MHz	25 MHz

*Bandwidths are measured at the upper −3 dB, and apply only to the cable length shown. Generally, shorter cable lengths increase bandwidth, longer ones decrease bandwidth.

1105 Battery Power Supply — Provides 1.8 hours of battery operation.
Order 1105 Battery Power Supply $795

Mesh Filter — Improves contrast and emc filtering.
Order 378-0682-00 . . . . . $22

Portable to Rackmount Assembly — Includes hardware for converting standard 434 to 19-inch rack installation.
Order 016-0272-00 . . . . . $90

Folding Polarized Viewing Hood —
Order 016-0180-00 . . . . . $17

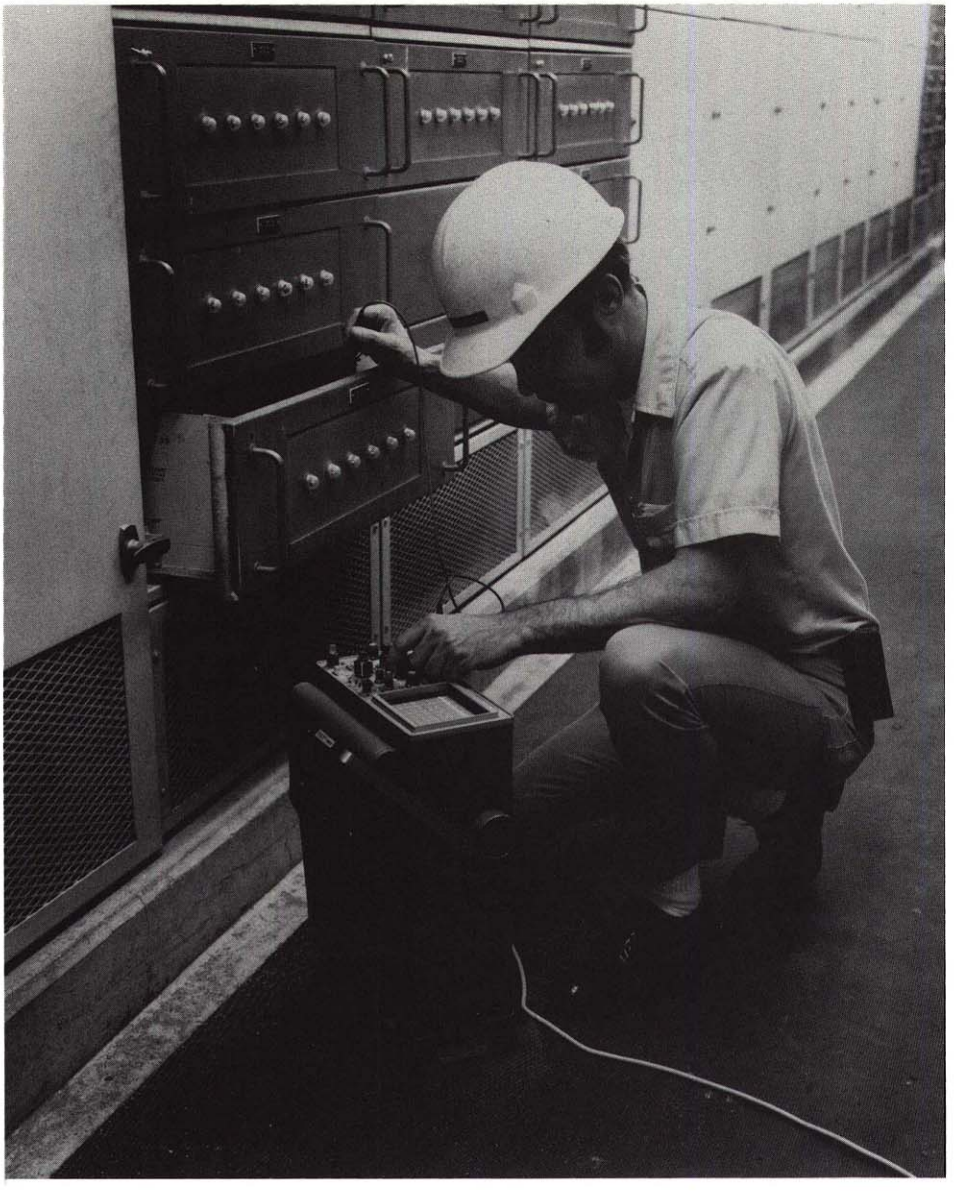
Clear Plastic Crt Filter —
Order 378-0677-00 . . . . . $1.90

SCOPE-MOBILE® Cart — Occupies less than 18 inches aisle space, has storage area in base.
Order 200C $160

RECOMMENDED CAMERA

C-30AP Option 01 General Purpose Camera — Includes 016-0301-00 mounting adapter/corrector lens.
Order C-30AP Option 01 . . . . . $705

For further information see Camera Section.



335 | 35-MHz Dual-Trace Delayed Sweep Portable Oscilloscope

35 MHz, Dual-Trace, Delayed Sweep

Small Size, Lightweight

1 mV/div Vertical Sensitivity at 25 MHz

Delay Lines Input

Rugged Construction

The portability of the 335 is a big plus in many digital and analog trouble-shooting applications. And it weighs only 10.5 pounds.

1 mV/div (at 25 MHz) vertical sensitivity insures that low level signals from magnetic recording leads, optical read heads, or industrial control transducers can be accurately and easily measured. **Delay lines** at the inputs let you view the leading edge of the triggering signal. By using a composite of channels 1 and 2 as a trigger source, stable displays of non-time-related signals can be obtained.

Operation from either ac (90 to 132 V, or 180 to 264 V, 48 to 440 Hz) **or dc** (+11 to +14 V or +22 to +28 V) assures that power can be obtained at nearly any location.

Rugged construction, plus environmental specifications that equal or better those of any portable scope, help the 335 withstand the wide range of temperature and humidity and rough handling it may encounter in field environments.

Color coding and functional layout of the front panel controls make the 335 **easy to operate.** Combine function controls and side mounting probes lead to small size and an uncluttered control panel.

VERTICAL DEFLECTION
(2 Identical Channels)

Bandwidth and Rise Time — Dc to at least 35 MHz, rise time 10 ns or less. For 1 mV/div to 5 mV/div bandwidth is at least 25 MHz, rise time 14 ns or less. For ac coupling, the lower 3 dB point is 10 Hz or less with a 1X probe and 1 Hz or less with a 10X probe.

Deflection Factor — 1 mV/div to 10 V/div (1-2-5 sequence) accurate ±3%. Uncailbrated, continuously variable between steps and to at least 25 V/div.

Display Modes — Ch 1, Ch 2 (normal or inverted) alternate, chopped (300 kHz rate) added, X-Y.

CMRR — Common mode rejection ratio at least 20 dB at 10 MHz for common mode signals of 6 div or less.

Input R and C — 1 MΩ ±2% paralleled by approx 24 pF.

Max Input Voltage, ac or dc coupled, 500 V (dc + peak ac). 500 V p-p ac at 1 kHz or less.

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL DEFLECTION

Time Base A — 0.2 μs/div to 0.5 s/div (1-2-5 sequence). X10 magnifier extends fastest sweep rate to 20 ns/div.

Time Base B — 0.2 μs/div to 50 mS/div (1-2-5 sequence). X10 magnifier—extends fastest sweep rate to 20 ns/div.

Variable Time Control — Time Base A provides uncalibrated, continuously variable sweep rates between steps and to at least 1.25 s/div. Warning light indicates uncalibrated settings.

Time Base A and B Accuracy, center 8 div —

	+20°C to +30°C	−15°C to +55°C
Unmagnified	±3%	±4%
Magnified	±5%	±6%

Horizontal Display Modes — A only. A intensified by B, B delayed by A, B triggerable after A.

CALIBRATED SWEEP DELAY

Delay Time Range — Continuously variable from 1 μs to at least 5 s after the start of the delaying (A) sweep.

Differential Time Measurement Accuracy —

Delay Time Settings between 1.0 and 9.0	+15°C to +35°C
one or more major dial divisions	±2%
less than one major dial divisions	±.02%

Jitter — 1 Part or less in 20,000 (0.005%) of X10 the A time/div setting.

TRIGGERING A AND B

A Trigger Modes — Normal (sweep runs when triggered). Automatic (sweep free-runs in absence of a triggering signal and for signals below 20 Hz). Single sweep (sweep runs once on the first trigger signal after the reset button is pushed).

Variable Trigger Holdoff — For the A sweep an adjustable holdoff control permits a stable display of complex waveforms. Sweep holdoff time can be increased at least X10.

B Trigger Modes — B runs after delay time (starts automatically at the end of the delay time). B triggerable after delay time (runs when triggered). The B (delayed) sweep runs once in each of these modes, following the A sweep delay time.

Trigger Sensitivity and Coupling —

Coupling		To 10 MHz	At 35 MHz
Dc	Internal	0.35 div	1.5 div
	External	70 mV	250 mV
	Ext ÷ 10	700 mV	2.5 V
Ac	above requirements increase below 60 Hz		
Ac Hf Rej	requirements increase above 20 kHz		
Ac Lf Rej	requirements increase below 40 kHz		

Trigger Sources — Internal Ch 1, internal Ch 2, internal composite (uses a composite of Ch 1 and Ch 2 signals to produce trigger), external, external ÷ 10, and line. The B sweep can also be started automatically at the end of the time base A delay.

X-Y OPERATION

Input — X-axis input is via the external horizontal input connection. Both Ch 1 and Ch 2 provide vertical inputs. Using chopped mode, two simultaneous X-Y displays can be obtained.

X-axis Deflection Factors — Variable from approx 20 mV/div to approx 20 V/div. Dc to at least 500 kHz.

Input Impedance — Approx 1 MΩ paralleled by 24 pF.

DISPLAY

Crt — 8 x 10 div (0.6 cm/div) display. P31 phosphor. 12 kV accelerating potential.

Graticule — Internal (non-parallax) non-illuminated, Vertical and horizontal centerlines marked in 5 minor div per major 0.6 cm.

Z-axis Input — +5 V signal causes noticeable modulation at normal intensity. Useful bandwidth dc to 600 kHz.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Non-operating: −40°C to +75°C.

Altitude — Operating: to 15,000 ft max, decrease max temperature by 1°C/1000 ft from 5000 ft to 15,000 ft. Nonoperating: to 50,000 ft max.

Vibration — Operating and nonoperating: 15 minutes along each of the three major axes. .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1-minute cycles.

Humidity — 5 cycles (120 hours) referenced to MIL-E-16400 F.

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 ms duration each direction along each major axis. Total of 12 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator — 0.5 V (±1%) approx 1 kHz from 20°C to 30°C.

Power Source — External ac source, 90 V to 132 V or 180 V to 264 V with a line frequency of 48 Hz to 440 Hz. Max power dissipation 24 W at 115 V. External dc source: +11 V to +14 V or +22 V to +28 V with a max current drain of 2A at +12 V or 1.0A at +24 V.

Dimensions	in	cm
Height	4.4	11.2
Width (with handle)	9.3	23.6
Depth (handle not extended)	13.6	34.7
Depth (handle extended)	17.6	44.8
Weights (approx)	**lb**	**kg**
Net (without accessories)	10.5	4.7
Shipping	17.0	7.6

INCLUDED ACCESSORIES

Two P6149 10X probes (010-6149-03), carrying case (016-0485-00), external dc cable assembly (012-0406-00), strap assembly (346-0131-00), two 1A-fuses (159-0064-00), two 0.4A-fuses (159-0139-00), two 2A-fuses (159-0107-00), three 0.2A-fuses (159-0080-00).

ORDERING INFORMATION

335 Portable Oscilloscope $1875

OPTIONAL ACCESSORIES

Viewing Hood — Order 016-0297-00 . . . . . $3.25

Crt Filter — Light blue. **Order 378-2016-00 . . . . . $1**

Crt Filter — Light amber. **Order 378-0843-00 . . . . . $1.60**

Crt Mesh Filter — With frame and holder. **Order 378-0063-00 . . . . . $10**

The SONY®/TEKTRONIX® 335 is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan, the 335 is available from Tektronix, Inc., its marketing subsidiaries and distributors.

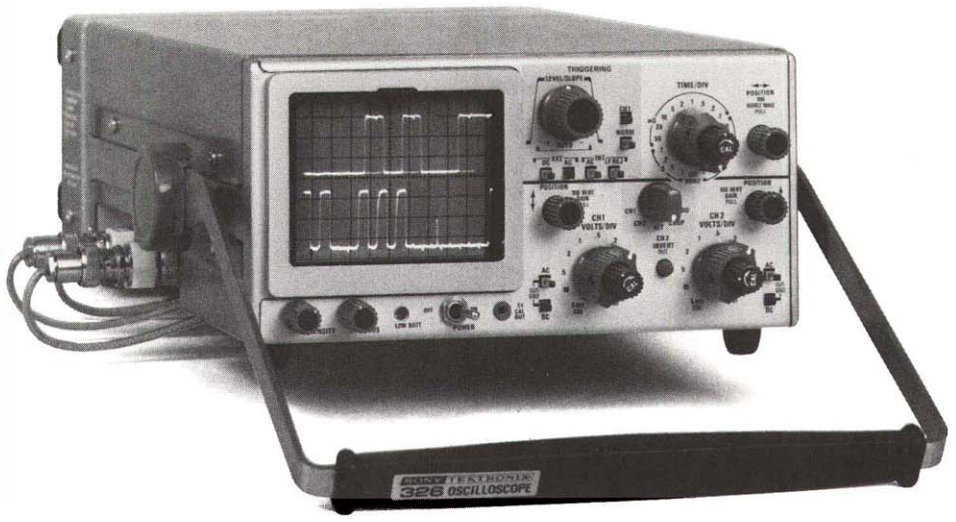
RECOMMENDED CAMERA

C-30AP — General Purpose Camera $690

Camera Adapter — mounts C30A to 335. Order 016-0327-00 . . . . . $42

For further information see Camera section.

326 | 10-MHz Dual-Trace Portable Oscilloscope



1 mV/div to 10 V/div Calibrated Deflection Factors

Compact Size — Weight < 13 Lb

5 MHz Bandwidth at 1 mV/div

Designed for Severe Environments

The 326 is an all solid-state, **dual-channel, 10 MHz portable** that can be operated from ac, dc, or internal rechargeable batteries.

Power consumption is extremely low . . . only 12 watts from an external dc source and 35 watts when powered from the ac line. The internal batteries will operate the 326 for 4 hours of continuous operation.

The portability/performance provided by the 326 Oscilloscope makes it most attractive for "on-site" applications such as maintaining remote computer terminals and on-board ship equipment.

VERTICAL DEFLECTION

Bandwidth and Rise Time — Dc to at least 10 MHz at 3 dB down, rise time 36 ns or less. Dc to at least 5 MHz, rise time 72 ns or less, at 3 dB down using 10X gain. For ac coupling, the lower 3 dB point is 10 Hz or less with a 1X probe and 1 Hz or less with the included 10X probes.

Deflection Factor — 10 mV/div to 10 V/div (1-2-5 sequence), accurate ±3%; 1 mV/div to 1 V/div using X10 gain. Uncalibrated continuously variable between steps and to approx 25 V/div.

Display Modes — Ch 1, Ch 2 (normal or inverted), alternate, chopped (approx 110 kHz rate), added.

CMRR — Common mode rejection ratio at least 20 dB at 2 MHz for common mode signals of 8 div or less.

Input R and C — 1 MΩ ±2% paralleled by approx 47 pF.

Max Input Voltage — ac or dc coupled, 500 V (dc + peak ac).

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL DEFLECTION

Time Base — 1 μs/div to 1 s/div (1-2-5 sequence); X10 mag extends sweep rate to 100 ns/div.

Variable Time Control — Uncalibrated, continuously variable between steps to approx 2.5 s/div.

Time Base Accuracy, center 8 div —

Unmagnified	1 μs/div to 0.2 s/div	±3%
	0.5 s/div to 1 s/div	±4%
Magnified	0.5 μs/div to 20 ms/div	±4%
	0.1 μs/div to 2 μs/div 50 ms/div and 0.1 s/div	±5%

TRIGGER

Modes — Automatic or manual level and slope selection with a single control. Automatic operation minimizes trigger adujstments and is useful above 30 Hz. With no input, automatic triggering provides a bright baseline at all sweep rates.

Trigger Sensitivity and Coupling —

Coupling		To 1 MHz	At 10 MHz
Dc	Internal	0.3 div deflection	1 div deflection
	External	150 mV	500 mV
Ac	(Int. only)	Requirements increase below 30 Hz	
Ac Lf Rej	(Int. only)	Requirements increase below 50 kHz	

Trigger Source — Internal Ch 1 or internal composite.

X-Y OPERATION

Input — X-axis input is via the external horizontal input connection. Both Ch 1 and Ch 2 provide vertical inputs.

X-axis Deflection Factors — Continuously variable from approx 15 mV/div to approx 15 V/div. Ac or dc coupled. Dc to at least 200 kHz at 3 dB down.

Input Impedance — Approx 1 MΩ paralleled by 62 pF.

DISPLAY

Crt — 8 x 10 div (0.6 cm/div) display. P31 phosphor normally supplied; P7 is optional without extra charge. 2 kV accelerating potential.

Graticule — Internal, black, non-illuminated. Vertical and horizontal centerlines marked in 5 minor div per major 0.6 cm/div.

Z-axis Input — External blanking input required +5 V to +20 V (dc coupled); is usable from dc to at least 100 kHz. Max input voltage, 50 V (combined dc + peak ac).

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Charging: 0°C to +40°C. Nonoperating: −40°C to +75°C.

Altitude — Operating: 15,000 ft max, decrease max temperature by 1°C/1000 ft from 5000 ft to 15,000 ft. Nonoperating: 50,000 ft.

Vibration — Operating: 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 gs to 55 Hz) 10 to 55 to 10 Hz in 1-minute cycles.

Humidity — Nonoperating: 5 cycles (120 hours) of MIL-Std-202C, Method 106B, omit freezing and vibration, and allow a post-test drying period at +25°C ±5°C at 20% to 80% relative humidity.

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 ms duration along each major axis. Total of 12 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator — 0.5 V (±1%) at approx 1 kHz from +20°C to +30°C.

Power Sources — Internal NiCd batteries provide approximately 4 hours operation at max trace intensity. Maximum time is achieved at 20°C to 25°C charge and 20°C to 30°C operating temperature. Internal charger charges the batteries when connected to an ac line with instrument turned on or off. Full recharge requires approximately 16 hours. A trickle charge mode prevents battery self-discharge when not in use. External dc source, 9 V to 32 V, 12 W.

Operates from an external ac source of 90 V to 136 V or 180 V to 272 V. 48 to 440 Hz, 35 W max at 136 V ac.

Dimensions	in	cm
Height	4.0	10.2
Width (with handle)	8.7	22.2
Depth (handle extended)		
(with charger)	15.0	38.1
(without charger)	12.2	31.0
Depth (handle extended)		
(with charger)	18.2	46.2
(without charger)	15.8	40.1
Weights (approx)	**lb**	**kg**
Net (without accessories)		
(with charger)	13	5.9
(without charger)	10	4.5
Shipping	19	8.6

INCLUDED ACCESSORIES

Two P6149 10X probes (010-6149-03), carrying case (016-0532-00), strap assembly (346-0098-00), viewing hood (016-0297-00), blue light filter (426-0871-00), external dc cable assembly (012-0406-00), test lead (012-0039-00), three 0.4-A fuses (159-0097-00), two 1.6-A fuses (159-0098-00), three 0.2-A fuses (159-0100-00).

ORDERING INFORMATION

326 Oscilloscope, including power pack $1975

INSTRUMENT OPTION

Option 76, P7 phosphor . . . . . No Charge

OPTIONAL ACCESSORIES

Battery Set — Set of 9 NiCd cells,
Order 146-0018-00 . . . . . $54

Battery Pack — Includes 146-0018-00 in battery housing, **Order 016-0296-00 . . . . . $120**

Power Pack — Additional power pack for charging battery pack (not included).
Order 016-0528-00 . . . . . $290

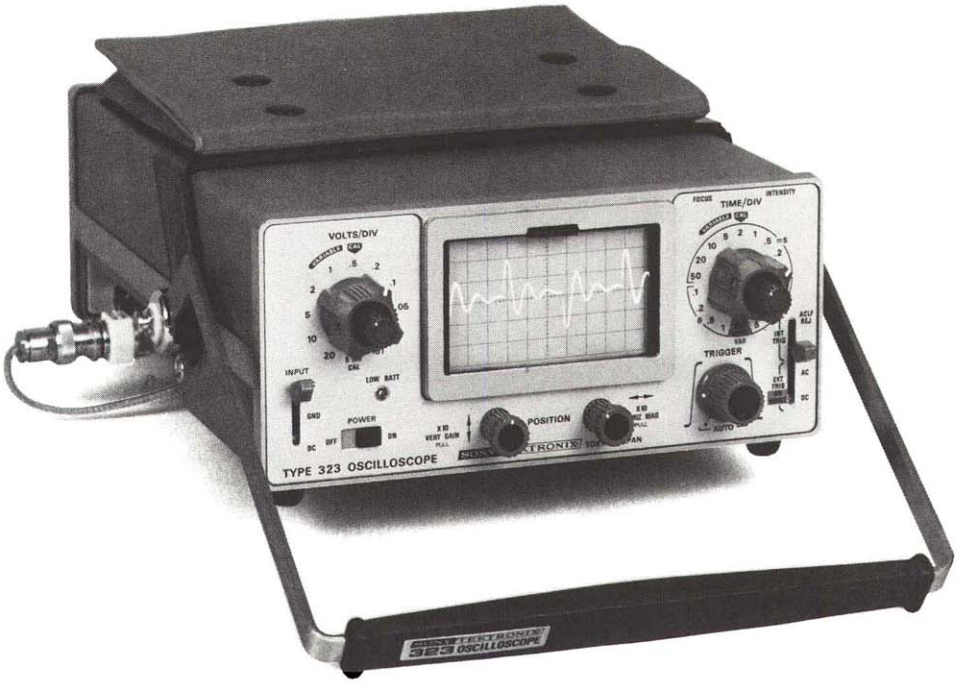
The SONY®/TEKTRONIX® 326 is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan the 326 is available from Tektronix, Inc., its marketing subsidiaries and distributors.

RECOMMENDED CAMERA

C-30AP General Purpose Camera $690

Camera Adapter — Mounts C-30A to 326.
Order 016-0327-00 Adapter $42

For further information see Camera section.



1 mV/div to 20 V/div Calibrated Deflection Factors

Compact Size — Weight ≃7 Lb

Operates to 7 Hours from Internal Batteries

Designed for Severe Environments

The 323 Portable Oscilloscope features "heavyweight" performance in a lightweight package (approximately seven pounds).

With the 323 you have the option of using **ac, dc, or internal rechargeable batteries** for power. And like other 300-Series Oscilloscopes, **power consumption is very low:** typically 1.6 watts from an external dc source (maximum 4.5 watts), and 14 watts when powered from the ac line. Internal rechargeable batteries provide 7 hours of continuous operation, sufficient for a full working day.

The 323 has been purchased on its environmental specs alone... to withstand high shock conditions, and to tolerate extreme temperatures.

VERTICAL DEFLECTION

Bandwidth and Rise Time — Dc to at least 4 MHz at −3 dB down, rise time 90 ns or less. Dc to at least 2.75 MHz, rise time 130 ns or less, at lower −3 dB down using X10 gain. For ac coupling, the Tower −3 dB point is 2 Hz or less, extending to 0.2 Hz or less with the included 10X probe.

Deflection Factor — 10 mV/div to 20 V/div (1-2-5 sequence), accurate ±3% 1 mV/div to 2 V/div using X10 gain. Continuously variable between steps and to at least 50 V/div (uncalibrated).

Input R and C — 1 MΩ ±2% paralleled by approx 47 pF.

Max Input Voltage — ac or dc coupled, 500 V (dc + peak ac).

HORIZONTAL DEFLECTION

Time Base — 5 μs/div to 1 s/div (1-2-3 sequence). X10 mag extends sweep rate to 0.5 μs/div.

Variable Time Control — Uncalibrated, continuously variable between steps and to at least 2.5 s/div.

Time Base Accuracy, center 8 div

Unmagnified	
5 μs/div to 0.2 s/div	±3%
0.5 s/div to 1 s/div	±4%
Magnified	
2 μs/div to 20 ms/div	±4%
0.5 μs/div to 1 μs/div and 50 ms/div to 0.1 s/div	±5%

TRIGGER

Modes — Automatic or manual level and slope selection with a single control. Automatic operation minimizes trigger adjustments and is useful above 30 Hz. With no input, automatic triggering provides a bright baseline at all sweep rates.

Trigger Sensitivity and Coupling —

Coupling		to 400 kHz	at 4 MHz
Dc	Internal	0.3 div	.75 div
	External	75 mV	190 mV
Ac	requirements increase below 30 Hz		
Ac Lf Reject	requirements increase below 30 kHz		

Trigger Sources — Internal and external.

X-Y OPERATION

Input — X-axis input is via the external horizontal input connection. Y axis is from the vertical input.

X-axis Deflection Factors — Variable from approx 20 mV/div to approx 20 V/div, ac or dc coupled. Dc to at least 10 kHz at −3 dB down.

Input Impedance — Approx 1 MΩ paralleled by 62 pF.

DISPLAY

Crt — 6 x 10 div (0.6 cm/div) display. P31 phosphor normally supplied; P7 is optional without extra charge. 2 kV accelerating potential.

Graitcule — Internal, black, non-illuminated. Vertical and horizontal centerlines marked in 5 minor div per major 0.6 cm/div.

Z-axis Input — External blanking input requires +5 V to +20 V (dc coupled), is usable from dc to at least 100 kHz. Max input voltage 150 V (combined dc + peak ac).

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Charging: 0°C to +40°C. Nonoperating: −55°C to +75°C.

Altitude — Operating: to 30,000 ft; decrease max temperature by 1°C/1000 ft from 15,000 ft to 30,000 ft. Nonoperating: to 50,000 ft.

Vibration — Operating: 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 gs at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Nonoperating: 5 cycles (120 hours) of MIL-Std-202C. Method 106B omit freezing and vibration, and allow a post-test drying period at +25°C ±5°C at 20% to 80% relative humidity.

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 ms duration, each direction along each major axis. Total of 12 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator — 0.5 V, (±1%) at approx 1 kHz from +20°C to +30°C, (±2%) throughout the operating temperature range. Output resistance approx 10 kΩ. Output also switchable internally to vertical amplifier.

Power Source — Internal NiCd batteries provide approx 7 hours operation at max trace intensity. Max time is achieved at 20°C to 25°C charge and 20°C to 30°C operating temperature. Internal charger charges the internal batteries when connected to the ac line, operating or nonoperating. Front-panel light indicates when internal batteries are low. Full recharge requires at least 16 hours. A trickle charge mode prevents battery self-discharge when not in use. External dc source, 6 V to 16 V, 4.5 W, (typically 1.6 W). External ac soruce; 90 to 136 V, or 180 to 272 V, 48 to 440 Hz, 14 W max at 115 V.

Dimensions	in	cm
Height (with accessory pouch)	4.3	10.8
Width (with handle)	8.5	21.6
Width (with ac power cord)	9.3	23.5
Depth (handle not extended)	10.6	27.0
Depth (handle extended)	13.0	33.0
Weights (approx)	**lb**	**kg**
Net (without accessories)	7	3.2
Shipping	14	6.3

INCLUDED ACCESSORIES

One P6149 10X probe (010-6149-03), patch cord (012-0089-00), accessory pouch (016-0113-03), viewing hood (016-0247-01), power cord (161-0043-02), panel cover (200-0812-00), strap assembly (346-0051-00), blue filter (426-0811-00).

ORDERING INFORMATION

323 Oscilloscope
(includes power pack) $1400

INSTRUMENT OPTION

Option 76, P7 phosphor including amber filter (426-0513-00) ..... No Charge

OPTIONAL ACCESSORIES

Protective Cover — The protective cover for the 323 can be used during transport or storage, and is constructed of waterproof blue vinyl,
Order 016-0112-00 ..... $15

Power Pack — Extra power pack, in addition to the one supplied with the 323, allows one power pack to charge while the other is powering the oscilloscope. Pack contains 6 size "C" NiCd cells and battery charger. **Order 016-0119-02 ..... $200**

Battery Set — Set of 6 NiCd cells,
Order 146-0012-01 ..... $28

The SONY®/TEKTRONIX® 323 is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan the 323 is available from Tektronix, Inc., its marketing subsidiaries and distributors.

314 | 10-MHz Dual-Trace, Long-Term Storage Oscilloscope

1 mV/div Sensitivity at 10 MHz

Stored Viewing Time to 4 Hours

Integrate Mode for Intensifying Fast Rise Time, Low Repetition Rate Signals

Operates from Ac Line, 12 V Dc, or 24 V Dc

Small Size, Light Weight

The 10.5-pound, bistable storage 314 provides **1 mV/div sensitivity at 10 MHz,** with a 4-hour viewing time. With **long-term storage,** you can use the 314 to monitor signal lines where undesired transients are suspected. For fast rise time, low repetition rate signals, an **integrate mode** increases the intensity of the stored trace.

Compact size and operation from ac, dc, or external dc source mean that the 314 will easily go wherever you need a storage oscilloscope.

Combined function controls, color coding, and functional front-panel layout make the 314 **easy to use.** Probes mount on the side, permitting an uncrowded front panel and large crt.

The 1 mV/div sensitivity is particularly useful for measurement of transducer signals such as those from magnetic recording heads. An **autoerase mode,** with variable erase period from 1 to 5 seconds, enhances the ability of the 314 to make measurements on slowly changing analog signals such as those from a pressure transducer. Other applications for the 314 occur in industrial control systems, biophysical instrumentation, communication terminals, POS terminals, computer peripherals, and communication systems.

VERTICAL DEFLECTION

Bandwidth and Rise Time — Dc to at least 10 MHz. Rise time, 36 ns or less for a 4 div step input. For ac coupling, the lower 3 dB point is 10 Hz or less.

Deflection Factor — 1 mV/div to 10 V/div (1-2-5 sequence), accurate ±3%. Continuously variable between steps and to at least 25 V/div (uncalibrated).

Display Modes — Ch 1, Ch 2 (normal or inverted), chopped, alternate, added, and X-Y.

Input R and C — 1 MΩ paralleled by approx 47 pF.

Max Input Voltage — ac or dc coupled, 500 V (dc + peak ac).

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL DEFLECTION

Time Base — 1 μs/div to 5 s/div. X10 mag extends sweep rate to 100 ns/div.

Variable Time Control — Uncalibrated, continuously variable between steps and to at least 12.5 s/div.

Time Base Accuracy, center 8 div

Unmagnified	
1 μs/div to 0.2 s/div	±3%
0.5 s/div to 5 s/div	±4%
Magnified	
50 ms/div to 0.5 s/div	±5%
0.5 μs/div to 20 ms/div	±4%
0.1 μs/div and 0.2 μs/div	±5%

TRIGGER

Modes — Normal (sweep generator requires a trigger to generate a sweep). Automatic (minimizes trigger adjustment. Sweep generator free-runs in the absence of a trigger). Normal (sweep generator requires a trigger to generate a sweep). Single sweep (one sweep is initiated by the first trigger after a reset).

Trigger Sources — Internal: Ch 1, Ch 2 or composite, external.

Trigger Sensitivity and Coupling

Coupling		To 1 MHz	At 10 MHz
Dc	Internal	0.3 div deflection	1 div deflection
	External	150 mV	500 mV
Ac	requirements increase below 30 Hz		
Ac Lf Reject	requirements increase below 50 kHz		

X-Y OPERATION

Input — X axis input is via the external horizontal input connection. Both Ch 1 and Ch 2 provide vertical inputs. Using chopped mode, two simultaneous X-Y displays can be obtained.

X-axis Deflection Factors — Continuously variable from 20 mV/div to 2 V/div. Bandwidth, dc to at least 200 kHz.

Input Impedance — 1 MΩ ±2% paralleled by approx 62 pF.

DISPLAY

Crt — 8 x 10 div (0.6 cm/div) display. P44 phosphor. 2 kV accelerating potential.

Graticule — Internal, non-illuminated. Vertical and horizontal centerlines marked in 5 minor div per major 0.6 cm/div.

Z-axis input — Range +5 V to +20 V (dc coupled) with a 100 kHz or greater usable frequency range. Max input voltage, 50 V (dc + peak ac).

STORAGE FEATURES

Display Modes — Direct view, bistable storage, and non-store modes. Enhance mode to increase stored writing rate in the single sweep mode. Auto erase mode to automatically erase stored display after each sweep. Viewing time before auto erase can be varied from 1 sec or less to at least 5 sec. Integrate mode increases stored brightness of very fast repetitive signals.

Stored Writing Speed — Normal, at least 80 div/ms. Enhanced increases to at least 400 div/ms (250 cm/ms) in enhanced mode.

Erase Time — 300 ms.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: −15°C to +55°C. Nonoperating: −40°C to +75°C.

Altitude — Operating: to 20,000 ft max, decrease max temperature by 1°C/1000 ft from 5000 ft to 20,000 ft. Nonoperating: 50,000 ft max.

Vibration — Operating: 15 minutes along each of the three major axes. .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Nonoperating: 5 cycles (120 hours) of MIL-Std-202D, Method 106C. Omit freezing and vibration and allow a post-test drying period at 25°C ±5°C and 20% to 80% relative humidity.

Shock — Operating and nonoperating: 30 g's, ½ sine, 11 ms duration each direction along each major axis. Total of 12 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator — 0.5 V accurate ±1% from 20°C to 30°C, ±2% from −15°C to +55°C.

Power Sources — External ac source, 90 V to 132 V or 180 V to 264 V with a line frequency of 48 Hz to 440 Hz. Max power dissipation 29 W at 115 V. External dc source, +11 V to +14 V or +22 V to +28 V with a max current drain of 1.6 A at +12 V or 0.8 A at +24 V.

Dimensions	in	cm
Height	4.4	11.2
Width (with handle)	9.3	23.6
Depth (handle not extended)	13.6	34.7
Depth (handle extended)	17.6	44.8
Weights (approx)	**lb**	**kg**
Net (without accessories)	10.5	4.7
Shipping	17.0	7.6

INCLUDED ACCESSORIES

Two P6149 10X probes (010-6149-03), carrying case (016-0612-00), external dc cable assembly (012-0406-00); strap (346-0131-00), two 1.6-A fuses (159-0098-00), two 0.8-A fuses (159-0132-00), two 0.15-A fuses (159-0130-00), three 0.16-A fuses (159-0131-00).

ORDERING INFORMATION

314 Storage Oscilloscope $2385

The SONY®/TEKTRONIX® 314 is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan the 314 is available from Tetkronix, Inc., its marketing subsidiaries and distributors.

RECOMMENDED CAMERA

C-30AP General Purpose Camera $690

Camera Adapter-Mounts C-30AP to 314.
Order 016-0327-00 . . . . . **$42**

For further information see camera section.

5-MHz, 5 mV/div to 100 V/div

Internal Battery Pack

Integral 1 MΩ probe

The 221 miniscope weighs just 3.5 pounds and easily **fits into a tool box or brief case;** it measures only 3 x 5¼ x 9½ inches. Yet it has the capability needed for on-site service of much of today's complex equipment. This versatile miniscope has a **5-MHz bandwidth,** 5 mV/div sensitivity, and 0.1 μs/div sweep speed (using X10 magnifier) **packaged in an impact-resistant case.**

Internal **rechargeable batteries** allow at least three hours' operation away from external power sources. And the 221 will operate and charge from practically all the world's principal line voltages: 90 to 250 V, 48 to 62 Hz ac, or 80 to 250 V dc (all without making any change to the instrument).

The **1 MΩ low-capacitance probe** minimizes circuit loading. And because it's attached, it's always there when you need it. Vertical deflection factors extend from 5 mV/div, allowing on-screen measurement of signals up to 600 V dc + peak ac. The 1 μs/div to 200 ms/div time base is enhanced by a 10X magnifier that extends the fastest range to 0.1 μs/div. A variable control will slow the sweep to about 0.5 s/div.

A single rotary control on the 221 is used for all trigger level and slope functions. Controls are side mounted and recessed for protection, yet are highly accessible.

In applications where it is necessary to "float" the oscilloscope to make your measurements, these can be elevated to 700 V (dc + peak ac) above ground when operated from batteries. Although insulated, caution should be observed when connecting the probe to test points.

The 221 is used in a wide assortment of service applications. For example, in data transmission systems, the 221 is preferred for maintenance and testing of modems, because of its ability to see higher frequency noise. It can even help in building roads... by spot checking motors in a road grader's closed loop servo system that controls blade angle, depth of cut, and machine direction.

VERTICAL DEFLECTION

Bandwidth — Dc to 5 MHz (−3 dB point) at all calibrated deflection factors. Lower −3 dB point ac coupled is approx 2 Hz.

Deflection Factor — 5 mV/div to 100 V/div, accurate 3% from 0°C to +40°C and ±5% from −15°C to 0°C and +40°C to 55°C. Uncalibrated, continuously variable between steps to at least 300 V/div.

Input R and C — Approx 1 MΩ paralleled by approx 29 pF via attached signal acquisition probe.

Max Input Voltage — 600 V (dc + peak ac), 600 V p-p ac, 5 MHz or less.

HORIZONTAL DEFLECTION

Time Base — 1 μs/div to 200 ms/div, accurate ±3%.

Magnifier — Increases all sweep speeds X10 with a max sweep speed of 0.1 μs/div.

Variable Time Control — Extends minimum sweep rate to approx 0.5 s/div. Continuously variable between calibrated settings.

TRIGGER

Modes — Automatic or manual. Level and slope selected with a single control. Automatic operation minimizes trigger adjustment and provides a bright baseline with no input.

Trigger Sensitivity

Mode	To 1 MHz	At 5 MHz
Internal	0.5 div	1 div
External	0.5 V	1 V

X-Y OPERATION

Input — X-axis input is via the external trigger or the external horizontal input.

X-axis Deflection Factor — 1 V/div ±10%, dc to 500 kHz. Sensitivity is increased by a factor of 10 (0.1 V/div) using horizontal magnifier.

Max External Horizontal Input Voltage — 200 (dc + peak ac), 200 V (p-p ac) to 500 kHz, decreasing to 20 V p-p ac at 5 MHz.

Input Impedance — Approx 0.5 MΩ paralleled by approx 30 pF.

DISPLAY

Crt — 6 x 10 div (0.5 cm/div) display. P31 phosphor normally supplied; P7 optional without extra charge. 1 kV accelerating potential.

Graticule — Internal, black line, non-illuminated.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: (battery only), −15°C to +55°C. Charging or operating from ac line: 0°C to +40°C. Nonoperating: −40°C to +60°C.

Altitude — Operating: 25,000 ft, decrease max temperature by 1°C/1000 ft above 15,000 ft. Nonoperating: 50,000 ft.

Vibration — Operating and nonoperating: 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in one minute cycles. Held for 3 min at 55 Hz.

Humidity — 5 days at +50°C, 95% humidity.

Shock — Operating and nonoperating: 100 g's, ½ sine, 2 ms duration each direction along each major axis. Total of 12 shocks.

OTHER CHARACTERISTICS

Power Sources — Internal NiCd batteries provide at least 3 hours operation at max trace intensity for a charging and operating temperature between +20°C and +30°C. Internal charger charges the batteries when connected to an ac line with instrument turned on or off. Dc operation is automatically interrupted when battery voltage drops to approx 10 V to protect batteries against deep discharge. Full recharge requires approx 16 hours. Extended time charges will not damage the batteries. An expanded scale battery meter indicates full, low, and recharge. External power source, 90 to 250 V ac (48 to 62 Hz) or 80 to 250 V dc, 5 W or less.

Insulation Voltage — 500 V rms or 700 V (dc + peak ac) when operated from internal batteries, with the line cord stored and the plug protected. When operated from an external line, line voltage plus floating voltage not to exceed 250 V rms; or 1.4 x line + (dc + peak ac) not to exceed 350 V.

Dimensions	in	cm
Height	3.0	7.6
Width	5.2	13.3
Depth	9.0	22.8
Weights (approx)	**lb**	**kg**
Net (without accessories)	3.5	1.6
Shipping	≃8.0	≃3.6

INCLUDED ACCESSORIES

Viewing hood (016-0199-01), carrying case (016-0512-00), neck strap (346-0104-00), Two spare fuses (159-0080-00).

ORDERING INFORMATION

221 Oscilloscope, including batteries and probe $975

INSTRUMENT OPTION

Option 76, P7 Phosphor . . . . . No Charge

OPTIONAL ACCESSORIES

Alligator Clip Kit — A pair of alligator clips that allow connecting the probe and ground lead to large (up to ⅜ in) conductors. Includes: red clip (015-0229-00); yellow clip (015-0230-00); 6-32 to probe adapter (103-0051-01).
Order 015-0231-00 . . . . . $10.00

Probe-tip to BNC Panel Connector Adapter
Order 013-0084-01 . . . . . $8.00

Probe-tip to BNC Cable Adapter
Order 103-0096-00 . . . . . $8.00

Power Cable Adapter Assembly — A short length of two-wire power cord. One end has a female NEC socket fitting the 200-Series power cords; the other end is left open so that the wires can be attached to a non-NEC male power plug. Plugs not supplied.
Order 161-0077-01 . . . . . $3.50

213 | 1-MHz Miniscope/DMM

DMM and Miniscope in One Unit

Compact and Lightweight

True Rms Voltage and Current Measurements

Internal Battery

Rugged Construction

The 213 combines a precision, **3½ digit digital multimeter and a 1 MHz oscilloscope** in one instrument. It is a compact (3 x 5.2 x 8.9 inches) and lightweight (only 3.7 pounds) package that **will easily fit into your briefcase or tool kit.**

In operation the light weight 213 can be hand held, rested on the equipment being tested, or carried on a convenient neck-strap. Operating controls of the 213 are designed to be easily understood and to speed measurements.

The small size and internal battery power assures that the 213 can easily make measurements at many locations often inaccessible or impractical for other, larger instruments. Rugged construction equips the 213 to withstand hostile industrial or transportation environments. Battery operation and a **double-insulated case** aid the operator in isolating the 213 from ground or power line when making measurements at elevated voltage.

The 213, combining both oscilloscope and DMM functions, fits a multitude of on-site service applications. To pick just one, the 213 is used extensively for preventative maintenance on industrial control systems.

VERTICAL DEFLECTION (VOLTAGE)

Bandwidth — Dc to 1 MHz (−3 dB point) for 20 mV/div to 100 V/div deflection factors. Dc to 400 kHz (−3 dB point) for 5 mV/div and 10 mV/div. Lower −3 dB point for ac coupling is approx 1 Hz.

Deflection Factor — 5 mV/div to 100 V/div (1-2-5 sequence), accurate ±3%. Uncalibrated; continuously variable between steps to at least 250 V/div.

Input R and C — 10 MΩ paralleled by 150 pF for 5 mV/div through 1 V/div and 100 pF for 2 V/div through 100 V/div.

Max Input Voltage

Input Condition	Max Input Voltage
Dc coupled, 5 mV/div to 1 V/div	500 V (dc + peak ac) at 1 MHz or less
Ac coupled, 5 mV/div to 1 V/div	800 V (dc + peak ac) 500 V peak ac component
Ac, Dc coupled, 2 V/div to 100 V/div	800 V (dc + peak ac) at 1 MHz or less

VERTICAL DEFLECTION (CURRENT)

Bandwidth — Dc to at least 400 kHz (−3 dB point) for 20 μA/div through 100 mA/div deflection factors. Dc to at least 200 kHz (−3 dB point) for 5 μA/div and 10 μA/div.

Deflection Factor — 5 μA/div to 100 mA/div (1-2-5 sequence), accurate ±3%. Uncalibrated; continuously variable between steps to at least 250 mA/div.

Max Input Current — 2 A rms or 3 A peak for any range (fuse and diode protection).

HORIZONTAL DEFLECTION

Time Base — 2 μs/div to 500 ms/div (1-2-5 sequence), accurate ±5%.

Variable Magnifier — Increases all sweep speeds to at least X5 with a max sweep speed of 0.4 μs/div.

TRIGGER

Modes — Normal (sweep runs when triggered). Automatic (sweep free-runs in absence of trigger signal or for frequencies below 7 Hz).

Trigger Sensitivity and Coupling —

Coupling		1 MHz
Ac	Internal (auto)	0.5 div
	Internal (normal)	0.5 div
Dc	External	1 V

DISPLAY

Crt — 6 x 10 div (0.52 cm/div) display. P43 phosphor is standard.

Graticule — Internal, black line, non-illuminated.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: (battery only). −15°C to +55°C. Charging or operating from ac line: 0°C to +40°C. Nonoperating: −40°C to +60°C.

Altitude — Operating: to 25,000 ft, decrease max temperature by 1°C/1,000 ft above 15,000 ft. Nonoperating: 40,000 ft.

Vibration — Operating and nonoperating, 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles. Held for 3 minutes at 55 Hz.

Humidity — 40°C or less, 80% or less relative humidity.

Shock — Operating and nonoperating: 150 g's, ½ sine, 2 ms duration in each direction along each major axis. Total of 12 shocks.

OTHER CHARACTERISTICS

Power Sources — Internal NiCd batteries provide approx 3.5 hours operation at max trace intensity for a charging and operating temperature between 20°C and 30°C. Internal charger charges batteries when connected to an ac line with instrument turned on or off. Dc operation is automatically interrupted when battery voltage drops below 2 V to protect batteries against deep discharge. Full recharge requires approx 16 hours. External power source, 90 to 136 V ac (48 to 62 Hz). Option 1 allows operation from an external 180 to 250 V ac (48 to 62 Hz) or dc supply. Power consumption, 8 watts or less.

Insulation Voltage — 500 V rms or 700 V (dc + peak ac) when operated from internal batteries with line cord and plug stored. When operated from ac, line voltage plus floating voltage not to exceed 250 V rms or 1.4 X line + (dc + peak ac) not to exceed 350 V.

Dimensions	in	cm
Height	3.0	7.6
Width	5.2	13.2
Depth	8.9	22.6
Weights (approx)	**lb**	**kg**
Net (without accessories)	3.7	1.7
Shipping	8.6	3.9

DMM

Provides true rms readings of voltage and current.

DC AND AC VOLTAGE

Range — 0.1 V to 1000 V full scale in 5 ranges.

Resolution — 100 μV at 0.1 V full scale.

Accuracy in Dc Mode — For 25°C ±5°C.

Range (Full Scale)

0.1 V	±0.1% of reading ±3 counts. Temp coef is (±0.015% of reading + 0.04% of full scale) per °C.
1 V	±0.1% of reading ±1 count. Temp coef is (±0.01% of reading + 0.01% of full scale) per °C.
10 V and 100 V	±0.15% of reading ±1 count. Temp coef is (±0.015% of reading + 0.01% of full scale) per °C.
1000 V	±0.2% of reading ±1 count. Temp coef is (±0.02% of reading + 0.01% of full scale) per °C.

Accuracy in Rms Mode — For 25°C ±5°. Temperature coefficient (±0.05% of reading +0.1% of full scale) per °C.

Range	Within % of reading shown ±5 counts*		
	Dc	40 Hz to 4 kHz	4 kHz to 40 kHz
0.1 V	2.5%	1.5%	3.5%
1 V, 10 V, and 100 V	2%	1%	1%
1000 V	2%	1%	2%

*Accuracy limit increases linearly for crest factor greater than 2 up to twice indicated limit for crest factor of 5.

Input Resistance — 10 MΩ

Input Capacitance — 150 pF on 0.1 V to 10 V ranges, 100 pF on 100 V and 1000 V ranges.

Settling Time — DC: 1.5 sec to 0.1% of reading. RMS: 2 sec to 1% of reading.

Max Input Voltage —

Dc Coupled	
0.1 V to 10 V	100 V to 1000 V
500 V (dc + peak ac)	800 V (dc + peak ac)
Ac Coupled	
0.1 V to 10 V	
800 V (dc + peak ac)	

DC AND AC CURRENT

Range — 0.1 mA to 1000 mA full scale in 5 ranges.

Resolution — 100 nA at 0.1 mA full scale.

Accuracy in Dc Mode — For 25°C ±5°C.

Temperature Coef — (±0.02% of reading + 0.04% of full scale) per °C. 0.1 mA ±0.5% ±3 counts. 1 mA to 1000 mA ±0.25% ±3 counts.

Accuracy in Ac Mode —

Range	Within % of reading shown ±5 counts*		
	Dc	40 Hz to 4 kHz	4 kHz to 40 kHz
0.1 mA	2.5%	1.5%	4.5%
1 mA to 1000 mA	2.5%	1.5%	3.5%

*Accuracy limit increases linearly for crest factor greater than 2 up to twice the indicated limit for crest factor of 5.

Settling Time — 1.5 sec to 0.1% of reading.

Max Input Current — 2 A rms or 3 A peak on any scale (fuse and diode protection).

RESISTANCE

Ranges — 1 kΩ to 10 MΩ full scale in 5 ranges.

Resolution — 1 Ω on 1 kΩ scale.

Accuracy — For 25°C ±5°C.

Range	% of Reading
1 kΩ	0.5% ±3 counts
10 kΩ to 1 MΩ	0.5% ±1 count
10 MΩ	1% ±1 count

Settling Time — 2 seconds ±2 counts.

READOUT

Number of Digits — 3½ digits plus decimal point and sign.

Display Size — 1 cm high by 4 cm wide (5 characters).

Overrange Capability — At least 200% of full scale.

Overrange Indication — Readout displays scrambled characters.

INCLUDED ACCESSORIES

Viewing hood (016-0199-01), carrying case (016-0512-00), 2 test leads (alligator clip to banana jack) (red 012-0015-00) (black 012-0014-00), neck strap (346-0104-00), 2 power line fuses (159-0080-00), power line plug adapter (option 01 only) (161-0077-01), identification tag (334-2614-00), identification tag (000-7983-00).

ORDERING INFORMATION

213 Miniscope/DMM including batteries and probe **$1425**

POWER OPTIONS

Option 01, 180 to 250 V ac (48 to 62 Hz) or dc (includes batteries and probe) ..... **No charge**

OPTIONAL ACCESSORIES

Alligator Clip Kit — A pair of alligator clips that allow connecting the probe and ground lead to large (up to ⅜ in) conductor. Includes: red clip (015-0229-00); yellow clip (015-0230-00); 6-32 to probe adapter (103-0051-01).

Order 015-0231-00 ..... **$10**

Probe-tip to BNC Panel Connector Adapter

Order 013-0084-01 ..... **$8**

Probe tip to BNC Cable Adapter

Order 103-0096-00 ..... **$8**

Power Cable Adapter Assembly — A short length of two-wire power cord. One end has a female NEC socket fitting the 200-Series power cords; the other end is left open so that the wires can be attached to a non-NEC male power plug. Plugs not supplied.

Order 161-0077-01 ..... **$3.50**

500-kHz Dual-Trace Storage (214) Miniscope

Dual-Trace

Storage (214)

Internal Battery Pack

500 kHz, 1 mV/div to 50 V/div

Integral 1 MΩ Probe

The 212 and 214 feature similar signal acquisition capabilities: bandwidth to 500 kHz with deflection factors from 1 mV/div to 50 V/div. Both are lightweight (only 3.5 pounds) and compact (3 x 5¼ x 9½ inches). They differ in that the 214 offers storage capabilities. This is useful for viewing non-repetitive or slow moving signals.

Built of impact-resistant plastic and **fully self-contained,** these miniature portables are perfect for applications in severe environments. And they permit "floating" measurements since they are double insulated and can be elevated to 700 V (dc + ac) above ground when operated from batteries. Although insulated, normal caution should be observed when connecting the oscilloscope probe to the test point.

Both the 212 and 214 feature **integral probes** that are color matched with the vertical deflection controls to minimize measurement error. The probes have their own storage space and are part of the instrument — you can't forget and leave them behind. Clip-on 10X attenuators are available for higher voltage applications.

Trigger level and slope functions are simplified to **one rotary control** on the side of the unit. A convenient neckstrap is an included accessory, freeing both hands to perform other tasks.

In the single sweep mode the 214 can be set to wait for, then record, a single event. With this feature, the scope's sweep circuit is armed and will wait for the signal to arrive before it runs. When the signal occurs, the sweep runs once. When combined with storage, this provides the unique capabilities of automatically waiting for an event and then storing it for subsequent viewing.

212 application examples: 1) Monitoring helicopter airframe stress, via transducers, plus monitoring other electrical signals inside the cockpit. 2) Measuring pulse widths for a manufacturer of pacemakers with variable pulse widths.

214 application examples: 1) Helping check out automobile seatbelt systems. 2) Measuring turn-off characteristics of elevator hoist motors. 3) Monitoring biomedical equipment and, via storage, viewing of low frequency physiological signals.

VERTICAL DEFLECTION

Bandwidth — Dc to at least 500 kHz from 10 mV/div to 50 V/div, reducing to at least 100 kHz at 1 mV/div. Lower −3 dB point ac coupled is less than 2 Hz.

Deflection Factors — 1 mV/div to 50 V/div (1-2-5 sequence), accurate ±5%. Uncalibrated, continuously variable between steps to at least 125 V/div.

Display Modes — Ch 1 only, Ch 2 only, or Ch 1 and Ch 2 chopped (approx chop rate — 40 kHz) from 500 ms/div to 2 ms/div of time base, alternate from 1 ms/div to 5 μs/div of time base.

Input R and C — Approx 1 MΩ paralleled by approx 160 pF from 1 mV/div to 50 mV/div; and 140 pF from 100 mV/div to 50 V/div.

Max Input Voltage (1X probe only)

1 mV/div to 50 mV/div	600 V (dc + peak ac) ac not over 2 kHz.
0.1 V/div to 50 V/div	600 V (dc + peak ac) 600 V p-p ac 5 MHz or less

HORIZONTAL DEFLECTION

Time Base — 5 μs/div to 500 ms/div, accurate ±5%.

Variable Magnifier — Increases each sweep rate X5 with a max sweep speed of 1 μs/div.

External Horizontal Input — (Ch 1) — 1 mV/div to 50 V/div ±10%; dc to 100 kHz: X-Y phasing to 5 kHz less than 3°. Input characteristics same as Ch 1.

Max External Horizontal Input Voltage — 50 V (dc + peak ac), 100 V (p-p).

Input Impedance — R and C, 1 MΩ paralleled by approx 30 pF.

TRIGGER

Trigger Modes — Automatic or normal. Level and slope selected with a single control. Automatic operation minimizes trigger adjustment and provides a bright baseline with no input.

Trigger Sensitivity and Coupling

Coupling		to 500 Hz
Dc	Internal (w/composite trigger source)	0.2 div
	Internal (w/ch 2 trigger source)	0.2 div
	External	1 V to 20 V p-p

Single Sweep — Sweep generator produces one sweep when trigger is received. (214 only)

DISPLAY

Crt — Bistable storage, 6 x 10 div (0.52 cm/div) display P44 Phosphor (214 only). P31 Phosphor (212 only).

Graticule — Internal, black line, non-illuminated.

STORAGE FEATURES

Stored Writing Speed — Normal, at least 80 div/ms. Enhanced, increases single-sweep storage writing speed to at least 500 div/ms. Enhance is automatic from 0.1 ms to 5 μs/div in single sweep.

Stored Luminance — At least 8 footlamberts.

Storage Viewing Time — Approx 1 hr.

ENVIRONMENTAL CAPABILITES

Ambient Temperature — Operating: (battery only), −15°C to +55°C. Charging or operating from ac line, 0°C to +40°C. Nonoperating: −40°C to +60°C.

Altitude — Operating: 25,000 ft, decrease max temperature by 1°C/1000 ft above 15,000 ft. Nonoperating: 50,000 ft.

Vibration — Operating and nonoperating: 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in one-minute cycles. Held for three minutes at 55 Hz.

Humidity — 5 cycles (120 hours). 95% relative humidity, referenced to MIL-E-16400F.

Shock — Operating and nonoperating: 150 g's, ½ sine, 2 ms duration in each direction along each major axis. Total of 12 shocks.

OTHER CHARACTERISTICS

Power Sources — Internal NiCd batteries provide approx 5 hours operation (approx 3.5 hours in 214 stored mode) at max trace intensity for a charging and operating temperature between 20°C and 30°C. Internal charger charges the batteries when connected to an ac line with instruments turned off. Battery operation is automatically interrupted when battery voltage drops to approx 10 V to protect batteries against deep discharge. Full recharge requires approx 16 hours. Extended charge times will not damage the batteries.

A pilot light battery-charge indicator light will extinguish when oscilloscope has about 10 min (5 min for the 214) of operating time remaining in the batteries.

External Ac Source — 110 to 126 V, 58 to 62 Hz, 3 W Can be operated at 104 to 110 V with resulting slow discharge of internal batteries.

Insulation Voltage — 500 V rms or 700 V (dc + peak ac) when operated from internal batteries, with the line cord and plug stored. When operated from ac, line voltage plus floating voltage not to exceed 250 V rms; or 1.4X line + (dc + peak ac) not to exceed 350 V.

Dimensions	in	cm
Height	3.0	7.6
Width	5.3	13.3
Depth	9.5	24.1
Weights (approx)	**lb**	**kg**
Net (without accessories)	3.5	1.6
Shipping	7.0	3.2

INCLUDED ACCESSORIES

Viewing hood (016-0199-01), carrying case (016-0512-00), 2.4-A fuses (159-0121-00), identification tags (000-7983-00), identification tag (334-2614-00), carrying strap (376-0104-00).

ORDERING INFORMATION

212 Dual-Trace Oscilloscope, including batteries **$1000**

214 Dual-Trace Storage Oscilloscope, including batteries **$1425**

POWER OPTIONS

Option 01 for 220-250 V, (48 to 62 Hz) includes batteries ..... **No Charge**

Option 02 for 90 to 110 V, includes batteries ..... **No Charge**

OPTIONAL ACCESSORIES

10X Attenuator Package — A slip-on tip to provide lower circuit loading (4.4 MΩ, approx 20 pF) and higher max input voltage 1000 V (dc + peak ac) includes: 10X attenuator (010-0378-01); pincher tip (013-0071-00); flex tip (206-0060-00); banana tip (134-0013-00); IC adapter (206-0203-00).

Order 010-0378-01 ..... **$30**

Alligator Clip Kit — A pair of alligator clips that allow connecting the probe (or optional 10X attenuator) and ground lead to large (up to ⅜ in) conductors. Includes: red clip (015-0229-00); yellow clip (015-0230-00); 6-32 to probe adapter (103-0051-01).

Order 015-0231-00 ..... **$10**

Probe-tip to BNC Panel Connector Adapter

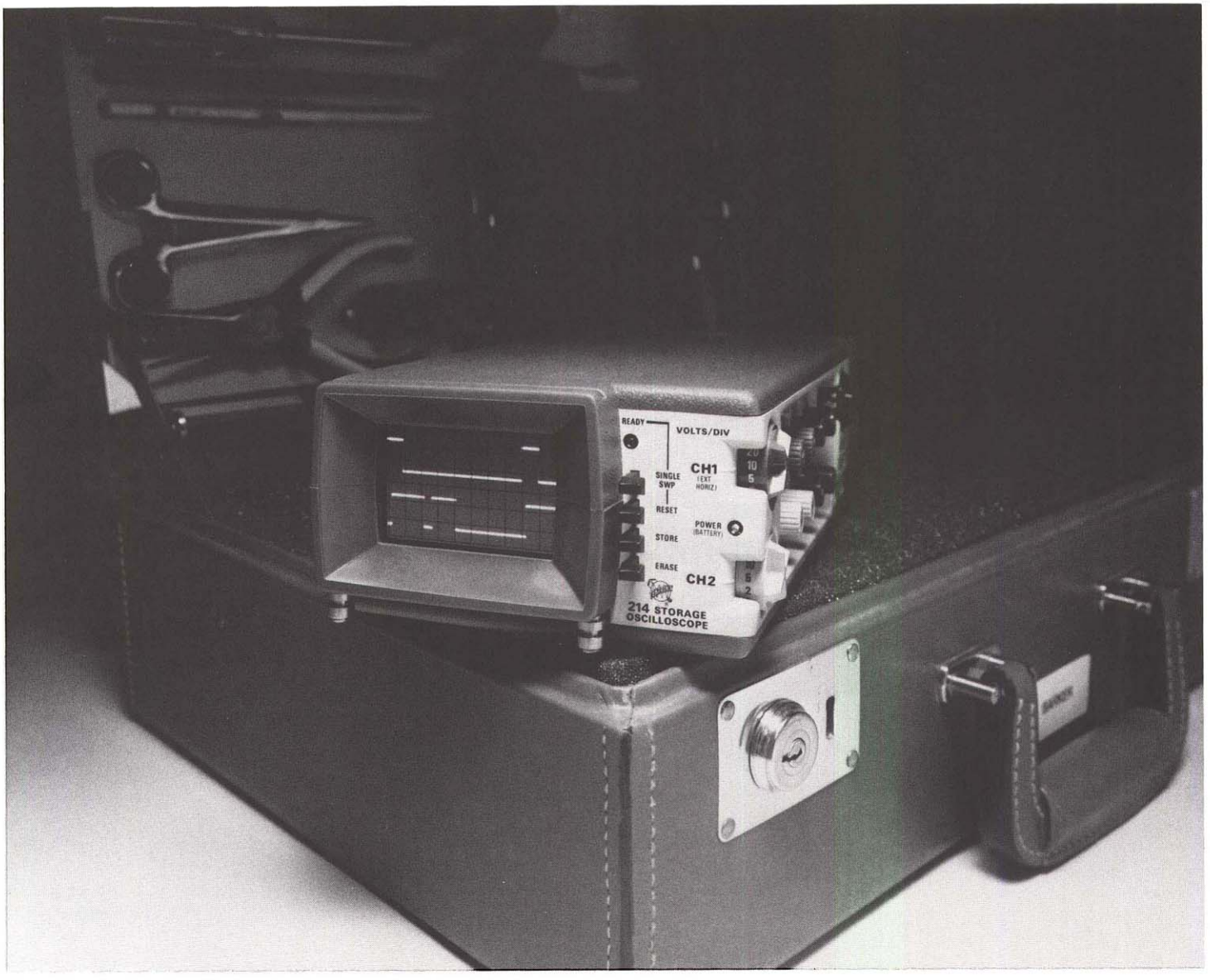
Order 013-0084-01 ..... **$8**

Probe-tip to BNC Cable Adapter

Order 103-0096-00 ..... **$8**

Power Cable Adapter Assembly — A short length of two-wire power cord. One end has a female NEC socket fitting the 200-Series power cords; the other end is left open so that the wires can be attached to a non-NEC male power plug. Plugs not supplied.

Order 161-0077-01 ..... **$3.50**



1105
1106 Battery Power Supplies

1105 BATTERY POWER SUPPLY

The 1105 is a rugged, portable power supply suitable for powering virtually any portable oscilloscope in the field.

Frequency — Square wave, 60 Hz ±10%.

Amplitude — Approx 108 V peak, operating from 24 V dc external or 22 V internal charge. Approx 137.5 V peak, operating from 28 V dc external or 30 V internal charge.

Amplitude (Option 01) — Approx 216 V peak, from 24 V dc external or 22 V internal charge. Approx 275 V peak, operating from 30 V dc external or 28 V internal charge.

Charging Power Source — 100 to 132 V ac, 48 to 440 Hz (or internal connections expand range). Option 01 — 200 to 264 V ac, 48 to 440 Hz (or internal connections expand range).

Battery Operating Time — Approx 140 VA hours.

Recommended Max Output Current — 0.9 amp.

Weight — 19.5 lb.

ORDERING INFORMATION

1105 Battery Power Supply **$795**

Option 01, 230 V Operation . . . . . **No Charge**

1106 BATTERY PACK

The 1106 is a convenient, snap-on battery power supply for TEKTRONIX 455, 464, 465, 466, or 475 Option 07 475A Oscilloscopes.

Output Power — 22 to 26 V dc; 140 watt-hours from full charge.

Charging Power Source — 90 to 132 V ac, 50 to 400 Hz; or 180 to 264 V ac, 50 to 400 Hz.

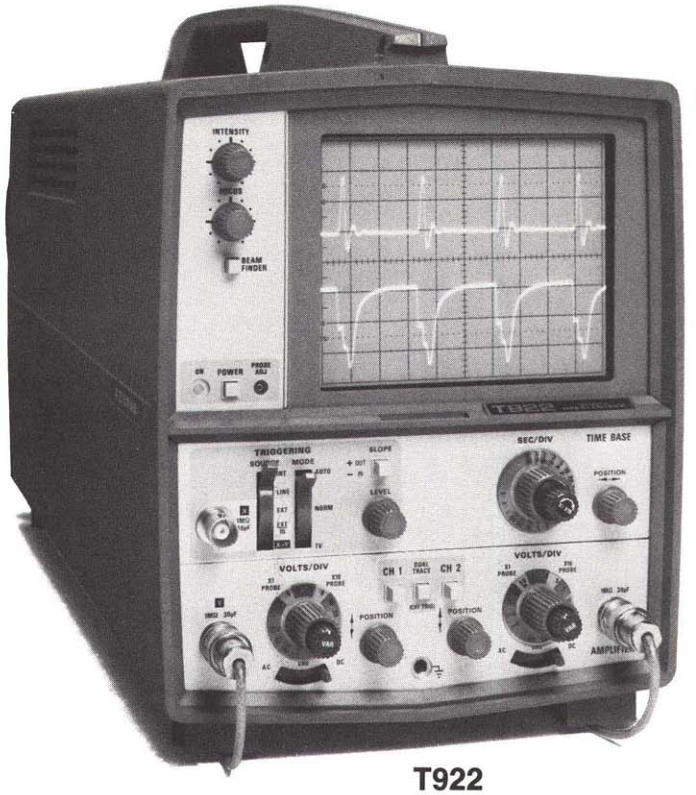
Charging Time — 14 to 16 hours.

Weight — 16 lb.

1106 Battery Pack **$525**

T900-Series Oscilloscopes

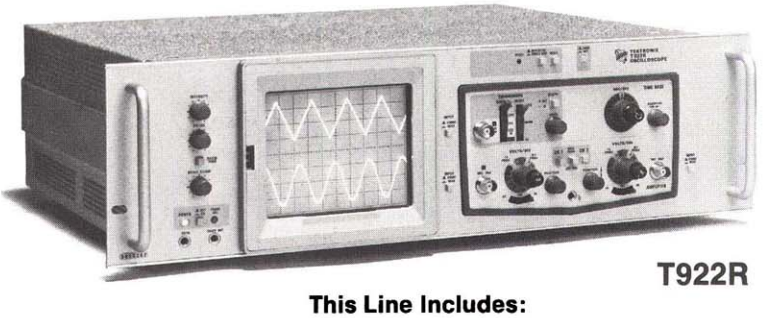
Here's an important line of oscilloscopes for engineers, technicians, and educators who want the quality, reliability, and support associated with TEKTRONIX products — all at a lower price. T900 Oscilloscopes are designed for convenience and cost savings without sacrifice of basic performance.



T922

T921

T912



T922R

T932

T935

Easy to Use

T900 Oscilloscopes are simple to operate. Each has a large, bright (8 x 10 cm) crt, beam finder, single knob trigger control, delay line to enable viewing of waveform leading edge, automatic selection of tv line or frame display, and functionally color-coded control panels. Convenience is further enhanced by a full complement of accessories, including 10X probes (included in price on bench-top models), optional scope stand, camera, and rain jacket. T900 Oscilloscopes are also easy to handle and fit into small spaces. They weigh 15-18 lb and measure only 7 x 10 x 19 inches. The T922R measures 5¼ x 17 x 19 inches and weighs 20 lb.

This Line Includes:

T912 — (Storage Model) Dc to 10 MHz, Dual-Trace, Mono Time Base $1300

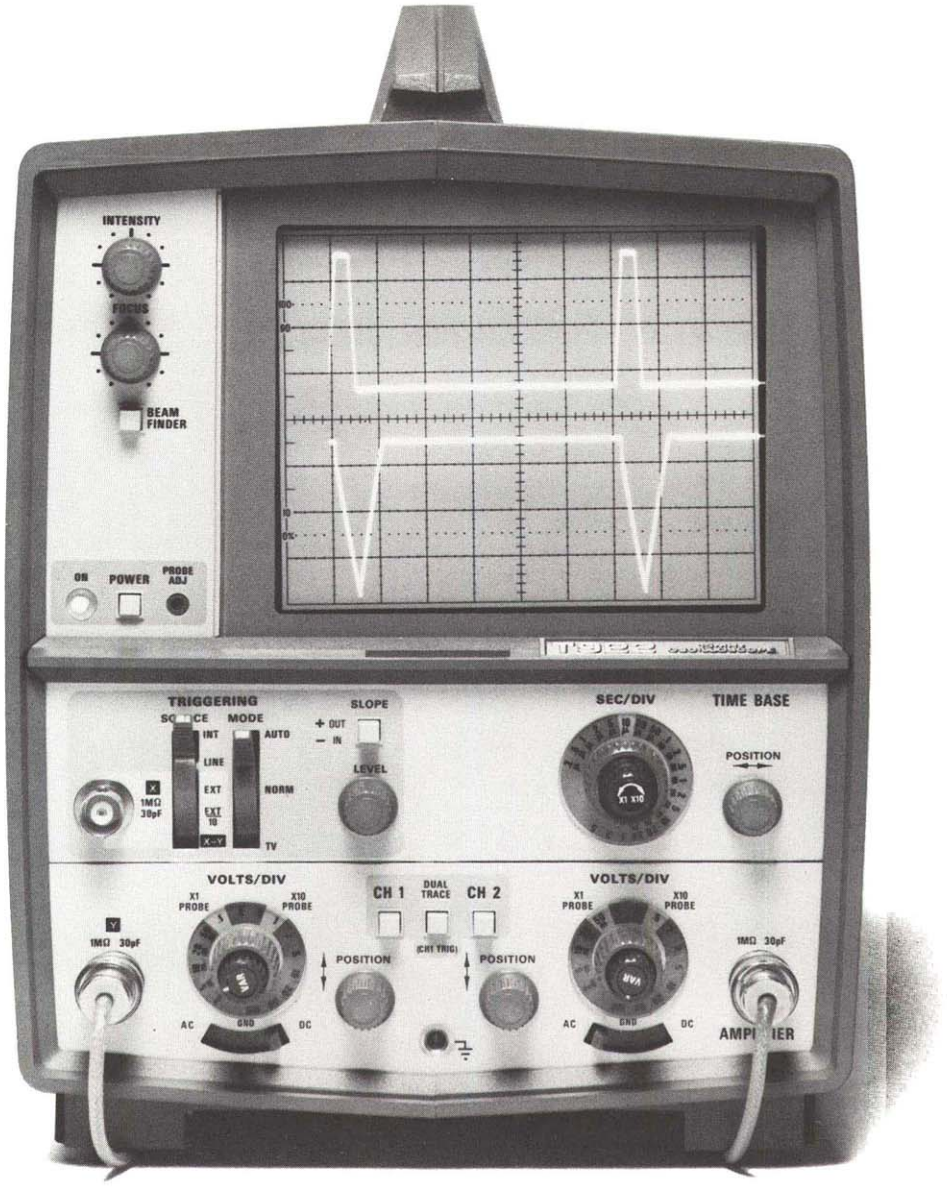
T921 — Dc to 15 MHz; Single-Trace, Mono Time Base $695

T922 — Dc to 15 MHz; Dual-Trace, Mono Time Base $850

T932 — Dc to 35 MHz; Dual-Trace, Mono Time Base $1195

T935 — Dc to 35 MHz; Dual-Trace, Mono Time Base with Delayed Sweep $1395

T922R — Dc to 15 MHz; Dual-Trace, Mono Time Base $1175



T900-Series Oscilloscope Features

① **12 kV, post-deflection-accelerator crt.** Provides bright 8 x 10 cm displays of low-rep-rate signals, even under adverse lighting conditions.

② **Internal graticule.** Helps eliminate parallax errors in critical measurements.

③ **Small, clearly-defined spot.** Ensures sharp traces and high resolution.

④ **Built-in delay-line.** Let's you see the leading edge of triggering signal.

⑤ **Beam-finder.** Quickly reveals presence or absence of input signal and locates the trace position.

⑥ **Power ON light.** Flashes if line voltage exceeds power supply regulation limits. (Regulated power supplies help insure 3% accuracy in amplitude and timing measurements.)

⑦ **Color-coded controls.** Shorten familiarization time and aid in easy operation. All functionally related controls are colored the same, and grouped for greatest convenience. Green is reserved for triggering controls, blue for mode selectors and red for variable (uncalibrated) controls.

⑧ **Automatic trigger mode.** Provides free-running internal trigger in absence of input signal for quick location of sweep trace.

⑨ **Tv trigger mode.** Automatically provides line or frame-triggered displays for best viewing of composite tv signals.

⑩ **Deflection factor switch.** Wide range (2 mV to 10 V/cm) accommodates all commonly encountered signal amplitudes. Clear windows on switch skirt yield two readings—one for X1 probe, the other for X10 probe. No distracting mental arithmetic to perform. Compensated step attenuator offers constant input impedance across entire bandwidth.

⑪ **Display mode switching.** Dual-trace mode (not provided for T921) provides automatic selection of alternate or chopped-sweep displays for best viewing, depending on selected sweep rate.

⑫ **Sweep rate selector.** Provides sweep rates from 200 ns to 0.5 s/div in 18 steps. (See pages 131 and 135 for T932, T935, and T912 sweep ranges.) Clear window on switch skirt clearly identifies sweep time/cm.

⑬ **Sweep expander control.** Variable from X1 to X10. Calibrated in X10 detent position for 5% accuracy. Expands center one centimeter of display by factor of ten (max), providing maximum equivalent sweep rate of 20 ns/div. (See pages 131 and 135 for T932, T935, and T912 sweep ranges.) For detailed displays of selected waveforms, just position signal to center of screen and turn sweep expander to desired magnification level.

⑭ **Impact-resistant case.** Molded from tough, durable Cycoloy KHP. Provides additional structural strength and attractive finish that doesn't wear off.

⑮ **Specially designed** T900 accessories add to convenience of use, and protection in transport or storage.

⑯ **ENVIRONMENTAL CAPABILITIES**

Temperature

Storage — −55°C to +75°C.

Operating — 0°C to +45°C.

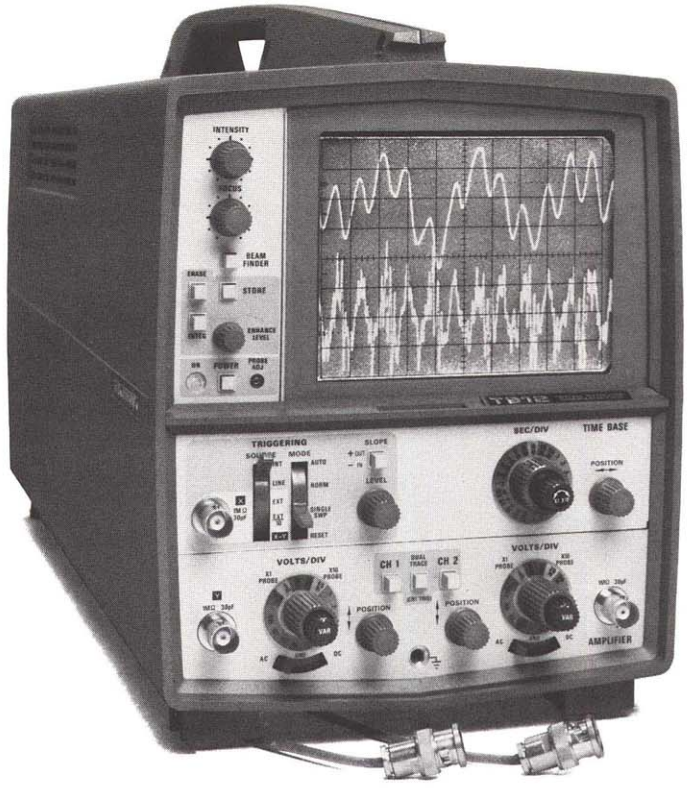
Altitude

Storage — To 15,200 meters; 50,000 ft.

Operating — To 4500 meters; 15,000 ft. Max operating temperature decreased 1°C/304.8 meters (1000 ft) above 1524 meters (5000 ft).

PHYSICAL CHARACTERISTICS

Dimensions	T900 Bench Models	Rackmount
Height	10.0 in (25.4 cm)	5¼ in (13.3 cm)
Width	7.09 in (18.0 cm)	17 in (43.2 cm)
Depth	18.7 in (47.5 cm)	19 in (48.2 cm)
Weight With Panel Cover	15.5 lb (7.0 kg)	
W/O Panel Cover	15.0 lb (6.8 kg)	20 lb (10 kg)



T912 10 MHz Oscilloscope with Storage

250 cm/ms Stored Writing Speed

Dc to 10 MHz at 2 mV/cm

50 ns/cm Sweep Rate (with X10 Sweep Expander)

8 x 10 cm Bistable Storage Crt

Small and Lightweight

Differential Input Option

The T912 Storage Oscilloscope is well-suited for a wide range of applications in education and industry. As a training aid in basic electricity and electronics courses, the storage feature is highly useful in creating visual representations of electrical signals. In physics and engineering courses, storage permits the user to capture and display single-shot events like the pressure curve generated in the chamber of an engine or the stress-strain characteristics of a material undergoing destructive testing.

The T912 has similar industrial applications, where it can also be used to compare input vs feedback signals in servo-mechanisms, shock and vibration analysis, and countless other transducer-aided measurements.

Besides bistable storage, the T912 offers other features seldom found in economy-model oscilloscopes. These include a delay line, which allows you to view the leading edge of fast-rising signals; a 21-step calibrated vertical attenuator; constant bandwidth throughout the sensitivity range of 10 V to 2 mV per centimeter; 18 calibrated sweep rates ranging from 0.5 s to 500 ns/cm; 3% amplitude and timing accuracy; and minimal corner shift over a broad vertical dynamic range.

The T912 may be ordered with a differential input option. In DIFF mode, the T912 displays the difference between Channel 1 and Channel 2 signals. The Channel 2 signal is automatically inverted: the algebraic sum of the Channel 1 signal and the inverted Channel 2 signal is then displayed on the crt.

VERTICAL SYSTEM

Mode Selection

Ch 1 — Displays only the Ch 1 signal.

Ch 2 — Displays only the Ch 2 signal.

Dual Trace — Displays Ch 1 and Ch 2 signals simultaneously. Alternate or chopped mode is automatically selected by the SEC/DIV control setting. Chopped mode is selected for settings $\geq$ 1 ms/div, alternate for settings $\leq$ 500 μs/div. Trigger is derived from Ch 1 signal only.

Deflection Factor

Range — 2 mV/div to 10 V/div in 12 steps in a 1-2-5 sequence.

Accuracy —

+20°C to +30°C	Within 3%
0°C to +45°C	Within 4%

Uncalibrated (VAR) Range — Continuously variable between settings. Extends deflection factor to at least 25 V/div.

Frequency Response — Dc to at least 10 MHz (measured at −3 dB).

Rise Time — 35 ns or less.

Chopped Mode Repetition Rate — $\simeq$ 250 kHz.

Input Resistance — $\simeq$ 1 MΩ.

Input Capacitance — $\simeq$ 30 pF.

Max Input Voltage —

Dc Coupled — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

Ac Coupled — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

HORIZONTAL SYSTEM

Calibrated Range — 0.5 s/div to 0.5 μs/div in 19 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends max sweep rate to 50 ns/div.

Accuracy —

	Unmagnified	Magnified
+20°C to +30°C	Within 3%	Within 5%
0°C to +45°C	Within 4%	Within 6%

TRIGGERING

Trigger Mode

Auto — Permits normal triggering on waveforms with repetition rate of at least 20 Hz. Sweep "free-runs" in the absence of adequate trigger signal, or one with a repetition rate below 20 Hz.

Norm — Permits normal triggering. Sweep does not run in the absence of an adequate trigger signal.

Single Sweep — Displays one sweep only. Sweep cannot be triggered again until reset.

Slope + Out − In — Sweep is triggered on the positive/negative-going slope of the triggering waveform.

Level — Variable control selects the amplitude point on the trigger signal when sweep triggering occurs.

Trigger Sensitivity

Auto and Norm — 0.5 div internal or 100 mV external from 2 Hz to 5 MHz, increasing to 1.5 div internal or 150 mV external at 10 MHz.

External Trigger Input

Max Input — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

Input Resistance — $\simeq$ 1 MΩ.

Input Capacitance — $\simeq$ 30 pF.

POWER SOURCE (AC)

Line Voltage Ranges — 100-120 V, 220-240 V line voltage and HI/LO range are accessible externally.

100-120 V Range — HI: 108 to 132 V rms. LO: 90 to 110 V rms.

220-240 V Range — HI: 216 to 264 V rms. LO: 198 to 242 V rms.

Line Frequency — 50 to 60 Hz.

Power Consumption — Watts (max) 65, amps (max) 0.6, at 120 V, 60 Hz.

CRT STORAGE DISPLAY

Writing Rate — At least 25 cm/ms.

Enhanced Writing Rate — At least 250 cm/ms.

Display Area — 8 x 10 cm, internal graticule.

Storage Phosphor — P1.

Beam Finder — Locates off screen display.

Nominal Accelerating Potential — $\simeq$ 2.76 kV.

PHYSICAL

Weight

With Panel Cover and Accessories — 18.0 lb (8.2 kg).

Without Panel Cover and Accessories — 17.5 lb (7.9 kg).

Specifications for X-Y operation, environmental performance, dimensions and accessories, see T922 information on page 130.

ACCESSORIES

(Included as Standard Equipment)

Probes — 2 each. P6006 general-purpose 10X voltage probes. Provides full bandwidth capabilities for the T912.

T912 — Dc to 10 MHz, Dual-Trace, Single Time Base Storage Oscilloscope (Includes Two 10X Probes) . **$1300**

Option 01, Differential Input . . . . . **add $50**

T921 15 MHz Single-Trace Oscilloscope

T922 15 MHz Dual-Trace Oscilloscope

Dc to 15 MHz at 2 mV/cm

20 ns/cm Sweep Rate with X10 Sweep Expander

Bright (12 kV) Display

Easy to Use

Small and Lightweight

Regulated Power Supplies

Differential Input Option (T922 only)

The T921 (single-trace) and T922 (dual-trace) Oscilloscopes provide the basic functions of a general-purpose oscilloscope at the lowest price consistent with quality construction and reliable performance. Small and easy to operate, they are an excellent choice for the student's workbench in basic electricity, electronics, and physics classes. The same characteristics suit them well for production line applications wherever electronic components, circuits, or equipment must be tested or calibrated. In the manufacturing and servicing of consumer electronics the T921 and T922 are a cost-effective answer to most test and measurement requirements. As a signal processing, measurement and display device for dynamic transducer measurements, both oscilloscopes offer superior performance at a relatively low cost.

Although lightweight (15 lb) and small (7 x 10 x 19 inches), the T921 and T922 provide an especially bright, high resolution, 8 x 10 cm crt display. Even in high ambient light conditions, low-rep-rate signals are easily viewed. Their features shorten familiarization time and help make day-to-day measurements easier and more accurate. Functionally related controls are color coded for easy identification and grouped together for convenience. Chopped or alternate sweep modes are selected automatically to yield the best display for the selected sweep rate.

An option for differential input may be ordered with the T922. In DIFF mode, the T922 displays the difference between Channel 1 and Channel 2 signals. The Channel 2 signal is automatically inverted; the algebraic sum of the Channel 1 signal and the inverted Channel 2 signal is then displayed on the crt.

Measurement accuracy of the T921 and T922 is superior to most similarly priced oscilloscopes. A twelve-step attenuator provides calibrated deflection factors ranging from 2 mV/cm to 10 V/cm. Both models offer 3% vertical amplitude and sweep timing accuracy, with minimal corner shift over a broad vertical dynamic range.

VERTICAL SYSTEM

Mode Selections

Ch 1 — Displays only the Ch 1 signal.

Ch 2 — Displays only the Ch 2 signal (T922 only).

Dual Trace (T922 only) — Displays Ch 1 and Ch 2 signals simultaneously. Alternate or chopped mode is automatically selected by the SEC/DIV control setting. Chopped mode is selected for settings $\geq$ 1 ms/div, alternate for settings $\leq$ 500 μs/div. Trigger is derived from Ch 1 signal only.

Differential Input (T922 Option 01) — Adds Ch 1 and Ch 2 and automatically inverts Ch 2 for a differential display.

Deflection Factor

Range — 2 mV/div to 10 V/div in 12 steps in a 1-2-5 sequence.

Accuracy —

+20°C to +30°C	Within 3%
0°C to +45°C	Within 4%

Uncalibrated (VAR) Range — Continuously variable between settings. Extends deflection factor to at least 25 V/div.

Frequency Response — Dc to at least 15 MHz (measured at −3 dB).

Rise Time — 23 ns or less.

Chopped Mode Repetition Rate (Dual Trace) — $\approx$ 250 kHz.

Input Resistance — $\approx$ 1 MΩ.

Input Capacitance — $\approx$ 30 pF.

Max Input Voltage —

Dc Coupled — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

Ac Coupled — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

HORIZONTAL SYSTEM

Calibrated Range — 0.5 s/div to 0.2 μs/div in 20 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends max sweep rate to 20 ns/div.

Accuracy —	Unmagnified	Magnified
+20°C to +30°C	Within 3%	Within 5%
0°C to +45°C	Within 4%	Within 6%

TRIGGERING

Trigger Mode

Auto — Permits normal triggering on waveforms with a repetition rate of at least 20 Hz. Sweep "free-runs" in the absence of an adequate trigger signal, or with a repetition rate below 20 Hz.

Norm — Permits normal triggering. Sweep does not run in the absence of an adequate trigger signal.

Tv — Provides triggering on tv field when SEC/DIV switch is set at 0.1 ms or slower. Triggers on tv line when SEC/DIV switch is set at 50 μs or faster.

Slope + Out − In — Sweep is triggered on the positive/negative-going slope of the triggering waveform.

Level — Variable control selects the amplitude point on the trigger signal when sweep triggering occurs.

Triggering Sensitivity

Auto and Norm — 0.5 div internal or 100 mV external from 2 Hz to 5 MHz, increasing to 1.5 div internal or 150 mV external at 15 MHz.

Tv — Composite sync 1 div internal or 100 mV external (about 2.3 div or 230 mV of composite video).

External Trigger Input

Max Input — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

Input Resistance — $\approx$ 1 MΩ.

Input Capacitance — $\approx$ 30 pF.

X-Y OPERATION

Sensitivity, Variable Magnifier — $\approx$ 100 mV/div (X10 mag), $\approx$ 1 V/div (X1 mag).

X-Axis Bandwidth — Dc to at least 1 MHz (measured at − 3 dB).

Input Resistance — $\approx$ 1 MΩ.

Input Capacitance — $\approx$ 30 pF.

Phase Difference between X and Y Axis Amplifiers — Within 5° from dc to 50 kHz.

CRT DISPLAY

Display Area — 8 x 10 cm, internal graticule.

Standard Phosphor — P31.

Beam Finder — Locates off screen display.

Nominal Accelerating Potential — $\approx$ 12 kV.

PROBE ADJUST

Output Voltage — $\approx$ 0.5 V.

Repetition Rate — $\approx$ 1 kHz.

Z-AXIS INPUT

Sensitivity — 5 V causes noticeable modulation.

Usable Frequency Range — Dc to 5 MHz.

Input Impedance — $\approx$ 10 kΩ.

POWER SOURCE (AC)

Line Voltage Ranges — 100-120 V, 220-240 V line voltage and HI/LO range are accessible externally.

100-120 V Range — HI: 108 to 132 V rms. LO: 90 to 110 V rms.

220-240 V Range — HI: 216 to 264 V rms. LO: 198 to 242 V rms.

Line Frequency — 50 to 60 Hz.

Power Consumption — Watts (max) 36, amps (max) 0.35, at 120 V, 60 Hz.

ACCESSORIES

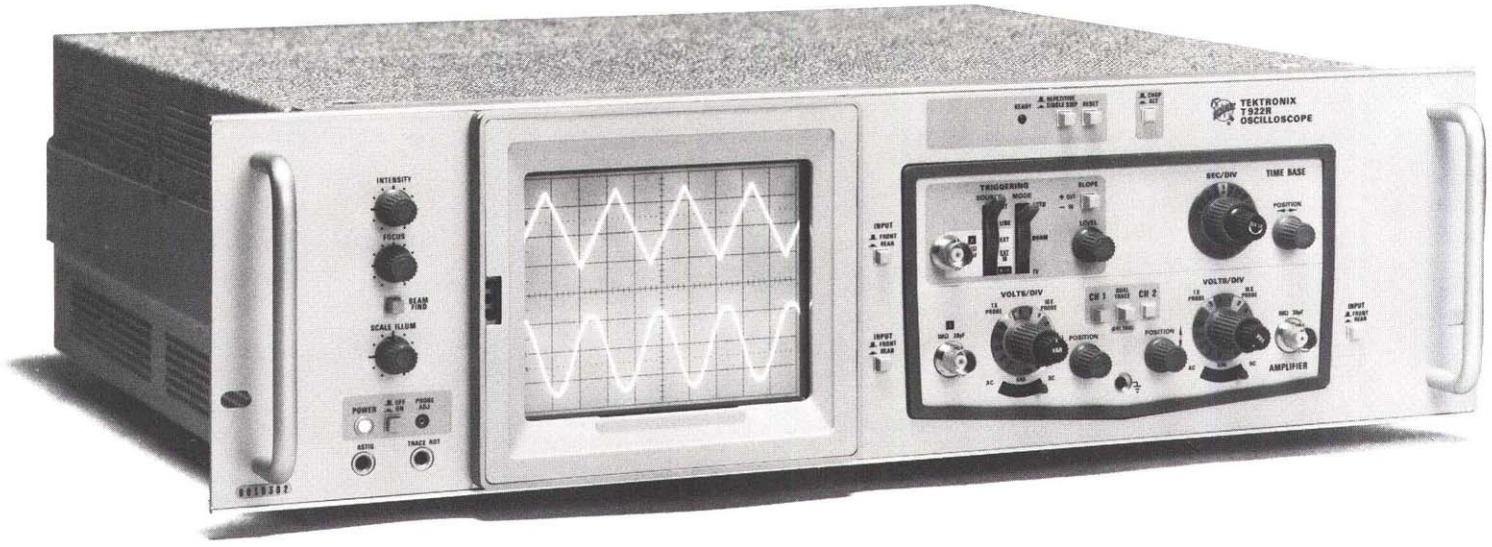
(Included as Standard Equipment)

Probe — P6006 general-purpose 10X voltage probe for each channel. Provides full bandwidth capabilities for either the T921 or the T922.

T921 — Dc to 15 MHz, Single-Trace, Mono Time Base Oscilloscope (Includes One 10X Probe) **$695**

T922 — Dc to 15 MHz, Dual-Trace, Mono Time Base Oscilloscope (includes Two 10X Probes) **$850**

Option 01, Differential Input for T922 . . . . . add $50



T922R 15 MHz Rackmount Oscilloscope

Only 13.3 x 48.2 x 43.2 cm., 10 kg. (5¼ x 19 x 17 in., 20 lb.)
Switchable Front and Rear Signal Inputs
Dc to 15 MHz at 2 mV/cm
Single Sweep Operation
Bright (12 kV) Display

This dual-trace instrument provides general-purpose oscilloscope functions plus monitoring capabilities at the lowest price consistent with quality construction and reliable performance. Front and rear panel inputs are selected by a front panel switch which provides for instant oscilloscope-to-monitor mode change; and you no longer have to remove cables or be bothered with front panel input capacitance. Measuring only 5¼ x 19 x 17 inches (13.3 x 48.2 x 43.2 cm), the T922R is designed and tested for the more rugged applications a rackmount is often subjected to.

Rackmount operating convenience is enhanced by rear panel inputs/outputs: external trigger input, gate out, sweep out, vertical signal out, Z-axis input. Outputs can be used to drive external recorders or other instrumentation. Signal integrity is guarded by ≥80 dB of isolation.

Functionally related controls are color coded for easy identification and grouped together for convenience. Chopped or alternate sweep modes are front-panel selectable to yield the best display for the selected sweep rate.

Measurement accuracy of the T922R is superior to most similarly priced oscilloscopes. A twelve step attenuator provides calibrated deflection factors ranging from 2mV/cm to 10V/cm. The T922R offers 3% vertical and sweep timing accuracy, with minimal corner shift over a broad vertical dynamic range.

Single sweep and graticule illumination facilitate camera operation. The T922R interfaces to most TEKTRONIX Cameras.

The T922R's exceptionally bright display is very useful in high ambient light environments.

T922R SPECIFICATIONS

Seven recessed rear panel BNC connectors provide: Ch 1, Ch 2 vertical signal input, External trigger input, Z-axis input, Sweep Output, Gate Output, Vertical Output.

VERTICAL SYSTEM

Mode Selections

Ch 1 — Displays only the Ch 1 signal.

Ch 2 — Displays only the Ch 2 signal.

Dual Trace — Displays Ch1 and Ch 2 signals simultaneously. Alternate or chopped mode is manually selectable.

Deflection Factor

Range — 2 mV/div to 10V/div in 12 steps in a 1-2-5 sequence.

Accuracy —

+20°C to +30°C	Within 3%
0°C to +45°C	Within 4%

Uncalibrated (VAR) Range — Continuously variable between settings. Extends deflection factor to at least 25 V/div.

Frequency Response — Dc to at least 15 MHz (measured at −3 dB).

Rise Time — 23 ns or less.

Chopped Mode Repetition Rate (Dual Trace) — ≃ 250 kHz.

Input Resistance — ≃ 1 megohm.

Input Capacitance — 30 picofarads.

Maximum Input Voltage — Dc Coupled, 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less. Ac Coupled, 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

HORIZONTAL SYSTEM

Calibrated Range — 0.5 s/div to 0.2 μs/div in 20 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends maximum sweep rate to 20 ns/div.

Accuracy —	Unmagnified	Magnified
+20°C to +30°C	Within 3%	Within 5%
0°C to +40°C	Within 4%	Within 6%

Z-AXIS INPUT

Sensitivity — 5 V signal causes noticeable intensity modulation. Polarity of the voltage causing a decrease in intensity is internally selectable.

TRIGGERING

Trigger Mode

Auto — Permits normal triggering on waveforms with a repetition rate of at least 20 Hz. Sweep "free runs" in the absence of an adequate trigger signal, or with a repetition rate below 20 Hz.

Norm — Permits normal triggering. Sweep does not run in the absence of an adequate trigger signal.

Tv — Provides triggering on tv field when SEC/DIV switch is set at 0.1 ms or slower. Trigger on tv line when SEC/DIV switch is set at 50 μs or faster.

Slope + Out − In — Sweep is triggered on the positive/negative-going slope of the triggering waveform.

Level — Variable control selects the amplitude point on the trigger signal when sweep triggering occurs.

Triggering Sensitivity

Auto and Norm — 0.5 div internal or 100 mV external from 2 Hz to 5 MHz, increasing to 1.5 div internal or 150 mV external at 15 MHz.

Tv — Composite sync 1 div internal or 100 mV external (about 2.3 div or 230 mV of composite video).

External Trigger Input

Maximum Input — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

Input Resistance — ≃ 1 megohm.

Input Capacitance — ≃ 30 picofarads.

X-Y OPERATION

Sensitivity, Variable Magnifier — ≃ 100/mV/div (X10 mag) ≃ 1 V/div (X1 mag).

X-Axis Bandwidth — Dc to at least 1 MHz (measured at −3 dB).

Input Resistance — ≃ 1 megohm.

Input Capacitance — ≃ 30 picofarads.

Phase Difference Between X and Y Axis Amplifiers — Within 5° from dc to 50 kHz.

CRT DISPLAY

Display Area — 8 x 10 cm, illuminated internal graticule.

Standard Phosphor — P31.

Beam Finder — Locates off screen display.

Nominal Accelerating Potential — ≃ 12 kV.

PROBE ADJUST

Output Voltage — ≃ 0.5 V.

Repetition Rate — ≃ 1 kHz.

OUTPUTS

Sweep/Gate Out — Output Voltage is ≃ 5 V positive going into 1MΩ, ≃ 50 mV into 50 Ω load.

Vertical Output — a composite of Ch 1 and Ch 2 with ≃ 0.5 V output per displayed division into a 1MΩ load. ≃ 50 mV with 50 Ω load. Bandwidth is at least 1 MHz.

POWER SOURCE (AC)

Line Voltage Ranges — 100-120 V, 220-240 V line voltage and HI/LO range are accessible externally.

100-120 V Range — HI: 108 to 132 V rms. LO: 90 to 110 V rms.

220-240 V Range — HI: 216 to 264 V rms. LO: 198 to 242 V rms.

Line Frequency — 50 to 60 Hz.

Power Consumption — Watts (max) 36, amps (max) 0.35, at 120 V, 60 Hz.

CAMERAS

T922R interfaces to all Tektronix cameras.

ACCESSORIES

None included as standard equipment.

T922R — Dc to 15 MHz, Dual-Trace, Mono Time Base $1175

T932 35 MHz Dual-Trace Oscilloscope

T935 35 MHz Dual-Trace Oscilloscope with Delayed Sweep

Dc to 35 MHz at 2 mV/cm

10 ns/cm Sweep Rate (with X10 Sweep Expander)

Delayed Sweep (T935)

Trigger Holdoff

Bright (12 kV) Crt Display

Small and Lightweight

The T932 and T935 Dual-Trace Oscilloscopes are designed for cost-sensitive applications that require greater measurement capability than the T921/T922 Oscilloscopes offer. Typical applications include design, production-line testing and servicing of digital equipment such as computer peripherals, point-of-purchase data processors, numerical machine controls, and digital consumer electronics, as well as communications and telemetry equipment. In these and countless similar applications, the T932 and T935 are the logical choices wherever performance and cost are equally important considerations.

The T932 and T935 are general-purpose oscilloscopes providing performance and convenience seldom offered in their price range. Their small size (7 in x 10 in x 19 in), light weight (15 lb), and impact-resistant cases adapt them equally well to a small space on the laboratory bench, in a car trunk, or under an airplane seat. But they also pack the performance capabilities required for many difficult measurement applications.

Features seldom found in moderately priced oscilloscopes include delayed sweep (T935 only) and trigger holdoff capabilities. Displayed signals that reveal insufficient detail on time-base (A) sweep may be selectively expanded using the delayed sweep feature. The trigger hold-off feature permits adjustment of the sweep repetition frequency without changing sweep time per centimeter. Both features are valuable measurement aids, especially in digital design and service applications.

For applications that require delayed sweep the T935 is a logical choice. Except for this feature, it is exactly like the T932 — and only costs $200 more.

VERTICAL SYSTEM

Mode Selection

Ch 1 — Displays only the Ch 1 signal.

Ch 2 — Displays only the Ch 2 signal.

Dual Trace — Displays Ch 1 and Ch 2 signals simultaneously. Alternate or chopped mode is automatically selected by the SEC/DIV control setting. Chopped mode is selected for settings $\geq$ 1 ms/div, alternate for settings $\leq$ 500 μs/div. Trigger is derived from Ch 1 signal only.

Deflection Factor

Range — 2 mV/div to 10 V/div in 12 steps in a 1-2-5 sequence.

Accuracy —

+20°C to +30°C	Within 3%
0°C to +45°C	Within 4%

Uncalibrated (VAR) Range — Continuously variable between settings. Extends deflection factor to at least 25 V/div.

Frequency Response — Dc to at least 35 MHz (measured at −3 dB).

Rise Time — 10 ns or less.

Chopped Mode Repetition Rate — $\approx$ 250 kHz.

Input Resistance — $\approx$ 1 MΩ.

Input Capacitance — $\approx$ 30 pF.

Max Input Voltage — Dc Coupled, 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less. Ac Coupled, 400 V (dc + peak ac) 800 V p-p ac to 1 kHz or less.

HORIZONTAL SYSTEM

Calibrated Range

A Sweep — 0.5 s/div to 0.1 μs/div in 21 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends max sweep rate to 10 ns/div.

B Sweep — (T935 only) 50 ms to 0.1 μs/div in 18 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends max sweep rate to 10 ns/div.

Accuracy —	Unmagnified	Magnified
+20°C to +30°C	Within 3%	Within 5%
0°C to +45°C	Within 4%	Within 6%

Delay Time Position Range — (T935 only) 0.5 to 10 div.

Delay Time Jitter — (T935 only) One part or less in 10,000 (0.01%) of ten times the SEC/DIV switch setting.

TRIGGERING

Trigger Mode

Auto — Permits normal triggering on waveforms with a repetition rate of at least 20 Hz. Sweep "free-runs" in the absence of an adequate trigger signal, or with a repetition rate below 20 Hz.

Norm — Permits normal triggering. Sweep does not run in the absence of an adequate trigger signal.

Tv — Provides triggering on tv field when SEC/DIV switch is set at 0.1 ms or slower. Triggers on tv line when SEC/DIV switch is set at 50 μs or faster.

Slope + Out — In — Sweep is triggered on the positive/negative-going slope of the triggering waveform.

more on next page.

Level — Variable control selects the amplitude point on the trigger signal when sweep triggering occurs.

Trigger Holdoff — Permits adjustment of time interval between end of sweep and next acceptable trigger to achieve stable displays of complex words.

Trigger Sensitivity

Auto and Norm — 0.5 div internal or 100 mV external from 2 Hz to 15 MHz, increasing to 1.5 div internal or 150 mV external at 35 MHz.

Tv — Composite sync 1 div internal or 100 mV external (about 2.3 div or 230 mV of composite video).

External Trigger Input

Max Input — 400 V (dc + peak ac) 800 V p-p ac at 1 kHz or less.

Input Resistance — ≈ 1 MΩ.

Input Capacitance — ≈ 30 pF.

X-Y OPERATION

Sensitivity, Variable Magnifier — ≈ 100 mV/div (X10 mag), ≈ 1 V/div (X1 mag).

X-Axis Bandwidth — Dc to at least 2 MHz (measured at −3 dB).

Input Resistance — ≈ 1 MΩ.

Input Capacitance — ≈ 30 pF.

Phase Difference between X and Y Axis Amplifiers — Within 3° from dc to 50 kHz.

CRT DISPLAY

Display Area — 8 x 10 cm, internal graticule.

Standard Phosphor — P31.

Beam Finder — Locates off-screen displays.

Nominal Accelerating Potential — ≈ 12 kV.

PROBE ADJUST

Output Voltage — ≈ 0.5 V.

Repetition Rate — ≈ 1 kHz.

Z-AXIS INPUT

Sensitivity — 5 V causes noticeable modulation.

Usable Frequency Range — Dc to 5 MHz.

Input Impedance — ≈ 10 kΩ.

POWER SOURCE (AC)

Line Voltage Ranges — 100-120 V, 220-240 V line voltage and HI/LO range are accessible externally.

100-120 V Range — HI: 108 to 132 V rms. LO: 90 to 110 V rms.

220-240 V Range — HI: 216 to 264 V rms. LO: 198 to 242 V rms.

Line Frequency — 50 to 60 Hz.

Power Consumption — Watts (max) 36, amps (max) 0.35, at 120 V, 60 Hz.

ACCESSORIES
(Included as Standard Equipment)

Probes — 2 each. P6108 general-purpose 10X voltage probe provides full bandwidth capability for either the T932 or T935.

ORDERING INFORMATION

T932 — Dc to 35 MHz, Dual Trace, Mono Time Base Oscilloscope (Includes Two 10X Probes) **$1195**

T935 — Dc to 35 MHz, Dual-Trace, Mono Time Base (with Delayed Sweep) Oscilloscope (Includes Two 10X Probes) **$1395**

T900 ACCESSORIES

209 SCOPE STAND

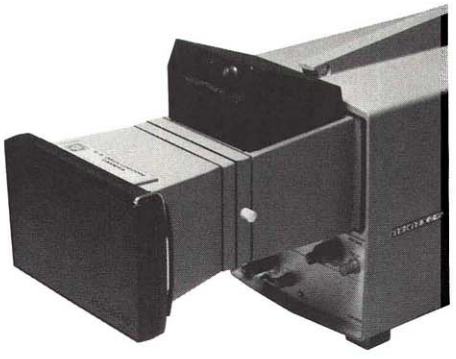
Supports any T900 Oscilloscope at convenient angle for viewing and easy access to controls. Quickly disassembled, it forms a lightweight (3 lb) package that can be neatly attached to the bottom of the oscilloscope for easy carrying. Consists of a molded plastic base, support bracket, and a 15 in aluminum support column.

Order: 209 Scope Stand **$70**

C-5A CAMERA

Recommended for all T900 Oscilloscopes. Attaches directly to front panel without adapters. Uses Polaroid pack film. Has fixed f/16 lens aperture and mechanically-actuated shutter with speeds of 1/5, 1/10, and 1/25 seconds. Bench model T900 oscilloscopes use the C-5A Option 03 which includes a built-in linear xenon tube that flashes to illuminate graticule when shutter opens. T922R uses C-5A Option 01, without xenon flash.

Order: C-5A, Option 03 . . . . . **$250**
C-5A, Option 01 . . . . . **$215**



VIEWING HOOD

Provides for convenient viewing in high ambient light conditions.

Order: Viewing Hood (016-0377-00). **$3**

PROTECTIVE COVERS

Front Panel Cover

Snaps over the oscilloscope front panel to protect controls during transport or storage. Molded from high-impact-resistant plastic. Storage compartment for two probes and cables is built into inner side.

Order: Protective front cover (016-0340-00) **$18**

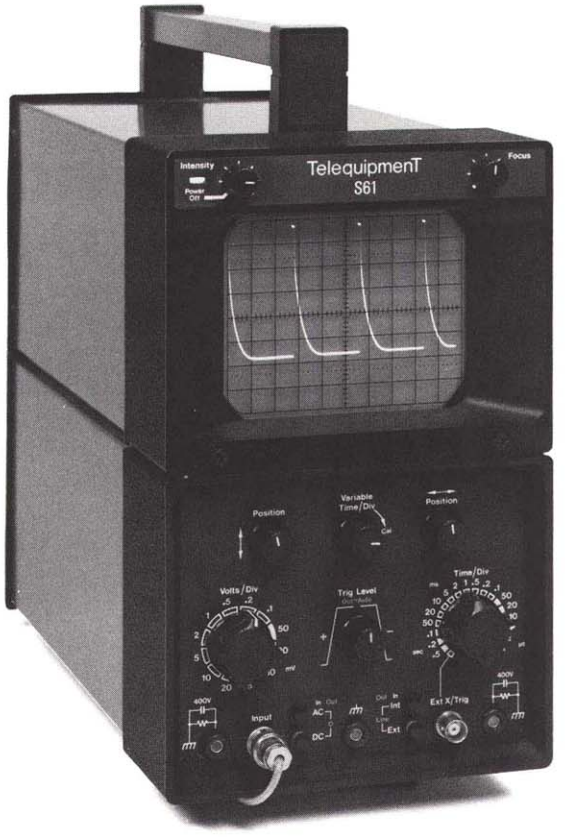
Dust Cover/Rain Jacket (not shown)

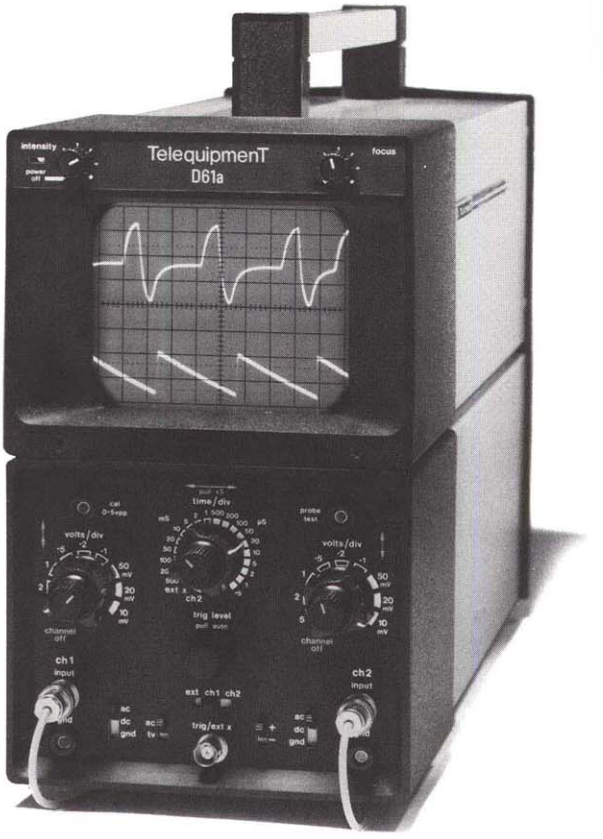
Provides protection against dust accumulation when not in use, and against rain and snow during transportation. Constructed of 15 mil tough durable vinyl. An opening at the top allows access to the oscilloscope handle.

Order: Protective cover (016-0361-00) **$18**

TELEQUIPMENT Oscilloscopes

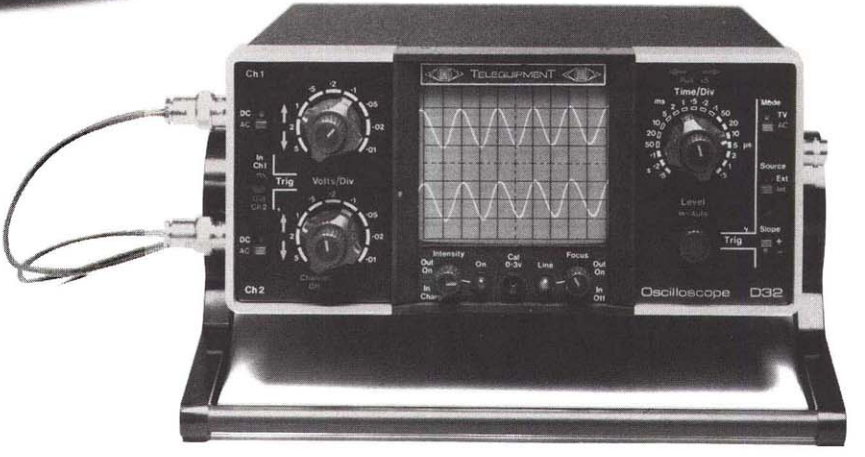
Low cost and a combination of features not normally found in comparably priced oscilloscopes make TELEQUIPMENT instruments an outstanding economy value. Features such as calibrated sweep rate and vertical step attenuators, triggered sweep, probe-calibration outputs and tv triggering make these instruments both versatile and easy to use.

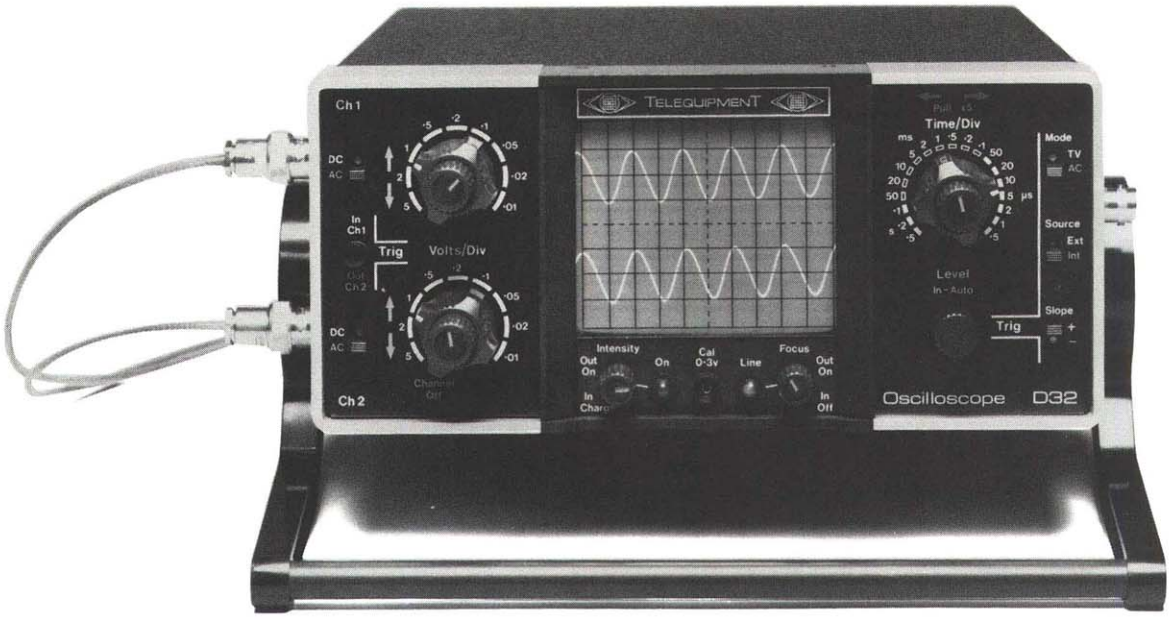




Warranty, sales, and service are the same as other TEKTRONIX products.

Telequipment is a division of Tektronix U. K. Ltd., a wholly owned subsidiary of Tektronix, Inc.





Dc to 10 MHz Bandwidth at 10 mV/div

Dual Trace

Weighs Only 10 lb

Automatic Selection of Tv Line or Frame Display

Automatic Selection of Chopped or Alternate Modes

$750 Includes Probes and Batteries

D32 is one of the most compact and most popular oscilloscopes in the TELEQUIPMENT line.

It offers 10 mV/div to 5 V/div sensitivity in 9 calibrated steps, automatic selection of chopped or alternate mode (depending on sweep speed setting), plus automatic selection of tv line or frame display.

Completely portable, the D32 measures only 4 x 9 x 11 inches, weighs only 10 lb, and can be easily carried. Ac line or battery operation (up to 4 hours continuous) make the D32 convenient to use in almost any environment.

SPECIFICATIONS

VERTICAL SYSTEM

Bandwidth — Dc coupled, dc to approx 10 MHz at 3 dB down. Ac coupled, 3 Hz to approx 10 MHz at 3 dB down.

Rise Time — 35 ns.

Deflection Factor — 10 mV/div in 9 calibrated steps (1-2-5 sequence) accurate within ±5%.

Input R and C — 1 MΩ/32 pF approx.

Max Input Voltage — ±250 V peak.

Display Modes — Channel 1 only, channels 1 and 2 alternate sweep, channels 1 and 2 chopped (at 100 kHz approx), chop or alternate selected automatically.

HORIZONTAL SYSTEM

Sweep Speeds — 19 sweep speeds from 500 ns/div to 500 ms/div in a 1-2-5 sequence. A X5 magnifier operates over the full time base range and increases the fastest sweep speed to approx 100 ns/div. Accuracy at X1 ±5%. X5 100 ms/div-500 ns/div ±7%. 200 ns/div-100 ns/div ±10%.

TRIGGER

Normal — Fully variable over 8 div on all waveforms.

Auto — Bright line in the absence of a trigger signal. Automatic trigger on symmetrical waveforms over 1 div with restricted level control.

Mode — Ac or tv: tv field for sweep ranges 0.5 s/div to 0.1 ms/div and tv line from 50 μs/div to 0.5 μs/div.

Source — Channel 1, Channel 2, or external.

Slope — Positive or Negative.

Sensitivity —

Internal — 0.3 div, 40 Hz to 2 MHz; 1 div, 2 MHz to 10 MHz.

External — 500 mV approx 40 Hz to 5 MHz, 1 V approx 5 MHz to 10 MHz.

CRT

Cathode Ray Tube — 8 x 10 div display area; each div is approx 0.7 cm. P31 phosphor supplied. 3 kV accelerating potential.

OTHER CHARACTERISTICS

Calibrator Output — 300 mV.

Power Requirements — Internal rechargeable battery contains 6 x 1.25 V 'D' cells (7.5 V dc) providing up to approx 4 hrs continuous use.

A built-in charger allows the batteries to be charged in 14 hrs with the instrument switched OFF or trickle charges the batteries if the instrument is switched ON.

Main-line Voltage: 100-125 V ac, 200-250 V ac. Frequency: 50-400 Hz. Consumption: 14 V A (line) 7 V A (battery).

Cooling — Convection.

Dimensions and Weight:

Height	Width	Depth	Net Weight
4 in	9 in	11 in	10.1 lbs
105 mm	230 mm	288 mm	4.5 kg

Included Accessories:

Batteries — 6 'D' cell, rechargeable, 1.25 V each.

Probes — 10 times passive probe, 2 each, each probe has a minimum of a 3.5 ft cable with a BNC connector on one end and a spring loaded sheath on the other.

Front Panel Cover — Molded plastic, fits snugly over instrument face to protect crt, knobs and switches from damage during transportation or storage.

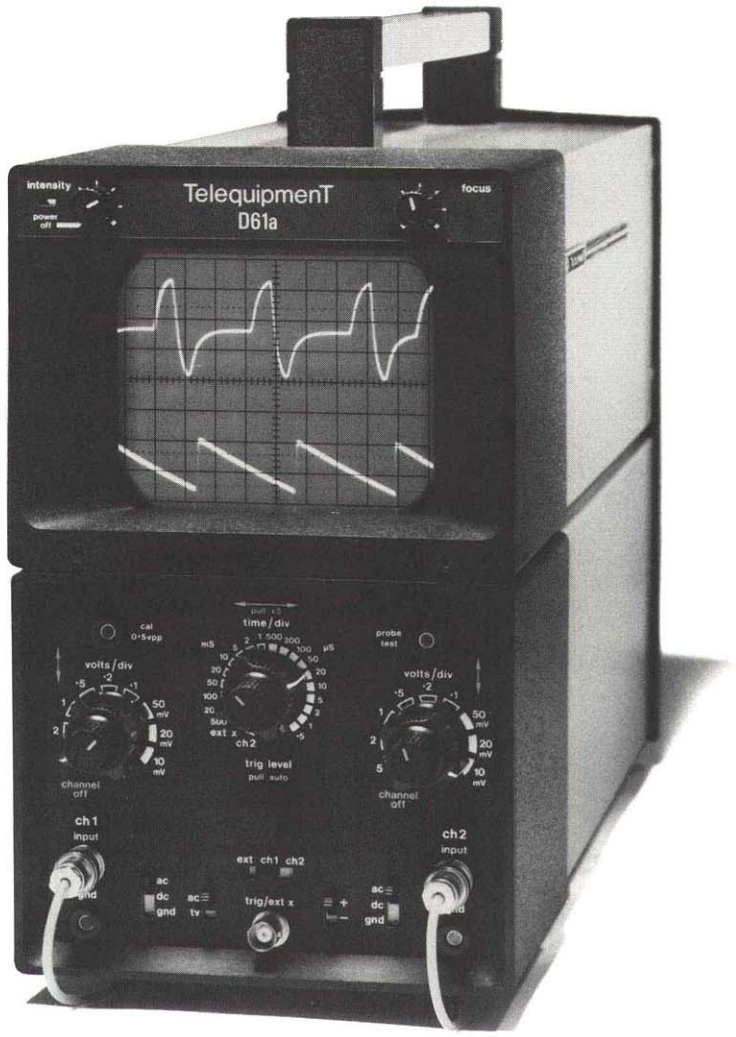
TL D32 Oscilloscope $750

Option 10, External Horizontal Input . . . . . add $50

Optional Carrying Cases:

Shoulder strap carrying case.
Order 016-0601-00 . . . . . $55

Attaché Type Carrying Case.
Order 016-0374-00 . . . . . $41



10 mV/div Sensitivity at 10 MHz

Automatic Triggering

Tv Frame and Line Triggering

Weighs under 15 lb

D61A Oscilloscope is a very economical, 10 MHz dual-trace instrument. It is fully transistorized, lightweight, and easy to use. Operation is simplified by automatic selection of chopped or alternate modes. Automatic selection of line or frame displays occurs in the tv position. Two identical input channels provide excellent X-Y capability, useful for displaying vector patterns when aligning and trouble-shooting color tv sets. New users, such as students and technicians, will find a D61A extremely easy to view and operate.

CHARACTERISTICS

VERTICAL DEFLECTION

Bandwidth and Rise Time — Dc to at least 10 MHz (3-dB down), 35 ns rise time.

Deflection Factor — 10 mV/cm to 5 V/cm in 9 calibrated steps (1-2-5 sequence), accurate within ±5%.

Max Deflection — 8 cm at 5 MHz, decreasing to 5 cm at 10 MHz.

Input R and C — 1 MΩ paralleled by approx 35 pF.

Max Input Voltage — 400 (dc + peak ac).

HORIZONTAL DEFLECTION

Time Base — 500 ns/cm to 500 ms/cm in 19 calibrated steps (1-2-5 sequence), accurate within ±5%.

X5 Magnifier — Operates over full time-base range, increases fastest sweep rate to 100 ns/cm.

Horizontal Amplifier (External X) — 2 Hz to 1 MHz (at 3-dB down); deflection factor approx 250 mV/cm; input impedance 1 MΩ paralleled by approx 10 pF.

TRIGGER

Modes — Automatic or Normal (Trigger Level).

Tv — Triggers on tv field or line; automatically selected by time/div switch.

Sensitivity — Internal, 2 mm deflection 40 Hz to 2 MHz, increasing to 1 cm at 2 MHz. External, 100 mV 40 Hz to 1 MHz increasing to 1 V at 1 MHz.

X-Y OPERATION

Full Sensitivity (Ch 1-Vert, Ch 2-Vert) — 10 mV/cm to 5 V/cm in 9 calibrated steps, accurate within 5%. Bandwidth is dc to at least 1 MHz (−3 dB). Phase difference between amplifiers is less than 1° at 50 kHz.

CRT

CRT — 5 in tube; 8 x 10 div, 1 cm/div; 3.5 kV accelerating potential.

Z-Axis Modulation — Z-axis input is ac coupled. A 10 V negative-going signal blanks the display with good contrast.

OTHER CHARACTERISTICS

Voltage Calibrator — Line-frequency squarewave, 500 mV p-p accurate within 1%.

Power Requirements — Voltage settings are 100-120 V, 48-440 Hz line frequency, approx 25 V A.

Probe Test — Provides a negative going rectangular pulse at time-base frequency to facilitate probe compensation.

Cooling — Convection.

Temperature Limits Ambient — −15°C to +40°C operating; −25°C to +70°C nonoperating.

Dimensions and Weights

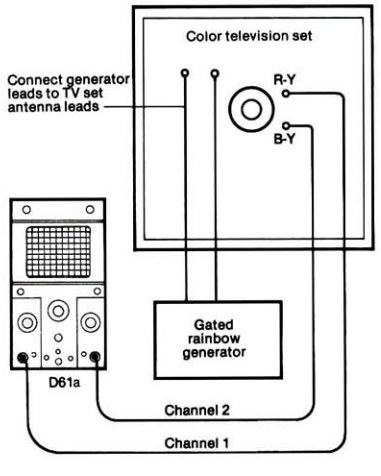
	in	cm
Height	11.0	28
Width	6.3	16
Depth	16.5	42
	lb	**kg**
Net Weight	14.3	6.5

ORDERING INFORMATION

TL D61A Oscilloscope $595

VECTOR DISPLAYS

The TELEQUIPMENT D61A Dual-Trace Oscilloscope is excellent for displaying vector patterns for aligning and trouble-shooting color TV sets. In a vector display mode it can check phase relationships of color signals.



Use the D61A in the "CH 2" mode. Select equal sensitivity settings for both X and Y. Connect channel 1 input to R-Y signal at picture tube. Connect channel 2 input to B-Y signal at picture tube. Generally, X10 probes would be used with vacuum tube sets, XI with solid state sets.

Two simple connections to the picture tube allow the serviceman to produce meaningful displays when used in conjunction of a gated rainbow generator.

TELEQUIPMENT Oscilloscopes

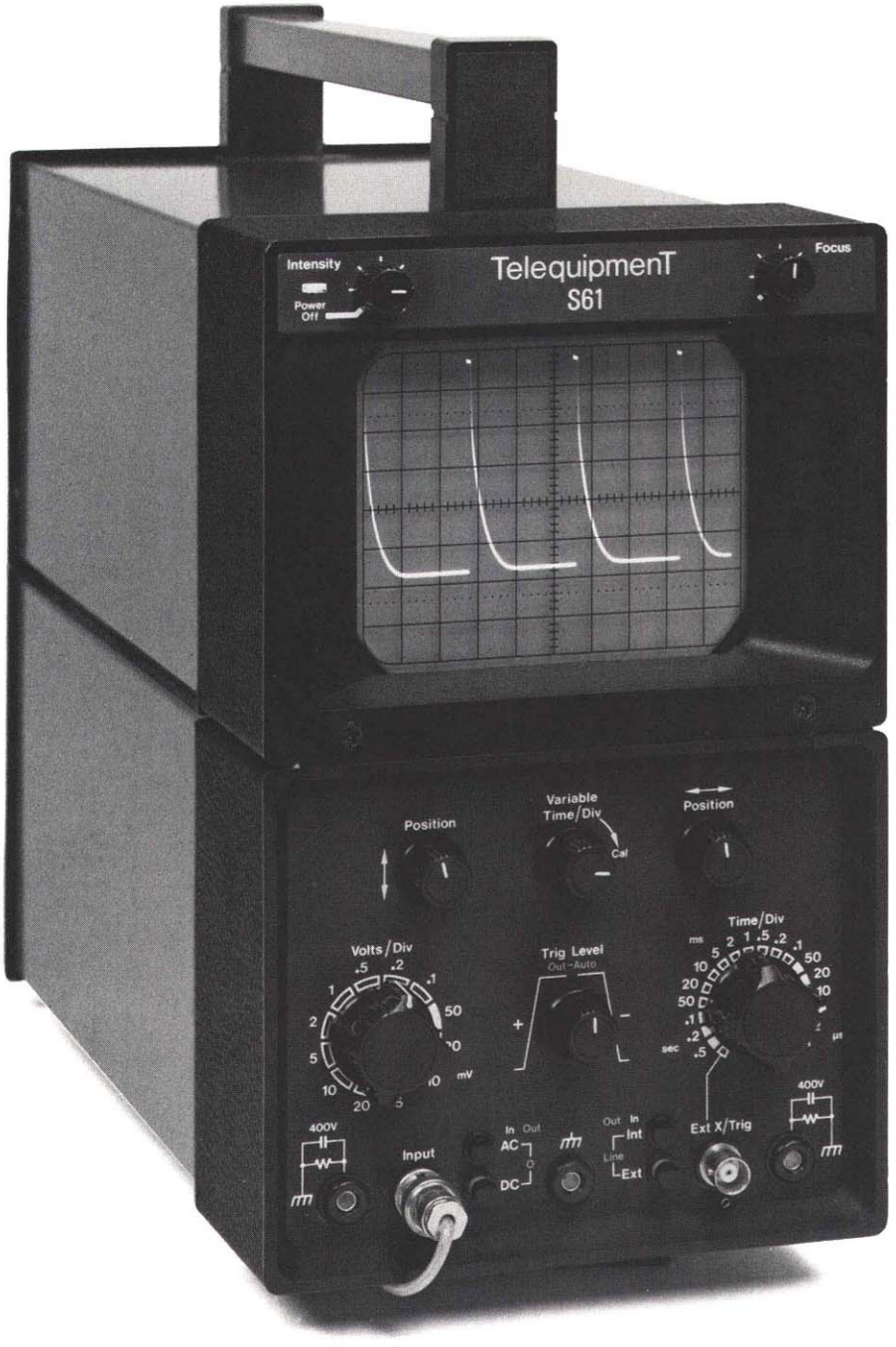
Low Cost 5 MHz Oscilloscope

Dc to 5 MHz Bandwidth

5 mV to 20 V/div Deflection Factors

Automatic Triggering

Single Trace



The S61 Oscilloscope is a very economical, 5 MHz single trace instrument. It is completely solid state with FET input circuitry for minimum drift and fast stabilization time.

It offers 5 mV to 20 V/cm sensitivity and sweep rates from 500 ms/div to 1 μs/div.

An inexperienced operator will find the S61, with very few controls, easy to operate. Automatic triggering provides a baseline in the absence of a signal.

VERTICAL DEFLECTION

Bandwidth and Rise Time — DC to at least 5 MHz (−3-dB down), 70 ns rise time. Low frequency 3-dB down point with ac coupling is 2 Hz.

Deflection Factor — 5 mV/cm to 20 V/cm in 12 calibrated steps (1-2-5 sequence), accurate within ± 5%.

Max Deflection — 8 cm at low frequency, decreasing to 5 cm at 5 MHz.

Input R and C — 1 MΩ paralleled by approx 35 pF.

Maximum Input Voltage — 400 V (dc plus peak ac).

HORIZONTAL DEFLECTION

Sweep Rates — 1 μs/cm to 500 ms/cm in 18 calibrated steps (1-2-5 sequence), accurate within ± 5%. A variable control provides overlap between ranges.

Horizontal Amplifier (external X) — Bandwidth approx dc to 1 MHz (−3 dB down); deflection factor approx 750 mV/cm; input impedance 100 kΩ paralleled by approx 20 pF.

TRIGGER

Modes — Normal, Auto, or Line; bright baseline provided in the absence of a signal in Auto mode.

Sensitivity — Internals, 0.5 cm deflection 40 Hz to 5 MHz. External, 500 mV 40 Hz to 5 MHz.

CRT

Crt — 8 x 10 div 1.0 cm/div; 2 kV accelerating potential.

Z-Axis Modulation — Z-Axis input is ac coupled. A 10 V negative pulse will intensify the trace with good contrast, a positive 10 V pulse will blank the trace.

Phosphor — P31.

OTHER CHARACTERISTICS

Power Requirements — Voltage settings are, 95 V to 130 V or 190 V to 260 V, 48 to 400 Hz, approx 25 VA.

Dimensions and Weights —

	in	cm
Height	11	28
Width	6.3	16
Depth	14.6	37
	Lb	Kg
Net Weight	14.3	6.5

TL S61 Oscilloscope **$375**

Realizing microprocessor potential calls for a new kind of design tool.

THE 8002 MICROPROCESSOR LAB

Acclaimed as one of the most important technological advances of the 1970s, the microprocessor has already brought about a renaissance in new product design. The design team or engineer now faces a new kind of development process. Thanks to the architecture of the microprocessor-based system—functions are created and stored in memory rather than on individual logic components—a design change may often be effected simply by substituting program instructions for hardware. Software thus becomes a significant factor in overall design.

More importantly, however, hardware/software design becomes a dynamic, interactive process, and the integration of the two becomes the critical design phase. For it is during integration that substantial savings in design costs, and design time, can be realized.

Two design approaches have evolved. The microprocessor development aid enables the designer to address microprocessor hardware and software as two interactive parts of a total concept. As originally developed for specific microprocessor components, this design tool can impose restrictions on the designer, limiting him to using a particular type of processor or adding a development aid for each new one.

The alternative is to rely on a time-sharing computer or minicomputer for software development. This process can be time-consuming, and provides no tool for hardware/software integration.

Now Tektronix introduces the 8002 Microprocessor Lab to support several microprocessors, initially the 8080 and the 6800; the Z-80 will be available soon, with more to follow. The 8002 provides software capability for entering, editing, and assembling source language to object code. With its options the 8002 provides for both software and hardware debugging.

The 8002 has three main advantages. First, the 8002 and its options provide a captive software development system which can save time during the program creation cycle. Second, the interactive in-prototype testing technique significantly shortens debug time, and so hastens the integration of hardware and software. Finally, by supporting several microprocessors, the 8002 frees the designer to select a processor solely on the basis of capability and cost-effectiveness.

The 8002: An interactive program development system

Featuring an innovative multiple processor architecture, the 8002 Microprocessor Lab initially supports software development for the 8080 and 6800. Support will soon be available for the Z-80 and support for other microprocessors will become available in the future.

The 8002 enables the user to enter a program via the system terminal, edit it quickly and easily, and assemble source language into executable object code. Software is provided for two processors chosen at the time of purchase.

Files are created and maintained under the direction of the Tektronix Disc Operating System. Software development for each additional microprocessor requires the addition of the appropriate flexible disc.

Several options expand the capability of the 8002. With the program emulation and debugging option, the user can run, test, change, trace, and debug code on an emulator processor that is identical to the processor in the prototype.

With the interactive prototype emulation and debugging option, the user may run, test, change, trace, and debug the program on the prototype. At this level, the prototype is controlled by the emulator processor through the prototype control probe.

With the real-time prototype analysis option, the user can monitor and display logic transactions on the address bus, the data buses, and eight other points in the user's hardware by the analyzer probe.

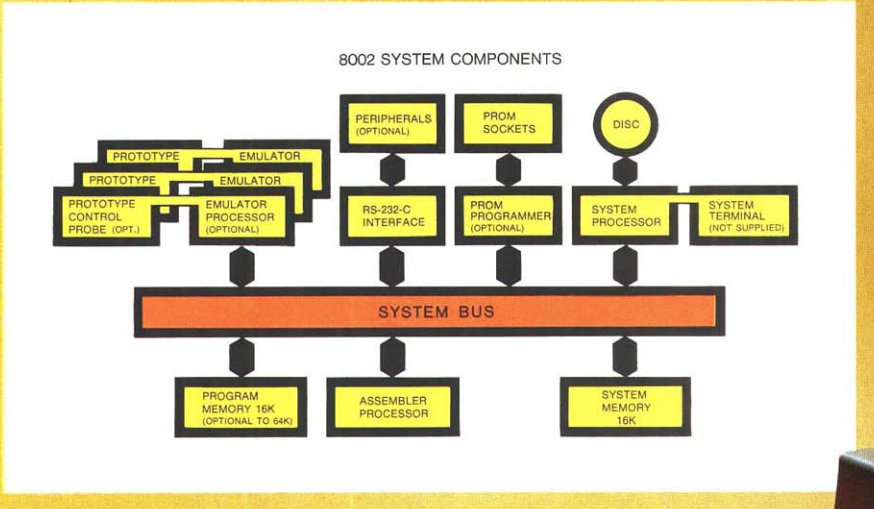
With the PROM programming option, the user can program object code for the 1702 uv erasable MOS PROM or the 2704/2708 uv erasable MOS PROM.

With these options as prerequisites, then, hardware and software integration may be performed in three progressive stages.

All levels begin with the installation of the appropriate emulator processor. At the first level, the software is run and debugged on the emulator processor. At the second level, which requires the prototype control probe, the prototype microprocessor and memory are emulated: I/O functions are performed in the prototype via the control probe.

At the third level, the real-time prototype analysis option provides all the capabilities of a microprocessor analyzer plus 8 lines of logic analyzer input. This allows the user to perform real-time trace, set breakpoints, and examine memory and register contents while using prototype memory.

With all three option levels, then, problems are easily isolated to functional blocks in the prototype system.



```
PRINT LIST2 COND
;
;**************************************************
;** THE CONTROL ROUTINE IS THE TOP OF THE STRUCTURE  **
;** AND CONTROLS THE OPERATION OF THE ENTIRE PROGRAM  **
;**************************************************
;
CNTRL: LXI     SP,STACK        ;SET STACK POINTER TO PROGRAMMABLE MEMORY
MOTZER: CALL   DSPLY           ;DISPLAY CONTENTS OF REGISTERS
        CALL   CMDNT           ;ENTER A COMMAND
        CALL   FETCH           ;FETCH THE CORRECT OPCODE
        ORA    A               ;SET ZERO FLAG AS PER CONTENTS
        JNZ    MOTZER          ;JUMP IF NOT ZERO,ERROR OCCURRED
        CALL   XQTER           ;GO EXECUTE THE CURRENT COMMAND
        JMP    MOTZER          ;LOOP FOREVER
$PAGE EQU
```

```
0002   0F00 3E00        MVI    A,0          ;PUT 0 IN A
0003   0F02 06FF  LOOP3: MVI    B,0FFH       ; LOOP COUNT FOR 3
0004   0F04 0EFF  LOOP2: MVI    C,0FFH       ;LOOP COUNT FOR 2
0005   0F06 0D    LOOP1: DCR    C            ;DECREMENT LOOP 1
0006   0F07 C2060F       JNZ    LOOP1        ;JUMP NOT 0
0007   0F0A 05           DCR    B            ;DECREMENT LOOP 3
0008   0F0B C2040F       JNZ    LOOP2        ;JUMP NOT 0
0009   0F0E D302         OUT    2            ;OUTPUT COUNT
0010   0F10 3D           DCR    A            ;DECREMENT LOOP3
0011   0F11 C2020F       JNZ    LOOP3        ;JUMP NOT 0
0012   0F14 76           HLT                 ;HALT
0013   0000              END
```

During a typical work session with the 8002, the operator installs the appropriate assembly software for each microprocessor, and enters lines of text via the system console. The line-oriented text editor facilitates program entry and correction. The assembler, with macro capability enabling the definition of a single command representing a multiple-step routine, greatly eases software development. TEKDOS allocates file space and, if so directed, creates duplicate files of important material.

The prototype program may be assembled into executable object code as a whole or in parts. When the time comes to combine the results of many assembly sessions, files that have been created independently are linked together. Should a change become necessary at the assembly level, it is simply made in the appropriate segment of the program, the routine is reassembled, and the program is linked together again.

The 8002 microprocessor lab

The 8002 mainframe and power supply includes:

The system processor.

The system memory—16k byte dynamic RAM.

The assembler processor.

The program memory—16k byte dynamic RAM. (Expandable to 64k bytes.)

The debug and front-panel I/O.

The dual flexible disc drive and controller, which provides 2 disc drives with a storage capacity of approximately 300k bytes each. A maximum of 72 files may be maintained on one disc.

The system communications board, which provides three RS-232-C peripheral I/O ports and a memory map used with the emulator processors.

Selection of two 8-bit microprocessor assembler discs.

The disc-operating system software.

The 8002 Microprocessor Lab $9950

The user may select two microprocessor assemblers at no charge from the factory-installed options when purchasing an 8002. Additional assemblers can be selected from the field-installed list.

Factory Installed	Field Installed	Option Description	Price
Option 1	8002F01	8080 Assembler Software	+$550
Option 2	8002F02	6800 Assembler Software	+$550
Option 3	8002F03	Z-80 Assembler Software (Available late summer 1977)	+$550

8002 Options

The 8002 Program Emulation and Debugging System adds the Emulator Processor and software for one or more microprocessors.

Factory Installed	Field Installed	Option Description	Factory Price	Field Price
Option 16	8002F16	8080 Emulator Support	+$1850	$1950
Option 17	8002F17	6800 Emulator Support	+$1850	$1950
Option 18	8002F18	Z-80 Emulator Support (Available late summer 1977)	+$1850	$1950

The 8002 Interactive Prototype Emulation and Debugging System adds the Prototype Control Probe for one or more microprocessors.

Factory Installed	Field Installed	Option Description	Factory Price	Field Price
Option 31	8002F31	8080 Prototype Control Probe	+$850	$950
Option 32	8002F32	6800 Prototype Control Probe	+$850	$950
Option 33	8002F33	Z-80 Prototype Control Probe (Available late summer 1977)	+$850	$950

The 8002 Real-Time Prototype Analyzer System adds Real-Time Trace and an 8-channel Analyzer Probe.

Factory Installed	Field Installed	Option Description	Factory Price	Field Price
Option 46	8002F46	The 8002 Real-Time Prototype Analyzer System	+$1950	$2150

Other Options for the 8002

Factory Installed	Field Installed	Option Description	Factory Price	Field Price
Option 47	8002F47	The 1702 PROM Programmer.	+$500	$550
Option 48	8002F48	The 2704/2708 PROM Programmer.	+$500	$550
Option 49	8002F49	16k byte dynamic RAM memory expansion board. The 8002 will accept up to 64k bytes of program memory.	+$1100	$1210

Peripherals for the 8002

System Terminal Interface

The system terminal is serially interfaced to the 8002 system processor via EIA RS-232-C interface or a 20 mA TTY current loop. Data formats and baud rates are switch selectable for TTY or EIA operation. The system communication board provides three additional RS-232-C ports and the operating system will support a paper tape punch/reader and a line printer.

Peripherals Available

TEKTRONIX CT8100 Crt Terminal $3495

TEKTRONIX CT8101 Printing Terminal $1750

TEKTRONIX LP8200 Line Printer $3585

The 8002 Microprocessor Lab, Tektronix' new interactive software development system, has been inserted in the 1977 Catalog to inform you of our latest new product introduction. Please use the Catalog Reply Card to request more information.

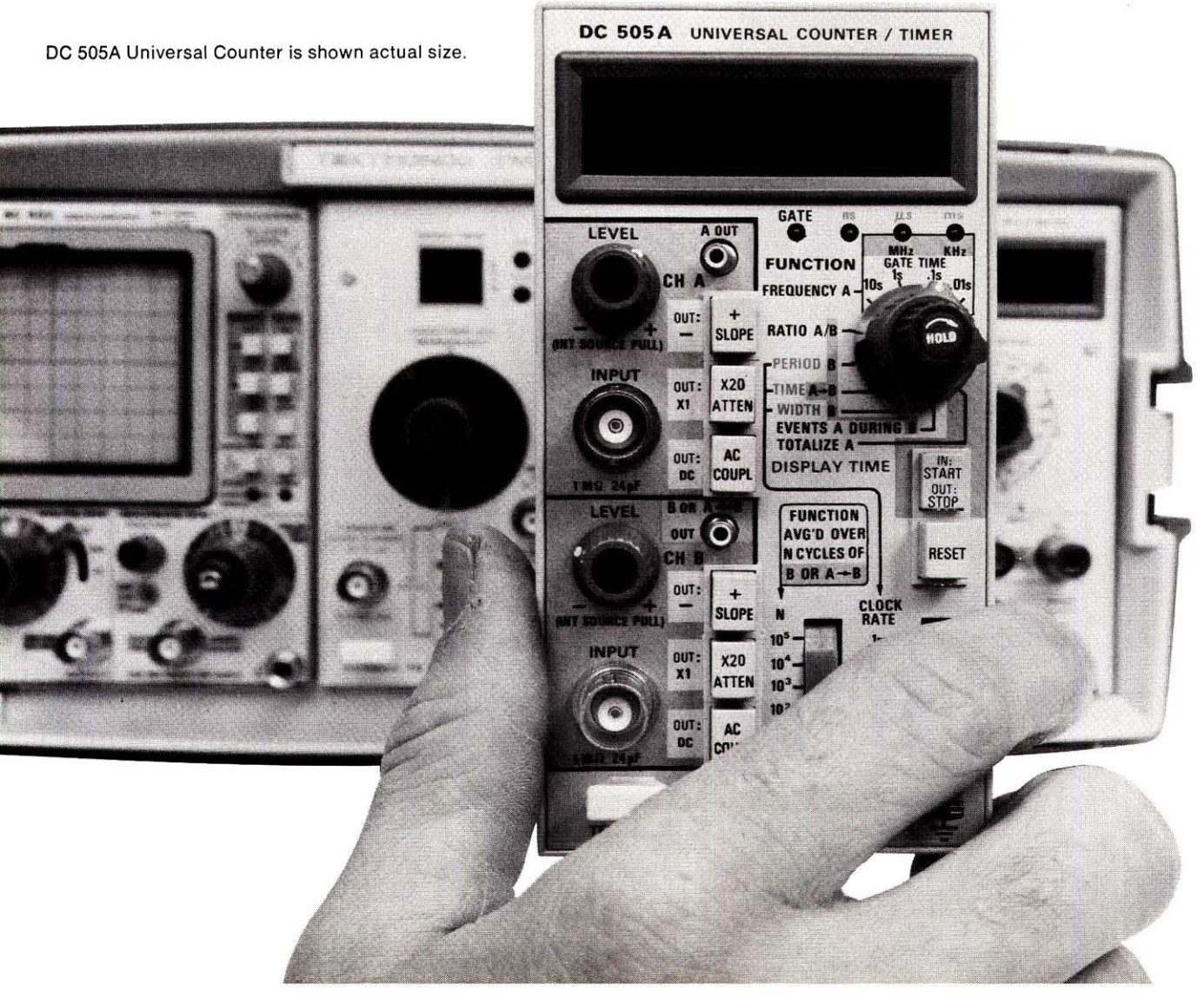
TM 500-Series

modular test and measurement instruments

TM 500 is a family of plug-in modular instruments, mainframes, and accessories. While any of the instruments can be selected on the basis of its performance as an independent unit, the ability of the TM 500 family to work together through the mainframe interface opens up many benefits to you.

Until you see TM 500 instrumentation, and discover its capabilities for yourself, you cannot fully appreciate how versatile yet compact it is. These instruments offer the quality and multiplicity of functions needed in modern electronics — and all within reach of your fingertips.

DC 505A Universal Counter is shown actual size.



Designed for Measurement Solutions

Over 30 compact plug-in test and measurement instruments which can work individually or be combined into powerful systems — that's TEKTRONIX TM 500.

TM 500 Plug-in Modular Instruments range from general-purpose devices like multimeters and power supplies to specialized units like oscilloscope calibration units and a digital delay trigger generator. The mainframes come in benchtop, rackmount, SCOPE-MOBILE® cartmounted and portable traveler models, with spaces for one to six plug-ins.

TM 500 allows you to assemble a specialized package of instruments to meet your individual measurement needs, or you can pick one of the standard combinations suggested in this catalog. You can also select an assortment of mainframes and an inventory of plug-in instruments, and then have the freedom to make one kind of measurement today and an entirely different one tomorrow.

Modularity Means More than Plug-Ins

Each TM 500 instrument is *designed* as a plug-in unit, with standard and special connections available at a rear connector as well as on the front panel. Any instrument can be plugged into any TM 500 Mainframe slot. Two power supply modules (PS 503A and PS 505) perform to maximum ratings when operated in the high power compartment of the TM 504 or TM 506 Mainframes. Plug-ins can be rotated among mainframes or exchanged with supplementary units in seconds.

This add-on capability also means that your TM 500 system can keep up to date without the need to replace the complete investment. New TM 500 units can add the capability to keep up with new developments, while your existing units go on with day-to-day work. And both new and old units will work together, too.

Your TM 500 Can Be A Measurement System

By connecting to the signal and control lines brought out at the rear of each plug-in, the optional mainframe interface board turns a TM 500 package into an integrated measurement system. Both standard and user-defined lines are available, and simple or complex systems can be assembled as the need arises.

Signals and inputs available at the rear connector of each plug-in include most front-panel connections, many internal values, and, on some units, bcd outputs. For automatic logging and calculating, you can connect a plug-in interface for TEKTRONIX Programmable Calculators. And, as the various industry interconnections standards develop, there will be TM 500 interfaces for many of these, too.

Flexible TM 500 Works Anywhere

TM 500 is designed to serve a wide variety of uses. The mainframes come in benchtop, rackmount, and a protected portable travel case style unit. The three and four compartment versions can be fitted to TEKTRONIX SCOPE-MOBILE® carts. With the variety of plug-ins available, this means that TM 500 is at home almost anywhere.

Since you can take TM 500 right to the problem, you can be sure that the measurement you make in the field is the same as the one on the bench. The measurement setup you build in the lab can go into rackmounted TM 500 units on the production line. And, with your traveler mainframe, you can take your instruments along as carry-on luggage when the best choice is to carry your lab equipment right to the problem.

Quality, Value, and Economy

TM 500 was designed to keep costs low and measurement value high. The mainframes include many of the more expensive components, such as the case and primary power supply, so they are shared by several plug-in instruments.

Extensive use has been made of the advanced technology and manufacturing techniques pioneered in TEKTRONIX Oscilloscopes — including the use of many Tektronix manufactured parts ranging from control knobs to integrated circuits.

Because of the wide selection of TM 500 instruments available, you can often tailor a TM 500 system to meet the needs of a special application at far less cost than that of a custom system or collection of the necessary separate instruments that would otherwise be required.

Since TM 500 is backed up by Tektronix, you save money in the long run as well. Worldwide customer assistance and service, quality engineering, and readily available parts are an important part of the value of TEKTRONIX TM 500 equipment.

Production Engineers

Time savings are among the most important reasons to buy TM 500 for production line use: time savings at the design stage, where the interconnection capability of the TM 500 system allows the quick construction of sophisticated measuring systems; time savings at the training and measurement stage, where the easy-to-read digital outputs reduce operator error and fatigue, and where bcd output and a calculator interface make it possible to set up automatic testing and measurement logging; and time savings on repairs, where individual instruments can be unplugged for quick replacement to get the system back in operation immediately, eliminating possible production bottlenecks.

TM 500 rackmounting, portable, and mobile cart mounting options give you a whole range of configurations to choose from. Single-compartment and double-wide compartment plug-in kits with front panel and internal circuit board make it possible to construct compatible interfaces and custom circuits for further flexibility. And for complex systems and limited areas, the compact size of the TM 500 instruments is also an important factor to consider.

Design Engineers

If you're expected to produce advanced circuit designs, then you need test instrumentation that can match your measurement requirements. That's why TM 500 state-of-the-art capability is a key benefit for design engineering use.

Modularity allows you to add units to keep up with advances in circuitry, while the compact size means that a full complement of instruments can be kept on a crowded workbench. Interconnection capability makes 30 input and output lines available, so you can build custom test systems for specialized design projects. And flexibility means that TM 500 will keep up with your imagination.

Maintenance Engineers

With portable, cartmounted, rackmount, and desktop versions, TM 500 packages can do the work wherever it needs to be done. For specialized jobs, "solution" oriented instruments make those measurement problems easy to lick.

For example, the TG 501 Time Mark Generator not only provides exact pulses for calibration of oscilloscope and recorder time bases, but it also allows you to match a variable pulse with your existing calibration, and then read the error in percent on the TG 501 display. Since the TM 500 units can be brought to the job, oscilloscopes and recorders can be calibrated on site, eliminating the errors and added down time caused by moving them back to a calibration bench.

For general repair work, the flexibility of the TM 500 line means that any of the more than 30 units can be in place and running in seconds, covering far more of the possibilities than would be possible with a more limited system. You can set up your TM 500 instruments to have the ones you need at your fingertips, and still be able to switch to others in seconds when the problem requires an unexpected measurement.

Educational Use

With TM 500, you can build student lab stations with the full capability of a complete range of instruments, yet assemble them within the stringent limitations of budgets and space that so often apply. You can supply basic TM 500 units to each student, with more specialized instruments rotated among groups as the curriculum requires. This saves the cost of duplicate purchases without limiting vital access to the measurements students need to make.

Although TM 500 equipment is quite sophisticated, it has been designed with human factors in mind. Color-coded front panels, standardization of connectors, and easy-to-read digital displays make TM 500 quite suitable for student use. In addition, the actual hands-on experience with commercial equipment is a valuable experience for students who will later be going on to further study or employment.

Service Engineers

With TM 500's extreme portability, you can concentrate on electronics instead of on the logistics of getting test equipment to where you need it. The traveler five-compartment mainframe will go just about anywhere you might have to go, and the measurement power of the TM 500 instruments it carries assures you that you'll rarely have to make a second call because you couldn't make a vital reading.

With a choice of two oscilloscopes, five counter/timers, and close to a dozen signal generators, you can pick the level of performance you need. The systems capability of the TM 500 line means that you can also assemble a package for repetitive measurements, allowing you to make routine measurements quickly.

Special units, such as the DD 501 Digital Delay and temperature-measuring DM 502 Digital Multimeter, make service work easier and more productive. And the custom interface capability means that you can build that adapter you need right in a blank plug-in, keeping your total measurement package neat and easy to handle.

Digital integrated circuits and modern high-stability quartz crystals have combined to permit time and frequency measurements of a greater accuracy than for any other electrical parameters. The TEKTRONIX TM 500 line of digital counter/timers offers all the versatility, operating ease, compactness, and value available with present state-of-the-art techniques. Five models are available: the DC 501, DC 502, DC 503, DC 504, and DC 505A.

The counters, DC 501 and DC 502, measure frequencies and totalize events from low audio frequencies up through 110 or 550 MHz. The new low-cost DC 504 combines frequency counting and totalizing, plus an rpm capability, with the ability to measure period for higher resolution and accuracy at low frequencies. The DC 503 and DC 505A are fully Universal Counter/Timers which totalize and measure frequency, and also provide single period, period averaging, frequency ratio, and time interval capability. The DC 503 also includes a time-manual (electronic stopwatch) feature. The sophisticated DC 505A provides time-interval averaging, direct pulse width measurements, and a unique events-A-during-B mode.

Applications for the DC 501 and DC 502 Frequency Counters and the DC 504 Period and Frequency Counter cover many measurements needed in communications work. Typical measurements include carrier and sub-carrier frequencies, modulation frequencies, pulse repetition rates in data communications, center frequency and corner frequencies of tuned filters, frequency of signaling tones, and verification of discriminator linearity. The totalize (event-counting) mode is also useful in industrial control applications or research environments.

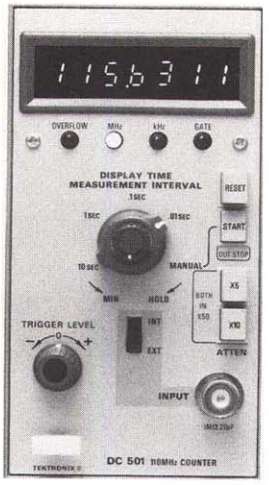
The second channel capabilities of the DC 503 and DC 505A Universal Counter/Timers permit measurement of frequency ratios and, more importantly, time intervals, in addition to the frequency and total events measures of single channel instruments. Time intervals are measured by counting the internal clock pulses which occur between a start event on channel A and a stop event on channel B. Resolution and accuracy are determined by the instrument's clock rate, and by whether time interval averaging is available.

The accuracy of counter/timer measurements is ultimately limited by the accuracy of the internal time base, although at some combinations of input frequency and counter operating controls, resolution may be the limiting factor. Two types of time bases are available in the TM 500 family of counters. The standard time base is quartz crystal providing a monthly aging rate and temperature stability of 1 part in 10^5 (0.001%). The option 1 time base is a high stability temperature-compensated quartz crystal which provides a one-hundred-times improvement in aging rate and a twenty-times improvement in temperature stability.

DIGITAL COUNTERS — COMPARISON OF CHARACTERISTICS

The following is a comparison of the main characteristics of the DC 501 through the DC 505A. A complete list of specifications appears on the following pages.

	DC 501	DC 502	DC 503	DC 504	DC 505A
Number of Digits	7	7	7	5	7
Frequency Range	110 MHz	550 MHz	100 MHz	80 MHz	225 MHz
Totalize	Yes	Yes	Yes	Yes	Yes
Period	No	No	Yes	Yes	Yes
Period Average	No	No	Yes	No	Yes
Time Interval	No	No	Yes; 1 μs maximum clock rate	No	Yes; 10 ns maximum clock rate
Time Interval Average	No	No	No	No	Yes
Ratio	No	No	Yes	No	Yes
Other	Option 01 FCC Type Approved	Option 01 FCC Type Approved	Time Manual	Rpm	Events A During B, single-jack pulse width, dc trigger level out
Price	**$650**	**$995**	**$750**	**$425**	**$1495**



DC 501

Direct Counting to 110 MHz
7-Digit LED Display
Manual Start/Stop (Totalize)
Auto Range and Time Base Options

The DC 501 Digital Counter directly measures frequency from 10 Hz to 110 MHz and totalizes (counts number of events) from 0 to 9,999,999 at a maximum rate of 110 MHz. Measurement readout is provided by seven-segment LEDs in a seven digit display. The decimal point is automatically positioned and leading zeros (to the left of the most significant digit or decimal point) are blanked. Register overflow is indicated by a front-panel LED. Signals to be counted can be applied via a front-panel BNC connector into an impedance of 1 MΩ and 20 pF or via the rear connector into an impedance of 50 Ω and 20 pF. Four gate times of 0.01 s, 0.1 s, 1 s, and 10 s are provided. A standard internal 1 MHz time base is provided with 1×10^{-5} accuracy (0° to 50° C) and an aging rate of 1×10^{-5} per month. An optional time base with 5×10^{-7} accuracy (0° to 50°C) and an aging of 1×10^{-7} per month is available at extra cost. Input sensitivity is approximately 300 mV peak-to-peak (100 mV rms sine wave) below 110 MHz. An automatic measurement interval option, also at extra cost, automatically selects the gate time (up to 10 seconds) to obtain maximum resolution with any input signal.

DC 501 Digital Counter $650
Option 01 (Time Base) . . . . . add $150
Option 02 (Auto Measurement) . . . . add $65

DC 502

Counts to 550 MHz with ÷10 Prescale (50-Ω Input)

Direct Counting to 110 MHz

7-Digit LED Display

Manual Start/Stop (Totalize)

Time Base Option

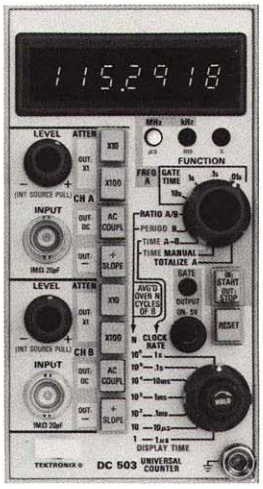
The DC 502 Digital Counter measures frequencies from 10 Hz to 550 MHz or totalizes events up to the readout capacity of 10^7-1 at the max rate of 550 MHz. Frequency measurements are accomplished using one of two inputs. The DIRECT INPUT has a frequency range of 10 Hz to 110 MHz, a 1 megohm input impedance, 300 mV peak-to-peak sensitivity (100 mV rms sine wave) and an adjustable trigger level range. The ÷ 10 PRESCALE INPUT has a frequency range from 50 MHz to 550 MHz with a 500 mV peak-to-peak sensitivity (170 mV rms sine wave) and a 50-Ω input impedance. The manual totalizing mode with front-panel start-stop control is available at both inputs; from the prescale input, 1 displayed count per 10 input events will result. Measurement display is accomplished with seven-segment LEDs in a seven-digit readout. The decimal point is automatically positioned by the measurement interval selected, and leading zeros (those to the left of the most significant digit or those to the left of the decimal point) are blanked. LEDs indicate when the gate is armed, and whether displayed numbers are in kHz or MHz, and when register overflow occurs. Four gate times of 0.01 s, 0.1 s, 1.0 s, and 10 s are provided. A standard internal 1 MHz clock is provided with 1 x 10^{-5} accuracy (0° to 50°C) and aging rate of 1 x 10^{-5} per month. An optional clock with 5 x 10^{-7} accuracy (0° to 50°C) and aging rate of 1 x 10^{-7} per month is available at extra cost.

DC 502 Digital Counter $995
Option 01 (Time Base) . . . . . add $150
Option 07 (for use with TR 502 and SW 503) . . . . . add $200

COMPARISON OF CHARACTERISTICS

	DC 501	DC 502
DISPLAY	7 digits (7-segment LEDs) storage, leading zero blanked. Overflow, gate open and kHz or MHz indicators.	
DIRECT INPUT Frequency Range	10 Hz to 110 MHz	
Sensitivity	300 mV p-p (100 mV rms sine wave)	
Impedance	1 MΩ, paralleled by 20 pF	
Triggering Level	Adjustable, ±2 V	
Max Safe Input	X1 Atten: 500 V at 80 Hz or less; derate −20 dB/decade to 250 Hz. 150 V 250 Hz to 300 kHz; derate −20 dB/decade to 3 MHz. 15 V 3 MHz to 110 MHz. X5 Atten: 500 V at 600 kHz or less; derate −20 dB/decade to 4 MHz. 75 V 4 MHz to 110 MHz. X10 and X50 Atten: 500 V at 1.2 MHz or less; derate −20 dB/decade to 8 MHz. 75 V 8 MHz to 110 MHz.	
Attenuation	X1, X5, X10, or X50	
Resolution	0.1 Hz with 10 s gate, 1 Hz with 1 s gate, 10 Hz with 0.1 s gate, 100 Hz with 0.01 s gate	
÷ 10 PRESCALE INPUT Frequency Range	Not Applicable	50 MHz to 550 MHz
Sensitivity		500 mV p-p (170 mV rms sine wave), or 1-2 mV rms (see special features below)
Impedance		50 ohms
Max Safe Input		10 V p-p
Resolution		1 Hz with 10 s gate 10 Hz with 1 s gate 100 Hz with 0.1 s gate 1 kHz with 0.01 s gate
STANDARD TIME BASE ACCURACY Temp Stability, 0° to 50°C after Warm-up	Within 1 part in 10^5 (0.001%)	
Long Term Drift	Within 1 part in 10^5 per month (0.001%)	
Setability	Adjustable within 1 part in 10^7 (0.00001%)	
OPTION 01 TIME BASE ACCURACY Temp Stability, 0° to 50°C after Warm-up	Within 5 parts in 10^7 (0.00005%)	
Long Term Drift	Within 1 part in 10^7 per month (0.00001%)	
Setability	Adjustable within 5 parts in 10^9 (0.0000005%)	
FCC Type Approval	Option 01 FCC Type approved for frequency monitoring in am and fm broadcast bands and on tv channels 2-6	Option 01 FCC Type approved for frequency monitoring in am and fm broadcast bands and on tv channels 2-26
Totalize	Counts events from 1 to 9,999,999 at a max rate 110 MHz. Start, stop, and reset commands via front-panel pushbuttons.	Same as DC 501 plus ÷ 10 totalize which counts events to 99,999,990 at a max rate of 550 MHz. Display is 1/10 the number of input events
REAR INPUTS — For routing from other compartments or from rear-panel connectors on Power Modules	Direct count input (50 ohms impedance, resistor may be removed for 1 megohm input), reset, external display scan clock, external time base	Reset, external display scan clock, external time base
REAR OUTPUTS — For routing from other compartments of Power Module or to rear-panel connectors on Power Modules	Bcd serial-by-digit, plus lines for MHz light, decimal point, internal display scan clock, time base out, data ready, etc	
SPECIAL FEATURES	Option 02—Automatically selects optimum measurement interval to fill the display, and displays appropriate kHz or MHz indication. Overflow is indicated for frequencies in excess of 99.99999 MHz.	A modification is available to provide 1-2 mV sensitivity from 50-550 MHz. See your Tektronix Field Engineer, Representative, or Distributor for more information.

DC 502 Option 07 Digital Counter (for use with the TR 502 Tracking Generator) has all usual characteristics of the DC 502 plus logic circuitry which allows the DC 502/TR 502/7L13 to select and determine unknown signal frequencies within the frequency range of the counter and with the sensitivity of the analyzer; includes the High Stability Time Base. The spectrum display center frequency is indicated by a bright dot on the analyzer crt and is automatically counted by the DC 502 Option 07.



DC 503

Direct Counting to 100 MHz
Six Measurement Functions
Period and Ratio Averaging
Interval Measurement Capability

The DC 503 Universal Counter offers counting to 100 MHz and provides the versatility of six measurement functions: frequency, period, ratio, time A→B, time manual, and totalize. The two channels (A and B) have individual BNC inputs and separate trigger level, attenuator, and coupling mode controls. Seven-digit readout is via seven-segment light emitting diodes (LEDs) with automatically positioned decimal point; leading zeros (to the left of the most significant digit or decimal point) are blanked. A flashing display indicates register overflow. The low-cost DC 503 offers high performance in a variety of applications. Its interval measurement capability with selectable clock rates is useful for digital equipment design and maintenance, particularly digital control and data communications work. The A-channel frequency range of dc to 100 MHz serves in communication and rf use. High resolution measurements of low frequencies are available quickly in the period mode with averaging up to 1 million periods available. TIME MANUAL provides an electronic stop watch function with selectable clock rates. TOTALIZE counts and displays the total number of input events at rates from dc to 100 MHz.

DC 503 ..... **$750**

Option 01 (Time Base) ..... **add $150**

NOTES:

$* = \left(\frac{0.01\ V}{dv/dt\ of\ triggering\ edge}\right) / \sqrt{N}$

$** = \left(\frac{0.1\ V}{dv/dt\ stop\ edge}\right) \pm \left(\frac{0.01\ V}{dv/dt\ start\ edge}\right) / \sqrt{N}$

***Input amplifier slew rate of 10 ns/volt will produce additional error in

(1) Time A → B mode if A and B level controls are not set for corresponding points on waveforms.

(2) Width B and Events A during B modes if B level control is not set at 50% of input pulse height.

COMPARISON OF CHARACTERISTICS

	DC 503	DC 505A
DISPLAY	7 digits (7 segment LEDs)	Storage, leading zeros blanked
FREQUENCY (A input) Range	0 to 100 MHz, dc coupled 10 Hz to 100 MHz, ac coupled	0 to 225 MHz, dc coupled 10 Hz to 225 MHz, ac coupled
Gate Times	0.01 s, 0.1 s, 1 s, 10 s	
Accuracy	±1 count ± time-base error	
TIME INTERVAL (A → B) Resolution, Single event	1 μs to 1 s, selectable	10 ns to 1 ms, selectable
Resolution, averaging on repetitive events	Not Applicable	≤ 100 picoseconds with 10 ns clock and 10^5 averaging. Clock rate selectable, 10 ns to 1 ms. Averaging factor independently selectable from 1 to 10^5. 5 ns minimum pulse width in either channel.
Accuracy	±1 count ± time-base error; other contributions negligible	±1 count ±time-base error. ± trigger error CH A* ± trigger error CH B*. ± channel delay match error of 2 ns max ± slew rate error*** + 2 counts (10 ns clock rate only). Best absolute accuracy, 3 ns.
WIDTH (B input) Resolution, single pulse	Use "tee" connector and Time Interval A→B mode; see specifications above	10 ns to 1 ms, selectable
Resolution, repetitive pulses	Not Applicable	≤ 100 picoseconds with 10 ns clock and 10^5 avg factor. Clock rate selectable 10 ns to 1 ms. Avg factor independently selectable from 1 to 10^5. 2 ns minimum pulse width.
Accuracy		±1 count ± time-base error + hysteresis error** ± slew rate error*** + 2 counts (10 ns clock rate only). Best absolute accuracy, 1.5 ns.
PERIOD + PERIOD AVERAGING (B input) Resolution	From 1 μs for single period to 1 picosecond with 10^6 averaging	From 10 ns to 1 ms for single period; to 0.1 picosecond max with 10 ns clock and 10^5 averaging
Accuracy	±1 count ± time-base error ±trigger error/N	±1 count ± time-base error ± trigger error† +2 counts (10 ns clock rate only)
RATIO (A/B)	Averaged over 1 to 10^6 cycles of signal at B	Averaged over 1 to 10^5 cycles of signal at B. Accuracy: ±1 count FREQ A ± trigger jitter chan B†
EVENTS A DURING B	Not Applicable	Averaged over 1 to 10^5 occurrences of signal at B. Accuracy: ±1 count FREQ A + hysteresis error** ± slew rate error***
TOTALIZE (A)	1 to 9,999,999 at max rate of 100 MHz. Front-panel start, stop, reset control.	1 to 9,999,999 at max rate of 225 MHz. Front-panel start, stop, reset control
TIME MANUAL	Electronic stop watch; accumulates and displays time following activation of front-panel start button. Clock rates selectable from 1 μs to 1 s.	Not Applicable
INPUT Freq Range, A	0 to 100 MHz, dc coupled 10 Hz to 100 MHz, ac coupled	0 to 225 MHz, dc coupled 10 Hz to 225 MHz, ac coupled
Freq Range, B	0 to 10 MHz, dc coupled 10 Hz to 10 MHz, ac coupled	0 to 225 MHz, dc coupled 10 Hz to 225 MHz, ac coupled
Sensitivity, A and B	300 mV p-p (100 mV rms sine wave)	150 mV p-p (50 mV rms sine wave) below 150 MHz. 300 mV p-p (100 mV rms sine wave) from 150 to 225 MHz
Impedance, A and B	1 MΩ paralleled by 20 pF	1 MΩ paralled by 24 pF
A & B Trig Lev	Adjustable ±1.5 V at X1 attenuation	Adjustable ±2.0 V at X1 attenuation
Max Safe Input, A and B	CH A X1 Atten: 50 V at 2 kHz or less; derate −20 dB/decade to 10 kHz. 10 V, 10 kHz to 25 MHz; derate −20 dB/decade to 50 MHz. 5 V, 50 MHz to 100 MHz. CH B X1 Atten: 50 V at 2 kHz or less; derate −20 dB/decade to 10 kHz. 10 V, 10 kHz to 10 MHz (frequency limit). CH A X10 and X100 Atten: 500 V at 2 MHz or less; derate −20 dB/decade to 100 MHz. CH B X10 and X100 Atten: 500 V at 350 kHz or less; derate −20 dB/decade to 10 MHz.	X1 Atten: 50 V at 10 kHz or less; derate −20 dB/decade to 100 kHz. CH A or CH B: 5 V 100 kHz to 225 MHz. X20 Atten: 250 V at 1 MHz or less; derate −20 dB/decade to 50 MHz. CH A or CH B: 5 V 50 MHz to 225 MHz.
Attenuation, A and B	X1, X10, X100	X1, X20
STD AND OPTION 01 TIME BASE SPECS	Same as DC 501/DC 502 (except, no FCC Type approval)	
REAR INPUTS	Same as DC 501	
REAR OUTPUTS	Same as DC 501/DC 502	

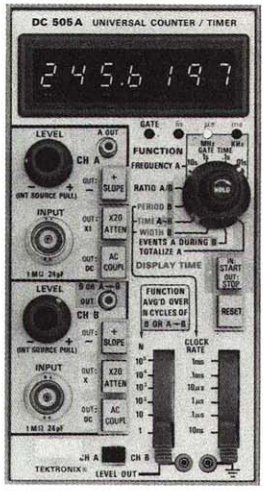
$† = \left(\frac{0.01\ V}{dv/dt\ triggering\ edge}\right) / N$

NOTE 1: Accuracies with averaging are dependent on the laws of statistics in Time A → B, Width B, and Events A during B modes.

SPECIAL FEATURES

A Out: Shaped output, after LEVEL and SLOPE selection, of signal into CH A. This output represents what goes into the display of FREQ A, RATIO A/B, and TOTALIZE A. Propagation delay from CH A INPUT to A OUT is ≈ 15 ns.

B or A→B Out: Shaped output, after LEVEL and SLOPE selection, of either CH B signal or A→B signal. This output represents the continuous signal used in generating the display gating for RATIO A/B, PERIOD B, TIME A→B, WIDTH B, and EVENTS A DURING B. Logic levels out are the same as for A OUT. Propagation delays from the channel INPUTS to B or A→B OUT are ≈ 15 ns.



DC 505A

Dc Output for Accurate Trigger Level Setting with Companion DMM

Direct Counting to 225 MHz

10 Nanosecond Clock Rate

Time Interval Averaging with Resolution to 100 Picoseconds

Two Equal Bandwidth Channels for Time Measurements on Narrow Pulses

Events A During B

The DC 505A is a high-performance universal counter featuring direct counting to 225 MHz. Both channels, A and B, have equal response for ratio, time interval, and other measurements requiring two channels. This new "A" version provides dc trigger level output both at the front-panel jack and rear interface connector. Any TM 500 Digital Multimeter may be connected via the rear interface to read the DC 505A trigger level setting when the DMM input switch is pushed to the INT position. Alternately, an external voltmeter or oscilloscope may be connected to the front-panel jack to perform this function. The DC 505A can perform virtually any counting-timing function below 225 MHz.

Various functions include conventional frequency operation on channel A, ratio of channel A to B frequency, period of signal B, time interval from channel A start to B stop, width B, events A during B, and totalize. An averaging feature allows measurements to be averaged from 1 to 10^5 times as selected by front-panel controls with the resultant average displayed on the LED readout. Averaging factor and clock rate are independently selectable. Pulse width may be measured directly with single shot resolution to 10 ns. By use of maximum averaging on width or interval measurements of repetitive waveforms, resolution to better than 100 picoseconds is possible. Typical application of the DC 505A is in the design, development, or maintenance of logic circuitry in high speed digital computers. It is a high-performance counter for state-of-the-art design and measurements up to 225 MHz.

DC 505A **$1495**
Option 01 (Time Base) . . . . . **add $150**

DC 504

Direct Frequency Counting to 80 MHz

Period Measurement for Resolution at Low Frequency

Rpm Counting

5-Digit LED Display

Low Cost

The DC 504 Counter/Timer measures frequency from 0 Hz (with 0.1 Hz resolution) to 80 MHz, period from 1 microsecond to 999.99 seconds, and totalizes events from 0 to 99,999 at a maximum rate of at least 80 MHz. A resolution of 0.1 Hz can be obtained by allowing the more significant figures of the counter to overflow. Five 7-segment light-emitting diodes (LEDs) provide a visual numerical display. The decimal point is automatically positioned and leading zeros (to the left of the most significant digit or decimal point) are blanked. Digit overflow is indicated by a front-panel LED. Signals to be counted/timed can be applied to either a front-panel BNC connector or to the rear interface connector. Internal switches select frequency or rpm operation, internal time base or external standard, and override display storage.

Display — 5 digits, LEDs.

Display Accuracy — ±1 count ± time-base accuracy (± trigger error in period mode only).

Frequency (or rpm) — Dc coupled: 0 Hz to at least 80 MHz. Ac coupled: 10 Hz to at least 80 MHz.

Frequency/rpm (Max Resolution) — kHz Positions: 0.1 Hz, 1 Hz, and 10 Hz (1 rpm, 10 rpm, and 100 rpm).* MHz Positions: 0.1 kHz and 1 kHz (1000 rpm and 10 k rpm).*

Sensitivity — 20 mV rms (56.6 mV p-p) below 15 MHz, 35 mV rms (99 mV p-p) at or below 50 MHz derating to typically <175 mV rms (495 mV p-p) at 80 MHz.

Triggering Level — Adjustable over at least −1.5 V to +1.5 V.

Trigger Source — Internal (rear connector interface) or external (front-panel BNC).

Max Safe Input — +250 V at 500 kHz or less; derate −20 dB/decade to 25 MHz. ±5 V 25 MHz to 80 MHz.

Impedance — 1 MΩ paralleled by approx 20 pF.

Coupling — Dc or ac.

*Assuming transducer output is one pulse per revolution.

Internal Time Base

	Standard	Option 1
Crystal Frequency	1 MHz	5 MHz temperature compensated
Stability (0°C to 50°C) after ½ hour warm-up	Within 1 part in 10^5	Within 5 parts in 10^7
Long-term Drift	1 part or less in 10^5 per month	1 part or less in 10^7 per month
Setability	Adjustable to within 1 part in 10^7	Adjustable to within 5 parts in 10^9

Totalize Events (Resolution) — 1.

Period (Resolution) — mSec Position: 1 μs and 10 μs. Sec Position: 0.1 ms, 1 ms, and 10 ms.

Display Time — Variable from about 0.1 s to about 10 s. Detent position at cw position of DISPLAY TIME knob provides a HOLD mode.

Data Inputs and Outputs — Available at plug-in connector for intra-compartment routing in any TM 500 Power Module/Mainframe. Bcd serial-by-digit (parallel data for one digit at a time) plus timing and control functions.

DC 504 Counter/Timer **$425**

Option 01 (Time Base) . . . . . **add $150**

The digital multimeter, with the capability of measuring voltage, resistance, and current, is the most widely used electronic test instrument employed today, with the possible exception of the oscilloscope. Modern digital techniques have vastly improved the resolution and accuracy of the traditional volt-ohm-milliammeter, simplified instrument use, and reduced the possibilities of human error. The TM 500 Digital Multimeter line consists of two general-purpose instruments, the DM 501 and DM 502 Digital Multimeters. In addition to the usual dc and ac voltage, resistance, and dc and ac current functions, both meters offer an optional temperature measurement function. Applying the tip of the optional temperature probe to a power transistor, integrated circuit, mechanical component, or any other surface provides digital readout of the surface temperature in degrees Celsius or degrees Fahrenheit at the user's choice. The DM 502 further extends measurement capability by providing a standard decibel (dB) measurement feature across all ac ranges.

The DM 501 and DM 502 are similar instruments in many respects. Each measures dc voltage to 1000 volts (extendable to 40,000 volts with the addition of the optional high-voltage accessory probe), ac voltage to 500 volts, both dc and ac current to 2 amps, and resistance to 20 megohms. Optionally, both provide probe measurement of surface temperatures from −55°C to +150°C. The most significant differences lie in the dB capability of the DM 502, the 4½ digits of the DM 501 versus 3½ in the DM 502, and the floating bcd output of the DM 501 (for compatibility with the TEKTRONIX 31/53 Calculator Instrumentation System and other digital readout systems).

Since the DM 501 is a 4½ digit instrument, it can provide significantly more precise values than 3½ digit instruments, including the DM 502. At a given signal level, the 4½ digit instrument can supply X10 better resolution and conversely it can also measure X10 as large a signal at any given resolution level.

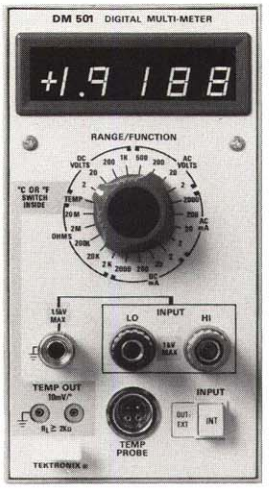
For example, an exact 2.000-volt signal must be measured on the 20-volt range on either instrument, since full scale on the nominal 2-volt range is actually 1.999 or 1.9999 volts. The specified possible error of the DM 502 (display 2.00) is ± 0.1% of reading ± 1 count, equal to ± 12 millivolts, or 0.6% of reading. The same input is displayed on the DM 501 as 2.000, and the possible error of ± 0.1% of reading ± 2 counts is 2.2 millivolts, or 0.11% — almost six times better.

The dB feature of the DM 502 is of great value in the general audio and communications industry: in mobile radio, microwave, telephone communication, computer time-sharing, and other applications of data transmission via voice links, broadcasting, high-fidelity and recording industries, sonar, acoustics, audiometrics, and many other fields. The absolute reference of the DM 502 may be selected, by internal jumper, as dBm (0 dB = 0.775 V or 1 mW in 600 Ω) or dBV (0 dB = 1 V). With either reference, the dynamic range extends from −60 dB to approximately +56 dB.

DIGITAL MULTIMETERS DM 501 AND DM 502 COMPARISON OF CHARACTERISTICS

The following is a comparison of the major characteristics of the DM 501 and DM 502. A complete set of specifications may be found on the following pages.

	DM 501	DM 502
Number of Digits	4½	3½
Dc Volts — full scale	2 V to 1 kV	0.2 V to 1 kV
Ac Volts — full scale	2 V to 500 V	0.2 V to 500 V
Dc Current — full scale	2 mA to 2 A	200 μA to 2 A
Ac Current — full scale		
Resistance — full scale	2 kΩ to 20 MΩ	200 Ω to 20 MΩ
Temperature Probe	Optional	Optional
dB	No	−60 dB to +56 dB
Bcd Output	Full Floating	Nonfloating
Input Impedance	10 MΩ	10 MΩ normal; FET input on 0.2 and 2 volt scales by internal jumper
Price	**$350 to $475**	**$250 to $375**



DM 501

0.1% Dc Voltage Accuracy

4½ Digit LED Display

Auto Polarity

Measures Volts, Current, Resistance, Temperature

Fully Isolated Serial Bcd Output

The DM 501 Digital Multimeter measures dc and ac voltage and current, resistance, and temperature. Dc voltage measurement accuracy is 0.1%. The ac functions are average responding and rms calibrated. A single front-panel control selects all functions and ranges. A pushbutton selects front-panel input or optional rear interface connector input. Temperature measurements are made using a TEKTRONIX P6058 Probe or other suitable sensing devices. Front-panel pin jacks provide external temperature readout, at 10 mV per degree, regardless of the position of the function switch. An internal switch selects calibration in degrees Celsius or Fahrenheit. Readout is a 4½ digit stored display using seven segment LEDs. The decimal point is automatically positioned by the RANGE/FUNCTION switch and leading zeros (those to the left of the decimal point or most significant digit) are blanked. Polarity indication is automatic. A blinking display indicates overrange. Serial bcd output is available at the rear interface connector.

DC VOLTAGE

Range — 2 V, 20 V, 200 V, and 1 kV full scale (19999 max reading), accurate within 0.1% of reading ±2 counts.

Resolution — 100 μV on 2 V range.

Common-Mode Rejection — ≥ 100 dB at dc, 80 dB at 60 Hz with 1 kΩ imbalance.

Step Response Time — <1 s.

Normal-Mode Rejection — ≥30 dB at 60 Hz increasing 20 dB per decade.

Input R — 10 MΩ, constant.

AC VOLTAGE

Range — 2 V, 20 V, 200 V, and 500 V full scale (19999 max reading), average responding, rms calibrated.

Accuracy — Within 0.7% of reading ±2 counts from 40 Hz to 10 kHz; 1.2% of reading ±2 counts, 20 Hz to 20 kHz. Usable to 100 kHz. Typically <5% down between 0.4 V and 500 V at 100 kHz.

Resolution — 100 μV on 2 V range.

Response Time — <10 s.

Input R — 10 MΩ paralleled by <100 pF.

AC and DC CURRENT

Range — 2 mA, 20 mA, 200 mA, 2 A full scale (19999 max reading), ac rms calibrated, average responding.

Resolution — 100 nA on 2 mA range.

Accuracy — Dc amps, 0.2% of reading ±10 counts; ac amps, 0.6% of reading ±2 counts from 40 Hz to 1 kHz ±0.6% of reading, ±10 counts, 1 kHz to 10 kHz. Usable to 100 kHz.

Input R — $\frac{0.2\text{ V}}{\text{Range Setting}} + 0.1\ \Omega$

RESISTANCE

Range — 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ full scale (19999 max reading).

Accuracy — Within 0.3% of reading, ±2 counts to 2 MΩ, 0.5% of reading, ±2 counts on 20 MΩ scale.

Resolution — 0.1 Ω on 2 kΩ range.

TEMPERATURE MEASUREMENT

Range — 55°C to +150°C (−67°F to +302°F selected by internal switch), using included temperature probe. The temperature probe functions regardless of the DM 501 mode and provides a front-panel analog signal output of 10 mV/° (into 2 kΩ or greater); thus temperature may be measured simultaneously with any other function. If temperature probe is not desired, order Option 01. If temperature capability is not desired, order Option 02; note: capability cannot be restored at a later date.

Accuracy — Within 1.5°C (2.7°F) from −55°C to +125°C and within 2.5°C (4.5°F) from −55°C to +150°C.

Resolution — 0.1°.

OTHER CHARACTERISTICS

Overrange Indication — Blinking display.

Measurement Rate — 5 measurements/second.

Max Input Voltage — 1 kV. The front-panel HI and LO connectors may be floated 1.5 kV max above ground, the rear inputs 350 V max. Current measuring functions are fused at 3 A. Ohms ranges are fused at 1/16 A.

Ambient Temperature — Performance characteristics are valid over a temperature range of +15°C to +35°C.

Standard Accessories — 1 Pair Test Leads (003-0120-00), 1 P6058 Temp Probe (010-0259-00).

ORDERING INFORMATION

DM 501 Digital Multimeter **$475**

Option 01 without Temp Probe (P6058) . . . . . **Sub $105**

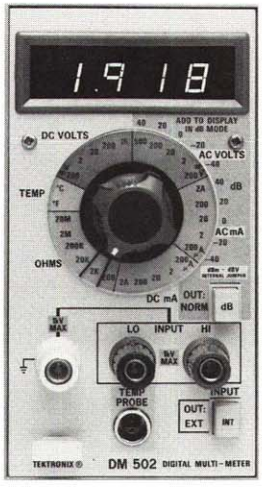
Option 02 without Temp Capability and Probe . . . . . **Sub $125**

Optional Accessories — Deluxe test lead with accessories including push-on spring-loaded hook tip and special IC package tip, high flexibility wire, red, 4 ft.
Order (012-0426-00) **$8.00**

As above except black.
Order (012-0426-01) **$8.00**

Test lead with alligator clip, 4 ft, black.
Order (012-0425-00) **$4.20**

High Voltage Probe to 40 kV
Order (010-0277-00) **$65**



DM 502

dB Readings from −60 dB to +56 dB

Six Functions Including Temperature and dB

0.1% Dc Voltage Accuracy

Autopolarity

DMM Prices Start at $250

The DM 502 Digital Multimeter measures dc and ac voltage and current, dBm, dBV, resistance, and temperature. The ac functions are average responding and rms calibrated. A single front-panel control selects all ranges. Front-panel pushbuttons select dB readout of ac functions in lieu of ac voltage or current and front-panel or rear interface connector input. dB is obtained by adding the selected dB scale value to the display reading. Readout in dBm or dBV is chosen by an internal jumper. An internal jumper also permits selection of FET input (>1000 MΩ) or 10 MΩ input impedance on the two lowest dc voltage ranges.

The readout is a 3½ digit display using seven-segment LEDs. The decimal point is automatically positioned by the RANGE/FUNCTION switch. Polarity indication is automatic. Maximum display at stated accuracy is 1999.

Nonfloating bcd output (referenced to the low input), is available at the rear interface connector if user wired.

DC VOLTAGE

Range — 0.2 V, 2 V, 20 V, 200 V, 1000 V.

Accuracy — Within ±0.1% of reading, ±1 count.

Common-Mode Rejection — ≥100 dB at dc, ≥80 dB at 50 or 60 Hz with 1 kΩ imbalance.

Normal-Mode Rejection — ≥80 dB at 50 or 60 Hz.

Step Response Time — ≤0.5 s.

Input R — 10 MΩ (jumper selectable for >1000 MΩ on 0.2 V and 2 V ranges).

AC VOLTAGE

Voltage Range — 0.2 V, 2 V, 20 V, 200 V, 500 V.

Accuracy — Within ±0.5% of reading, ±1 count, 40 Hz to 10 kHz. ±1.0% of reading, ±1 count, 20 Hz to 20 kHz. Usable to 100 kHz. Typically <10% down between 40 mV and 500 V at 100 kHz.

Response Time — ≤5 s.

Common-Mode Rejection — ≥60 dB at 50 or 60 Hz.

Input R — 10 MΩ paralleled by less than 60 pF.

dB VOLTS AND CURRENT

Scales — +40, +20, 0, −20, −40 dB. Reference is dBV (1 V) or dBm (1 mW dissipated in 600 Ω, 0.7746 V), selected by internal jumper.

Display — ±19.99 dB on any scale, except that the total dynamic range is limited to the range −60 dB to approx +56 dB by a 500 V max input specification.

Accuracy

Display Reading	Frequency Range	Max Error
0 to +19.99	20 Hz to 20 kHz	0.5 dB
0 to −10.00	20 Hz to 2 kHz	0.5 dB
	2 kHz to 20 kHz	1.0 dB
−10.00 to −19.99	20 Hz to 2 kHz	0.5 dB
	2 kHz to 7.5 kHz	1.0 dB
	7.5 kHz to 20 kHz	2.0 dB

Response Time — ≤5 s.

Common-Mode Rejection — ≥60 dB at 50 or 60 Hz.

RESISTANCE

Ranges — 200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ.

Accuracy — 200 Ω range, 0.5% of reading, ±1 count, +0.1 Ω; 2 kΩ through 2 MΩ range, ±0.5% of reading, ±1 count; 20 MΩ range, 1.0%, ±1 count.

Response Time — ≤0.5 s; 20 MΩ range, ≤5 s.

Max Output Current and Voltage — 1 mA max; approx 12 V max.

AC & DC CURRENT

Ranges — 200 μA, 2 mA, 20 mA, 200 mA, 2 A.

Accuracy — Dc current 0.2% of reading ±1 count; ac current 0.6% of reading ±1 count 40 Hz to 10 kHz.

Response Time — Dc ≤0.5 s; ac ≤5 s.

Input Impedance — $\frac{0.2\text{ V}}{\text{Range Setting}} + 0.1\ \Omega$ (<2 kΩ with 200 μA range)

TEMPERATURE MEASUREMENT

Ranges — Celsius: −55°C to +150°C. Fahrenheit: −67°F to +200°F.

Accuracy — With probe shipped with instrument ±2°C (±3.6°F). With any P6430 probe prior to calibration with instrument, ±8°C (±14.4°F).

The temperature probe functions in all other modes in °C with analog signal out of 10 mV/° at rear interconnect.

OTHER CHARACTERISTICS

Overrange Indication — Blinking display.

Measurement Rate — 3.33 per second.

Inputs — The max input voltage is 1 kV. The front-panel HI and LO connectors may be floated 1 kV max above ground, the rear inputs 350 V. Current measuring functions are fused at 2.5 A. Ohms functions protected to 120 V rms indefinitely, 250 V rms ½ hour.

Ambient Temperature — Performance characteristics are valid over a temperature range of +15°C to +40°C.

Standard Accessories — 1 pair Test Leads (003-0120-00), 1 P6430 Temp Probe (010-6430-00).

ORDERING INFORMATION

DM 502 Digital Multimeter **$375**

Option 02 without Temp Capability and Probe . . . . . **Sub $125**

Optional Accessories — Deluxe test lead with accessories including push-on spring-loaded hook tip and special IC package tip, high flexibility wire, red, 4 ft.
Order (012-0426-00) **$8.00**

As above except black.
Order (012-0426-01) **$8.00**

Test lead with alligator clip, 4 ft, black.
Order (012-0425-00) **$4.20**

High Voltage Probe to 40 kV
Order (010-0277-00) **$65**

During the recent dynamic growth of digital logic and computers, the pulse generator, long a valuable signal source, has acquired added importance. Pulse generators are especially useful for testing response of wideband systems and for simulating signals from a variety of devices. Pulse generators are also used to provide stimulus to living tissue in physiological and biological research. In addition they are used to drive lasers, simulate data transmission signals, test switching speeds of active devices or memory elements, and for a wide variety of other functions.

The TM 500 line consists of four general-purpose pulse generator modules and a specialized generator. The specialized generator, the PG 506, is intended primarily for oscilloscope calibration. The PG 501 and PG 502 are designed for 50 ohm systems, and have repetition rates, amplitudes, and transition times compatible with the common digital integrated-circuit families such as TTL, DTL, and ECL. Furthermore, the PG 502, with 250 MHz repetition rate and independent control of the pulse top and bottom levels, is ideal for ECL design and testing.

The new PG 508 is designed for both 50 Ω and higher impedance circuits such as MOS, HTL, and CMOS logic. Its accurate 50 Ω output impedance allows you to deliver clean signals into reactive loads or at the end of an unterminated cable. The PG 508 sets a new standard in operator convenience with its control error light, trigger/gated light, selectable 1 MΩ or 50 Ω trigger input impedance, and an expanded trigger level range.

PULSE GENERATORS — COMPARISON OF CHARACTERISTICS

The following is a comparison of the main characteristics of the PG 501, PG 502, PG 505, and PG 508. A complete list of specifications appears on the following pages.

	PG 501	PG 502	PG 505	PG 508
Rep Rate Range	5 Hz to 50 MHz	10 Hz to 250 MHz	1 Hz to 100 kHz	5 Hz to 50 MHz
Pulse Width Range	10 ns to 100 ms	2 ns to 50 ms	5 μs to 0.5 s	10 ns to 100 ms
Rise and Fall times	Fixed, ≤ 3.5 ns	Fixed, ≤ 1.0 ns	≤ 1 μs to ≥ 20 ms, Independently variable up to 20:1	5 ns to ≥ 50 ms, Independently variable up to 100:1
Maximum Amplitude	±5 volts across 50 Ω	5 volts in a ±5 V window across 50 Ω	80 volts behind 4 kΩ	20 volts in a ±20 volt window to Hi Z, 10 volts in a ±10 V window to 50 Ω
Output Controls	Independent Amplitude Controls for + and − outputs	Independent pulse top and pulse bottom, complement switch	Amplitude, inversion switch	Independent pulse top and pulse bottom, complement switch
External Trigger and Ext Duration (width)	+1 V, + Slope 50 Ω input Z	+1 V, + Slope 50 Ω input Z	+0.5 V to +10 V, + Slope, 10 kΩ input Z	−3 V to +3 V, + or − Slope, 1 MΩ or 50 Ω input Z
Other	Simultaneous Pos and neg outputs, output LOCKED ON mode	Manual trig, Square-wave Mode, selectable internal 50 Ω Reverse Termination	Delay anywhere along 10-volt input ramp, custom timing positions	10 ns to 100 ms delay, double pulse, three-state trigger/gate light, control error light, manual trigger, manual gate, true 50 Ω output Z, custom timing positions, counted pulse burst with DD 501.
Price	**$425**	**$1495**	**$450**	**$1100**

PG 508 Pulse Generator

5 Hz to 50 MHz Plus Custom Range

Independently Variable Rise and Fall Times

Delay and Double Pulse Capability

20 V Output in a ±20 V Window to Hi Z, 10 V to 50 Ω

Independent Pulse Top and Bottom Level Controls

True 50 Ω Output Impedance for Clean Waveforms

Control Error Light Warns of Improperly Set Switch or Variable Controls

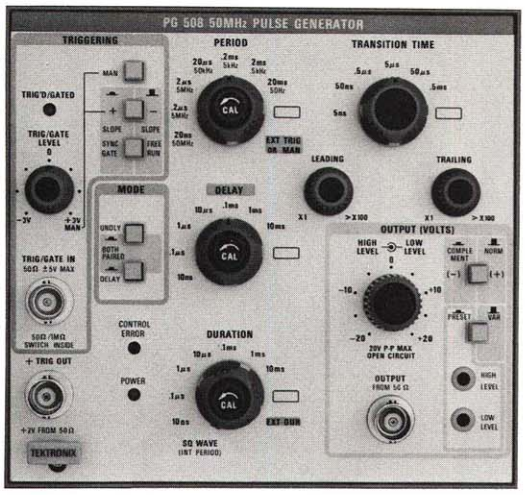
3-State Trigger Light Indicates Proper External Triggering

Selectable 1 MΩ Trigger Input Impedance for Optimum Match to Circuitry — Lets You Use Your Scope Probe

The PG 508 is a high-performance 50 MHz pulse generator that occupies two compartments of the TM 500 Series Power Module/Mainframes. While it is primarily intended to be a highly versatile general-purpose pulse generator, it is ideally suited for logic circuit design in MOS, CMOS, TTL, and ECL within the 50 MHz range of the instrument. Its broad ranges of output period, delay, duration, transition times... and its output up to 20 V p-p offer you benefits equaled by few other pulse generators on the market. But when you consider its selectable 1 megohm/50 Ω trigger input impedance, control error light, 3-state trigger/gate light, preset or external control of output voltage levels, and capability of interfacing with other TM 500 Instruments, none surpass the PG 508.

The PG 508 is the only pulse generator on the market with the convenience of preset or external tracking of the output voltage levels. A simple push of the preset button changes the output from variable top and bottom level controls to front panel screwdriver adjustments. Preset can also be used to track external supply voltages. This feature helps avoid the time spent in repeated setup of commonly used voltage levels and also avoids accidental changes in output. Most CMOS logic circuits, for example, can withstand only 0.3 V more input than the supply voltage. The PG 508 is truly designed to help you in your applications. A touch of a button complements the output voltage allowing an effective duty cycle range approaching 100%.

Although the PG 508 is a sophisticated instrument, the planning apparent in its selected control functions, and in the front panel itself, greatly simplifies its use and reduces the chance of error in setup. A control error light indicates improper switch or variable control settings, such as a pulse



DURATION setting greater than pulse PERIOD or excessive delay or transition times.

Independent rise and fall time controls allow the PG 508 user to have up to a 100:1 difference in rise and fall times. Rise and fall times are also not affected by changes in output amplitude levels. The square-wave mode reduces knob twisting when you want to vary the repetition rate over a wide range.

A unique arrangement of gating, slope, and manual controls allows you to gate the PG 508 on with a positive or negative going signal, or manually gate the instrument on or off by pressing the MAN button. In addition, with the DD 501 you can "dial up" a predetermined number of pulses in a burst from the PG 508. And the MANUAL button and MAN position in PERIOD let you add to that number, one by one. This is particularly valuable for simulating data of a given number of bits, or for checking logic circuitry where a suspected malfunction occurs at a specific number.

With the trigger input switched (internally) to 1 megohm impedance, you can "poke" into the circuitry under test using a 1X or 10X scope probe to trigger the PG 508 just as you would your favorite triggered sweep oscilloscope. In the external duration mode, the PG 508 can be used as a pulse regenerator, logic level translator, or sine wave to pulse converter. With the trigger level adjusted for the appropriate input signal, the output is set for the level of signal desired. The PG 508 provides the output to drive MOS, CMOS, DTL, HTL, I^2L, T^2L, or ECL. Its range of transition time control lets you create a signal accurately duplicating actual circuit drive observed in circuits under evaluation. Its high trigger input impedance makes it the only pulse generator on the market at this writing that can convert from MOS or CMOS logic levels to other logic families.

While the PG 508 is particularly attractive to the logic world, the independent output level controls, external trigger, delay, and double pulse capability make it extremely useful in radar, laser, rf switching, and signal processing applications.

Pulse Period — $\leq$ 20 ns to $\geq$ 200 ms in seven decade steps plus variable, with overlap on all ranges. Periods longer than 200 ms can be obtained in custom range position. Jitter: $<$ 0.1% + 50 ps.

Pulse Delay — (time between leading transitions in the paired pulse mode) $\leq$ 10 ns to $\geq$ 10 ms in seven decade steps plus variable, with overlap on all ranges. Delays longer than 100 ms can be obtained in custom range position. Duty Factor: delays to at least 70% of pulse periods for periods of 0.2 μs or greater, decreasing to at least 50% for a 20 ns period. Jitter: $\leq$ 0.1% + 50 ps.

Pulse Duration — $\leq$ 10 ns to $\geq$ 100 ms in seven decade steps plus variable, with overlap on all ranges. Durations longer than 100 ms can be obtained in custom range position. An additional position provides durations of approx 50% of the period setting for square wave output. Duty Factor: pulse durations to at least 70% of pulse periods for periods of $\geq$ 0.2 μs, decreasing to at least 50% for a 20 ns period. Jitter: $\leq$ 0.1% + 50 ps.

Pulse Transition Times — Independently adjustable leading and trailing transition times from $<$ 5 ns typical ($<$ 7 ns at some offset and amplitude levels) to $\geq$ 50 ms, measured from the 10% point to the 90% point in six decade steps plus variable. Variable controls with 100:1 range (50:1 on 5 ns) provide overlap on all ranges. Transition times longer than 50 ms are obtainable in the custom range position.

Pulse-Transition Linearity — Deviation from straight line $\leq$ 5% between the 10% and the 90% point for transition times greater than 10 ns.

Pulse Amplitude — Pulse high and low levels independently adjustable over a $\pm$20 V range from a 50 Ω low reactance source. Max pulse amplitude into a 50 Ω load is $\geq$ 10 V p-p; minimum is $\leq$ 0.5 V p-p. Max pulse amplitude into an open circuit is $\geq$ 20 V p-p; minimum is $\leq$ 1.0 V p-p. The preset level controls are adjustable over the same ranges.

Pulse Aberrations — $\leq$ 5%, + 50 mV p-p for pulse levels between + and − 5 volts into a 50 Ω load. May increase to $\leq$ 10%, +50 mV p-p for pulse levels outside this range.

Trigger Output — Amplitude $\geq$ + 2 V from 50 Ω. Source Impedance: 50 Ω. Duty Cycle: internal triggering, $\simeq$ 50%; external triggering: determined by duty cycle of triggering signal.

Trigger/Gate Input — Sensitivity: 80 mV p-p to 10 MHz; 250 mV p-p to 50 MHz. Input impedance: internally selected, 50 Ω or 1 MΩ paralleled by $\simeq$ 20 pF. Max input: $\pm$ 5 V peak into 50 Ω, $\pm$ 20 V peak into 1 MΩ. Minimum input pulse width: 10 ns. Trigger level range: $\pm$ 3 V. Polarity: front panel selectable, + or − slope.

Trig'd Gated Light — Flashing: input triggered at greater than approx a 10 Hz repetition rate or following the input signal at slower repetition rates. On: (Logic True) TRIG/GATE IN input potential above TRIG/GATE LEVEL setting with + SLOPE selected or below TRIG/GATE LEVEL setting with − SLOPE selected. Off: (Logic False) TRIG/GATE IN input potential below TRIG/GATE LEVEL with + SLOPE selected or above TRIG/GATE LEVEL with − SLOPE selected.

Synchronous Gate — Rate generator starts synchronously with the gating signal and completes the last output pulse in progress when the gating signal ends.

Pulse Delay Modes—Undelayed, delayed, and paired. Paired pulse mode limited to 25 MHz. Minimum pulse separation governed by duration duty factor specification.

Fixed Delays — Trig/Gate Input to Trigger Out: $\simeq$ 25 ns. Trigger Out to Pulse Out: $\simeq$ 23 ns in SQ WAVE or EXT DUR modes, $\simeq$ 35 ns in other modes.

Control Error Light — Steady On: indicates invalid operating mode, output is undefined. Flashing: timing control settings selected do not properly define the output pulse because valid limits have been exceeded. Steady Off: indicates valid operation for most control settings.

Counted Burst (with DD 501) — Max PG 508 repetition rate for exact count: 20 MHz. Usable to 50 MHz. Minimum time between bursts: 100 ns.

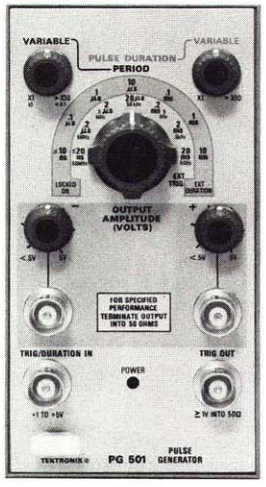
ORDERING INFORMATION

PG 508 50 MHz Pulse Generator **$1100**

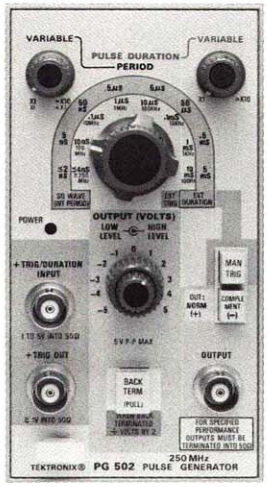
PG 508T 50 MHz Pulse Generator **$1250**
(includes PG 508, TM 503 Mainframe, and 016-0195-01 blank panel)

For Counted Burst, order the
DD 501 Digital Delay (page 169) **$725**

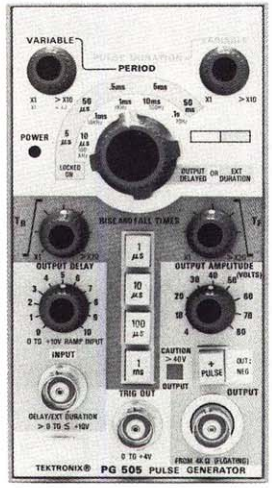
Suggested 10 in BNC 50 Ω cable (2 req) for interconnecting PG 508 and DD 501:
012-0208-00 . . . . . **$10.00**



PG 501



PG 502



PG 505

5 Hz to 50 MHz

Simultaneous Plus and Minus Outputs

5 V and 3.5 ns into 50 Ω

Independent Period and Duration Controls

Trigger Out

Pulse Period — 20 ns or less to 20 ms (within 5% from 0.2 μs to 2 ms and within 15% at 20 ms) in decade steps. Continuously variable between steps and to at least 0.2 s.

Pulse Duration — 10 ns or less to 10 ms (within 5% from 0.1 μs to 10 ms) in decade steps. Continuously variable between steps and to at least 0.1 s.

Duty Factor — At least 70% for periods of 0.2 μs or more. Duty factor decreases to 50% at 20 ns period. Minimum off time is 10 ns.

Pulse Rise Time and Fall Time — 3.5 ns or less.

Aberrations — With 3.5% at 5 V amplitude.

Pulse Amplitude — 0.5 V or less to at least 5 V into 50 Ω load.

Pulse Coincidence (+ and − outputs) — Leading edge of pulse outputs within 1 ns of each other (measured at 50% amplitude points).

Trigger Output — At least +1 V into 50 Ω load, occurring approx 8 ns prior to pulse output. Duty cycle ≃ 50% when using internal period.

External Trigger/Duration Input — At least +1 not to exceed +5 V (dc + peak ac). Trigger/Duration recognition level, + 1 V or less. Trigger/Duration reset level, +100 mV or less. Minimum on and off time is 10 ns. 50 Ω input impedance.

PG 501 Pulse Generator **$425**

MANUAL (ONE-SHOT) TRIGGER GENERATOR

The Manual (one-shot) Trigger Generator is used for manually initiating a pulse or complete train of events with instruments which do not have a manual trigger button or where a remote operation capability is desired, such as with some oscilloscopes and the PG 501, PG 505, and RG 501.

Order 016-0597-00 . . . . . **$40**

10 Hz to 250 MHz

1 ns Rise Time

5 V Output, ±5 V Window

Independent Pulse Top and Bottom Level Controls

Selectable Internal Reverse Termination

Manual Trigger Button

The PG 502 (250 MHz Pulse Generator) features: fast rise and fall time; independent top and bottom pulse levels; and adjustable pulse duration. The fast rep rate makes the instrument ideal for design and testing of fast logic and switching circuits.

Pulse Period — 4 ns or less to 10 ms (within 5% in calibrated positions except 15% on 10 ms range) in decade steps. Continuously variable between steps and to at least 100 ms.

Pulse Duration — 2 ns or less to 5 ms (within 5% in calibrated positions except 15% on 5 ms range) in decade steps. Continuously variable between steps and to at least 50 ms. Square-wave mode approx 50% duty factor.

Duty Factor — At least 50% in normal mode, approx 100% in complement mode. Minimum off time is 2 ns.

Pulse Rise Time and Fall Time — Less than 1 ns.

Aberrations — Within ±5% at 5 V p-p amplitude, except negative transition aberrations may exceed 5% for durations less than 5 ns.

Pulse Top Flatness — Within 2%, beginning 10 ns after transition.

Pulse Amplitude — Pulse high and low levels independently adjustable over a −5 to +5 V range, with pulse amplitude limited between ≥0.5 V and ≤5 V. Complement switch inverts pulse between same two selected voltage levels. Front-panel selectable 50 Ω internal back termination divides output levels by two.

Offset — ±5 V max, depends on amplitude setting.

Trigger Output — At least 1 V into 50 Ω, occurring approx 10 ns prior to pulse output. Duty cycle ≃ 50% when using internal period.

External Trigger/Duration Input — Trigger threshold less than 1 V; reset threshold greater than 0.1 V; max input 5 V. 50 Ω input impedance.

PG 502 Pulse Generator **$1495**

1 Hz to 100 kHz

Independently Variable Duration and Period

80 V Output

Variable Rise Time and Fall Time

Delay Mode

The PG 505 Pulse Generator features: floating output; independently adjustable rise and fall times; external control of period or period and duration. A special position on the pulse period and pulse duration controls allows addition of an internal capacitor to custom-select pulse period and duration. When driven from an externally supplied 0 to 10 volt ramp, the delay control of the PG 505 permits the output pulse to occur at any selected voltage point on the ramp, thus providing controllable time delay to any set time along the ramp.

Pulse Period — 10 μs or less to 100 ms (within 5%) in decade steps. Continuously variable between steps and to at least 1 s.

Pulse Duration — 5 μs or less to 50 ms (5 μs to 5 ms within 5%, 50 ms within 20%) in decade steps. Continuously variable between steps and to at least 0.5 s.

Duty Factor — (pulse duration/pulse period), 0 to 100%.

Pulse Rise Time and Fall Time — 1 μs or less to 1 ms in decade steps with T_R or T_F controls set at (X1). T_R or T_F control extends time to at least 20 ms. Accurate within 5% with T_R or T_F set at (X1).

Aberrations — Within 5% at max p-p output into 4 kΩ, 20 pF load.

Pulse Amplitude — 4 V or less to at least 80 V from a 4 kΩ source. Polarity selectable for + or − output.

Isolation of Pulse from Ground — 200 V dc.

Trigger Output — 0 to +4 V into 50 Ω.

External Trigger/Duration Input — Accepts TTL level signals.

Delay Mode — Delay range (with respect to delay signal) 0 to 10 V within 5%.

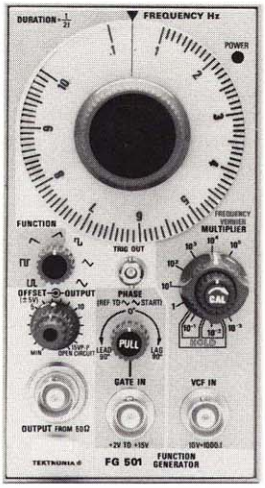
PG 505 Pulse Generator **$450**

The function generator is one of the most rapidly growing types of signal sources due to its extreme versatility and reasonable cost. It provides a variety of waveshapes, including triangular, square, sine, and, in some cases, pulses and ramps. Triangular waveforms, used in conjunction with oscilloscopes, determine the overload (clipping) point of amplifiers. Square waveforms simultaneously reveal low frequency response (by sag), high frequency response (by rise time), and transient response (by ringing and other aberrations) of amplifiers. Sine waves, universal in the electronics industry, show the full frequency response of various devices. Further, pulses and square waves are used as clock and signal sources in logic circuitry. Ramps and triangles provide time bases for oscilloscopes and paper recorders, and test signals for voltage comparators. The high frequency coverage of modern function generators extends into the audio, video, and radio spectra, and is useful in the telecommunications field as a modulation signal source. Their extreme low frequency range is useful in biological and geophysical simulations, servo systems, mechanical testing and simulations, and other applications. Built-in sweep in the FG 504 or an external ramp applied to the vcf (Voltage Controlled Frequency) input of any TEKTRONIX Function Generator permits the function generator to act as a sweep generator. A full 1000:1 sweep frequency range on TEKTRONIX Function Generators provides convenient testing of broadband amplifiers from subaudio to 40 MHz. Also, the same vcf input, fed from a low-level modulating signal, provides a frequency-modulated carrier. Logarithmic sweep, available in the FG 504, is especially useful when sweeping wide (100:1 or greater) frequency ranges. It spreads out the lower octaves, reduces the time necessary to sweep the full range, and makes Bode plots or graphs easier to read. The gate or burst feature is useful in testing tone-controlled systems, loud-speaker transient response characteristics, and Automatic Gain Control circuits. The FG 501 and FG 504 provide control over the starting phase of the output waveform in the burst mode.

External trigger in the FG 504 allows your signal to initiate one complete waveform from the FG 504, particularly useful when generating pulses or ramps. Phase lock, a powerful tool in the FG 504, permits an external repetitive signal to control the output frequency of the FG 504. Also, digital signals can be converted to high or low voltage sine waves, ramps, or pulses. Sine waves can be converted to digital signals, or the FG 504's output frequency can be referenced to your frequency standard. With the DD 501 Digital Delay in the "divide by n" mode the FG 504 can become a limited frequency synthesizer locked to your reference frequency.

	FG 501	FG 502	FG 503	FG 504
Waveforms	Sine, Square, Triangle, Pulse, Ramp		Sine, Square, Triangle	Sine, Square, Triangle, Ramps & pulses with variable symmetry
Variable Symmetry	no	no	no	7% to 93% duty cycle
Frequency Range	0.001 Hz to 1 MHz	0.1 Hz to 11 MHz (pulse, ramp 1.1 MHz max)	1.0 Hz to 3 MHz (usable 0.01 Hz to 5 MHz)	0.001 Hz to 40 MHz 0.001 Hz to nominally 4 MHz with variable symmetry
Custom Frequency Range	no	no	With user-installed capacitor	Shipped with capacitor for 20 Hz to 20 kHz range
Dial Accuracy (% of Full Scale)	Within 3%	Within 3% to 1 MHz Within 5% to 10 MHz	Within 5%	Within 3% to 4 MHz Within 6% to 40 MHz
Amplitude Open Circuit	15 V p-p max	10 V p-p max	20 V p-p max	30 V p-p max
Into 50 Ω	7.5 V p-p max	5 V p-p max	10 V p-p max	15 V p-p max
Output Step Attenuator	no	no	no	0 to −50 dB in 10 dB steps
Offset	±5 V dc open circuit, ±2.5 V dc into 50 Ω load			±7.5 V dc open circuit, ±3.75 V dc into 50 ohms
Output Impedance	50 ohms			
Amplitude Flatness Sine Wave ref 10 kHz	±1.5 dB, 0.001 Hz-1 MHz ±0.5 dB, 20 Hz to 20 kHz	±1.5 dB, 0.1 Hz-11 MHz ±0.5 dB, 20 Hz to 20 kHz	±2 dB, 0.1 Hz to 3 MHz ±0.5 dB, 20 Hz to 20 kHz	±0.5 dB, 0.001 Hz to 40 kHz ±2 dB, 40 kHz to 40 MHz
Square, Triangle	±1 dB ref sine	±3 dB ref sine	±1 dB ref sine	Square wave ±0.5 dB to 20 MHz, ±2 dB to 40 MHz
Frequency Stability (% of Full Scale)	≤0.05% for 10 min, ≤0.1% for 1 hour, ≤0.5% for 24 hours			
Sine Wave Distortion	≤0.5% 1 Hz to 20 kHz ≤1.0% 20 kHz to 100 kHz ≤2.5% 100 kHz to 1 MHz	≤0.5% 10 Hz to 50 kHz Harmonics: ≤ −30 dB at all other frequencies	≤0.5% 1 Hz to 30 kHz ≤1.0% 30 kHz to 300 kHz ≤2.5% 300 kHz to 3 MHz	≤0.5% 20 Hz to 40 kHz Harmonics: ≤ −30 dB 40 kHz to 1 MHz ≤ −20 dB 1 MHz to 40 MHz
Square Wave Response	≤100 ns rise and fall ≤5% total aberrations	≤20 ns rise and fall ≤3% total aberrations	≤60 ns rise and fall ≤3% total aberrations	≤6 ns fixed 10 ns to 100 ms variable ≤5% + 30 mV aberrations
Triangle Linearity (10% to 90%)	Within 1% 0.001 Hz to 100 kHz Within 2% 100 kHz to 1 MHz	Within 1% 0.1 Hz to 100 kHz Within 3% 100 kHz to 1 MHz Within 5% 1 MHz to 11 MHz	Within 1% 1.0 Hz to 100 kHz Within 5% 100 kHz to 3.0 MHz	Within 1% 10 Hz to 400 kHz Within 5% 400 kHz to 40 MHz typ within 2% 0.001 Hz to 10 Hz
Voltage Controlled Frequency	Up to 1000:1 frequency change with 10 V external signal. Slew rate ≥0.3 V/μs, typically ≥0.5 V/μs.			
Burst/Gate	Input impedance, 1 kΩ. Control signal required +2 V; +15 V max. Bursts are synchronous with gate. Phase continuously variable from −90° to +90°.	Input impedance, 1 kΩ. Control signal required, +2 V; +15 V max. Bursts are synchronous with gate.	Not applicable	Input impedance ≥ 10 kΩ Trigger level +1 V to +10 V Sensitivity 1 V p-p Generator completes integral number of cycles ±80° phase control
Triggered Mode	no	no	no	Single waveform with external or manual trigger
Trigger Output	TTL compatible +2.5 V into 600 Ω	TTL compatible +2.5 V into 50 Ω	TTL compatible +2.5 V into 600 Ω	TTL compatible 0 to ≥ 2 V, 50 Ω Output Z
Phase Lock	no	no	no	100 Hz to 40 MHz
Internal Sweep	no	no	no	Logarithmic or linear 0.1 ms to 100 second duration Separate start-stop frequency dials
Amplitude Modulation	no	no	no	100% with 5 V p-p input
Output Hold Mode	0.001 Hz to 10 Hz	no	no	0.001 Hz to 400 Hz
Price	**FG 501 . . . . . $500**	**FG 502 . . . . . $595**	**FG 503 . . . . . $400**	**FG 504 . . . . . $1200**

FG 501, FG 502, FG 503, and FG 504 Function Generators



FG 501

0.001 Hz to 1 MHz

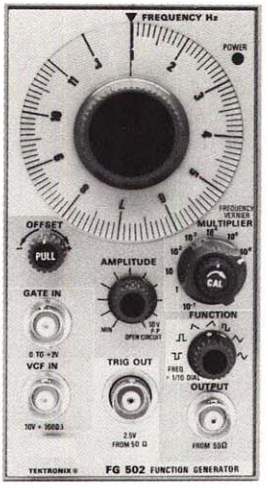
Five Waveforms

Vcf and Gated Burst

Hold Mode

The FG 501 produces low-distortion sine, square, triangle, pulse, and ramp waveforms from 0.001 Hz to 1 MHz. An external vcf input permits control of the output frequency from an external voltage source. Frequency sweep up to 1000:1 ratio may be accomplished by applying a voltage ramp to the vcf input. A hold control allows the operation of the generator to be halted instantaneously at any point in its cycle. Release of the hold will then allow the operation to continue normally. A gate input is provided to allow "burst" or single cycle operation, with the phase of the generator output at the start of the burst controllable over a ±90° range. Output signal voltage is adjustable to 7.5 V p-p into a 50-ohm load, with dc offset also adjustable up to ±2.5 V.

FG 501 Function Generator **$500**



FG 502

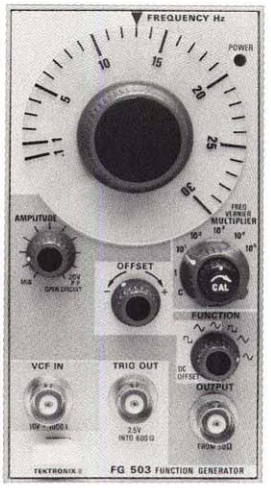
0.1 Hz to 11 MHz

Five Waveforms

Vcf and Gated Burst

The FG 502 Function Generator provides low-distortion sine, square, and triangle waveforms, and positive or negative ramps and pulses. Output frequency is continuously variable from 0.1 Hz to 11 MHz. The high frequency range from 1 to 11 MHz permits the versatility of the function generator to be extended into the medium radio frequency range. Voltage controlled frequency input permits the FG 502 to be used as a sweep generator. The external gate input permits the FG 502 output in any of its modes to be controlled by an externally supplied pulse to generate bursts of various output waveforms. This feature has application in wireline or radio remote control equipment and in certain phases of the telephone industry.

FG 502 Function Generator **$595**



FG 503

1.0 Hz to 3 MHz

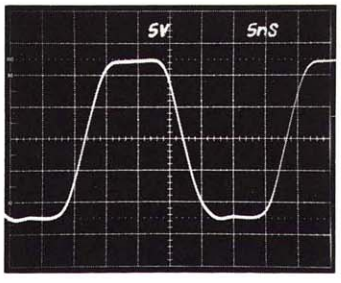
Three Waveforms

Vcf

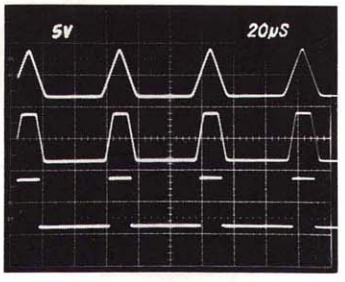
The FG 503 Function Generator provides high-quality low-distortion sine, square, and triangle waveforms. Six decade frequency multiplier steps, a custom position for user-determined frequency multiplication, a dial calibrated from 1.0 to 30 (uncalibrated from 0.1 to 1.0), and a frequency vernier control work together to select frequencies in overlapping ranges from 1 Hz to 3 MHz. The output frequency may be swept over a 1000:1 ratio by an external voltage. Output amplitude and offset controls are provided. A trigger output is available for controlling external devices or equipment. Amplitude up to 10 V p-p can be developed across a 50-ohm load (20 V p-p open circuit). Selectable offset up to 3.75 V dc across 50 ohms (7.5 V dc open circuit) is also featured.

FG 503 Function Generator **$400**

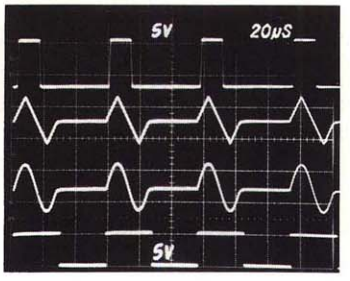
FG 504 OUTPUT WAVEFORMS



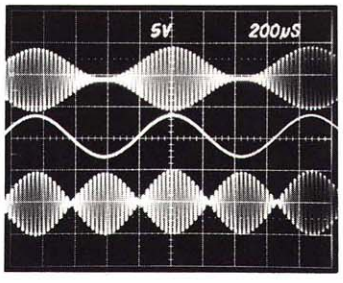
FG 504 30 volt output with 6 ns rise and fall times for superior pulse waveforms.



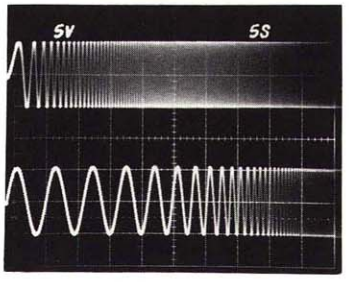
Variable rise and fall times increase pulse waveform flexibility.



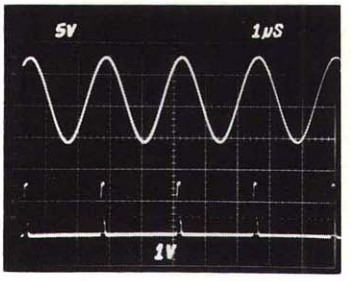
FG 504 completes one waveform when triggered from external signal on bottom trace.



True four quadrant multiplier permits normal am or double sideband suppressed carrier modulation.



FG 504 both linear or logarithmic sweep available for a wide range of sweep applications.



Phase lock allows the FG 504 output (top trace) to lock to virtually any periodic input waveform.

0.001 Hz to 40 MHz

Three Basic Waveforms, Plus a Wide Range of Shaping with Variable Rise and Fall and Symmetry Controls

Logarithmic or Linear Sweep

Separate Frequency Dials Set Lower (START) and Upper (STOP) Limits of Sweep

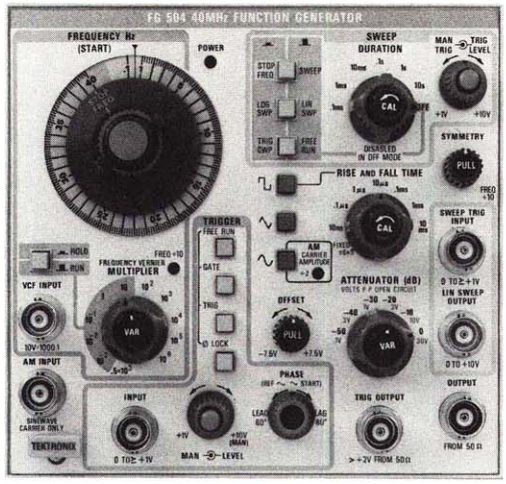
Up to 30 V p-p Output

Built-in Attenuator

Am and Fm

Phase Lock Mode

External and Manual Trigger or Gate



The output of the FG 504 may be phase locked, gated, or triggered by a reference signal, letting you convert from one waveform to another, such as pulses to sine waves, as well as adjust phase relationships. Post attenuator offset enables use of the full ±7.5 V offset range with small signals. And the FG 504 output can be amplitude or frequency modulated by external signals.

The FG 504 also provides trigger output, external voltage control input, and sweep output. (Contact your Tektronix Field Engineer for a data sheet discussing FG 504 applications in detail.)

Frequency Range — Sine, Triangle and Square Waveforms: 0.001 Hz to 40 MHz calibrated range. Ramps, Pulses or waveforms requiring use of VARIABLE SYMMETRY control: 0.001 Hz to nominally 4 MHz. Multiplier switch has position for user-determined range by capacitor selection. Maximum frequency on this range is 400 kHz. A 5 μF capacitor provides a full scale frequency of 400 Hz. Instrument shipped from factory with capacitor installed for 20 Hz to 20 KHz range in 0.5 x 10^3 position.

Frequency Resolution — 1 part in 10^4 of full scale setting using the FREQUENCY VERNIER control.

Frequency Stability — ≤0.05% for 10 minutes, ≤0.1% for 1 hour, ≤0.5% for 24 hours. The FREQUENCY Hz dial must be on the calibrated portion. The instrument must be at a constant ambient temperature between 0°C and +50°C and checked after a 1 hour warmup.

Dial Calibration — 1 to 40 calibrated, 0.1 to 1 uncalibrated.

Dial Accuracy — (+15°C to 35°C) Start Dial: Within ±3% of full scale from 0.001 Hz to 4 MHz. Within ±6% of full scale from 4 MHz to 40 MHz. Measurements made at +25°C ±10°C. Stop Frequency Dial: 5% of the difference between the start and stop frequencies plus the FREQUENCY Hz (START) dial error. Stop Dial uncalibrated on the 10^6 MULTIPLIER range.

Maximum Dial, VCF, and Sweep Range —

MULTIPLIER	FREQUENCY RATIO
10^6	500:1
10^5-10^2	1000:1
10^1, 1, 10^{-1}, 10^{-2}	100:1
10^{-3}	40:1

Internal Sweep — Linear or Logarithmic. Accuracy: Limited by Start and Stop Frequency dial specifications. Can be set more accurately using an external frequency monitor. Sweep Duration: 100 s to 0.1 ms in six decades. Variable control overlaps decades. Stop Frequency to Swept Stop Frequency Error: Within 2% maximum from 100 s to 1 ms sweep duration. Within 10% maximum from 1 ms to 0.1 ms sweep duration. Linear Sweep Output: Amplitude: 0 V to + 10 V from 1 kΩ. Amplitude Accuracy: Within ±5% from 100 s to 1 ms, within ±10% from 1 ms to 0.1 ms. Sweep Trigger Input: Input Sensitivity: 1 V p-p. Trigger Level: 1 V through 10 V. Maximum Input: +20 V. Manual Trigger: Front panel control.

Voltage Controlled Frequency Input — Nominal sensitivity (Hz/volt) = 4 x MULTIPLIER setting per volt. A positive-going voltage increases frequency. Maximum Frequency: 40 x MULTIPLIER setting. Minimum Frequency: Maximum frequency divided by vcf range of MULTIPLIER setting (see DIAL, VCF, and SWEEP RANGE). Slew Rate: 0.3 V/μs maximum. Input Impedance: 10 kΩ.

Output Amplitude — 30 V p-p into an open circuit, 15 V p-p into 50 Ω.

Amplitude Flatness — Sinewave (reference at 10 kHz): Within ±0.5 dB from 0.001 Hz to 40 kHz. Within ±2 dB from 40 kHz to 40 MHz. Typically within ±0.5 dB to 40 MHz. Triangle (reference at 10 kHz): Within ±0.5 dB from 0.001 Hz to 40 kHz. Within ±2 dB from 40 kHz to 40 MHz. Squarewave (reference at 10 kHz): Within ±0.5 dB from 0.001 Hz to 20 MHz. Within ±2 dB from 20 MHz to 40 MHz. Sine, Triangle and Squarewave Amplitude Match: Within ±1 dB at 10 kHz.

Output Attenuator — Open Circuit Voltages:

ATTENUATOR STEP	MAXIMUM OUTPUT VOLTAGE (p-p)
0 dB	30 V
-10 dB	9.5 V
-20 dB	3 V
-30 dB	950 mV
-40 dB	300 mV
-50 dB	95 mV

Variable −20 dB extends minimum signal amplitude to 10 mV. See square wave aberrations specification. Accuracy: ±0.5 dB/decade.

Offset Range — ±7.5 V into an open circuit, ±3.75 V into 50 Ω. Maximum signal plus offset peak output amplitude of ±15 V into an open circuit or ±7.5 V into 50 Ω. Offset defeatable by front panel control.

Waveforms — Sine, Triangle and Square: Ramps and Pulses by use of the VARIABLE SYMMETRY control.

Variable Symmetry — Duty Cycle Range: 7% to 93%; 20% to 80% on triangle and sine waveforms above 1 MHz. Actuation of VARIABLE SYMMETRY control divides output frequency by approximately ten.

Triangle Symmetry — Within 1% from 10 Hz to 400 kHz, within 5% from 400 kHz to 40 MHz on calibrated portion of FREQUENCY Hz dial. Typically within 2% from 0.001 Hz to 10 Hz.

Triangle Linearity — Within 1% from 10 Hz to 400 kHz, within 2% from 400 kHz to 4 MHz, within 10% from 4 MHz to 40 MHz measured from the 20% to 80% points on the waveform. Typically within 2% from 0.001 Hz to 10 Hz.

Sine-wave Distortion (Total Harmonic Distortion) — ≤0.5% from 20 Hz to 40 kHz. Greatest harmonic at least 30 dB down from 40 kHz to 1 MHz and 20 dB down from 1 MHz to 40 MHz. Typically ≤1% from 0.001 Hz to 20 Hz. Measured under the following conditions: terminated in 50 Ω, at 25°C ±10°C ambient, with zero offset, ≤30 dB attenuation and with FREQUENCY Hz (START) dial set between 4 and 40.

Square wave — Rise and fall time (FIXED): ≤6 ns. Aberrations: ≤5% p-p + 30 mV into a 50 Ω load.

Variable Rise and Fall Time (Square and Pulse Waveforms) — Range: 10 ns to 100 ms in 7 steps measured from 10% to 90% points on waveform. Variable control has ≥10 x range. Period of waveform must exceed combined rise and fall times by ≥20%.

Amplitude Modulation Input — a 5 V p-p signal produces 100% modulation of a sine wave carrier from dc to 4 MHz with <5% distortion at 70% modulation when driven from a source impedance of ≤600 Ω. From 4 MHz to 40 MHz there is <10% distortion at 65% modulation. Distortion specifications valid for modulating frequencies from 20 Hz to 20 kHz. Modulation frequency bandwidth is dc to 100 kHz. A modulating source impedance of ≤10 kΩ ensures proper modulation and divides the output amplitude by 2. Input Impedance: >1 MΩ.

External Trigger/Gate/Phase Lock Input — Input Impedance ≥10 kΩ. Sensitivity: 1 V p-p. Maximum input Amplitude: +20 V. Trigger Mode: (for triggering a single cycle of main generator waveform). Trigger Level: 1 to 10 V. Minimum Period: 75 ns. Maximum Triggered Frequency: ≥20 MHz. Gate Mode: (for gating multiple-cycle bursts of main generator waveform). Minimum Period: 75 ns. Maximum Gated Frequency: ≥20 MHz. Duration of gate determines number of output cycles with integral number of cycles completed. Phase Lock Mode: Frequency Range: 100 Hz to 40 MHz. Capture Range: ±10 major dial divisions from 100 Hz to 4 MHz. ±8 major dial divisions from 4 MHz to 40 MHz. Lock Range: Generator will lock to a changing external signal, without readjusting the PHASE control, within ±10 major dial divisions from 100 Hz to 4 MHz and within ±1 MHz from 4 MHz to 40 MHz Phase Adjustment Range: ±80° from 100 Hz to 4 MHz.

Gate and Trigger Phase Control — Phase Adjustment Range: Triangle and sine waveforms only, ±80° from 0.001 Hz to 4 MHz.

Manual Trigger/Gate — Available at front panel.

Trigger Output — 0 V to ≥ + 2 V from 50 Ω.

Hold Mode — Drift: ≤10% of p-p output amplitude/hour. Range: 0.001 Hz to 400 Hz.

Power Consumption — 48 W from power line.

Power Dissipation — 24 W maximum in plug-in.

Performance Conditions — The electrical characteristics are valid if the FG 504 is calibrated at an ambient temperature between +20°C and +30°C, and operated between 0°C and +50°C, unless otherwise noted. Forced air circulation is required above +40°C (TM 515, TM 506, RTM 506 or equivalent).

FG 504 40 MHz Function Generator . . . $1200

FG 504T 40 MHz Function Generator . . $1350
(includes FG 504, TM 503 Mainframe, and 016-0195-01 blank panel)

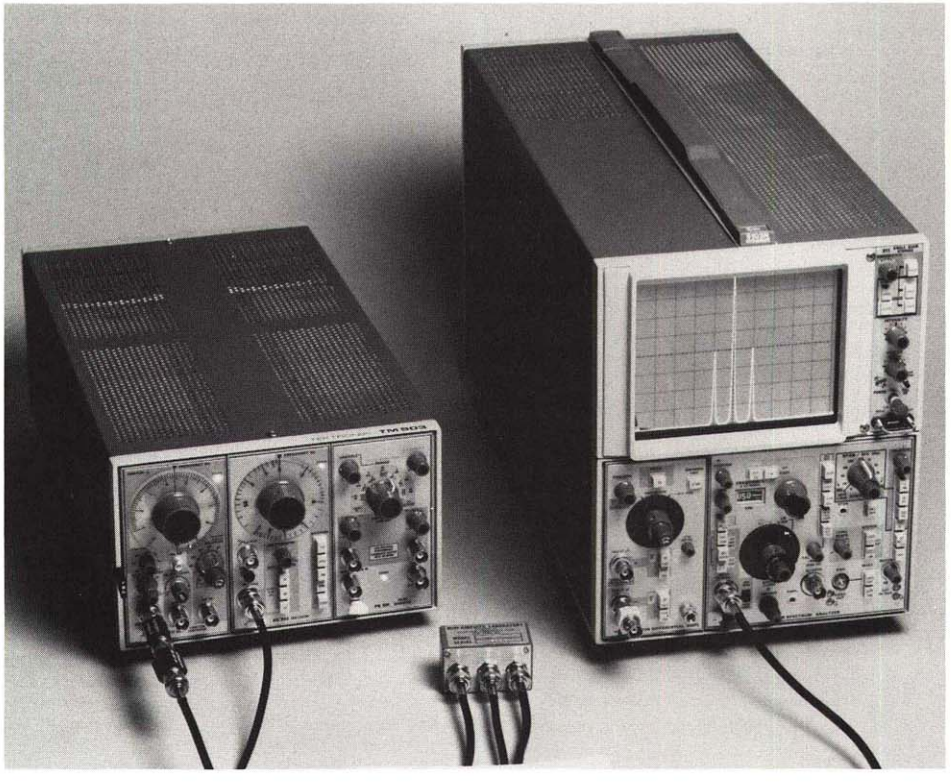
The Sweep, Audio, and Ramp Generators include the SG 502 Audio Oscillator, the SW 503 Sweep Generator, and the RG 501 Ramp Generator. The SG 502 Audio Oscillator features extremely low distortion and wide-range flat response for critical audio and communication systems and component testing. The RG 501 Ramp Generator provides single or repetitive ramps of controllable amplitude and duration, excellent linearity, and short retrace time.

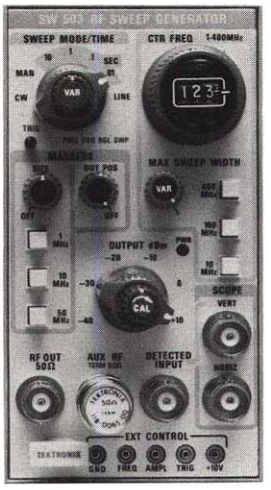
The SG 502 Oscillator is an RC design featuring distortion less than 0.035% over the entire audio range of 20 Hz to 50 kHz. Distortion does not exceed 0.1% over the balance of its 5 Hz to 500 kHz coverage. Output amplitude is flat with ±0.3 dB over the entire range. The output impedance is the 600 ohm audio industry standard. Amplitude control of 70 dB is available in 10 dB steps plus a 40 dB variable attenuator. A fixed-amplitude square wave is present simultaneously.

The SG 502 is used in various applications in conjunction with several other TM 500 instruments. One of these is the Audio Frequency Communications package, as discussed, where it and the DM 502 and DC 504 find ready application in telephonic communications, as well as in fields which use telephone lines for voice or low-speed data transmission, like the broadcasting industry and computer time-sharing industry.

The SW 503 Sweep Generator puts most of the features associated with larger laboratory-type sweep generators in a single compartment TM 500 Plug-in.

Frequently, the RG 501 Ramp Generator is used in conjunction with other TM 500 instruments; for instance, function generators, the PG 505 Pulse Generator, the MR 501 Monitor or other TEKTRONIX Crt Monitors, or an X-Y recorder. The ramp generator's output is an ideal time base for the monitor or recorder. Used with the PG 505 Pulse Generator, the RG 501 permits a pulse to be triggered at any selected point along a ramp: a single PG 505 and RG 501 can generate pulses delayed a controlled time following the RG 501 gate output and multiple PG 505s can be driven from one RG 501 to generate delayed pulse trains of almost any description. With any of the TM 500 Function Generators, where vcf (voltage controlled frequency) input is fed by the RG 501 output, a linear frequency sweep of up to 1000:1 width may be generated.





SW 503 Sweep Generator

1 to 400 MHz Range

1, 10, and 50 MHz Markers Built-in

Continuously Variable Dot Marker System

+10 dBm (+50 dBmV) Output

Remote Programming Capability

The SW 503 is a 1 to 400 MHz RF SWEEP GENERATOR with two marker systems built-in. Standard crystal comb markers at 1, 10, and 50 MHz intervals automatically adjust their width as the sweep width range is selected. Even more unique is the variable position dot marker whose frequency can be automatically displayed on a TEKTRONIX DC 502 Option 07 Counter. The counter will also monitor the frequency when using the SW 503 as a cw signal source.

The SW 503 can be amplitude modulated, frequency modulated, or remotely programmed with voltages to control amplitude, frequency, or sweep triggering.

The versatility and many features of the SW 503 make it an excellent choice for specialized sweep testing or for general laboratory use.

CHARACTERISTICS

Center Frequency Range — 1 to 400 MHz. Dial accuracy: ±8 MHz (note 1). Drift: 100 kHz/5 min — 2 MHz/8 hrs (note 2).

Swept Frequency Range — 1 to 400 MHz. Sweep width: 200 kHz min, 400 MHz max. Display linearity: ≤2% @ 400 MHz position, ≤3% @ 100 MHz and 10 MHz positions.

Signal Purity — Residual fm: ≤10 KHz. Harmonic Spurious: ≥30 dB below output from 10 to 400 MHz, ≥25 dB below output from 3 to 10 MHz ≥15 dB below output from 1 to 3 MHz. Non-harmonic Spurious: ≥40 db below output.

Output — Impedance: Model SW 503 50 Ω, Model SW 503, Option 01 75 Ω. Level: 0.7 VRMS MAX, SW 503 CALIBRATED −40 to +10 dBm 50 Ω, SW 503, Option 01 CALIBRATED 0 to +50 dBmV 75 Ω. Attenuation:

Step 50 dB in 10 dB steps, absolute accuracy 0.2 dB/step referred to zero attenuation, vernier ≥20 dB. Flatness: ±0.25 dB (measured at maximum output using precision detector ≤1.15 vswr).

Blanking — Retrace blanking of the rf output provided for sweep operation, removed for cw operation.

Aux Rf Output — −2 dBm min. into 50 Ω.

Operating Modes — Repetitive sweep, single sweep, externally triggered sweep, line-lock sweep, manual sweep, cw.

Sweep Time — Continuously variable from 10 ms to 100 s in 4 decade steps, plus vernier.

Horizontal Output — 0.5 volts p-p (output symmetrical to ground reference).

Crystal Markers — Type: birdie-by-pass, comb markers. Marker comb frequency: 1, 10, and 50 MHz. Marker accuracy: 0.005%. Marker width: automatically changes from approx 400 kHz to 50 kHz as the sweep width range is selected. Marker size: adjustable from 1 mV to 1 V p-p. Rectified marker: internal switch removes the negative portion of the birdie for use with x-y recorders. Size varies with detector's output impedance. Max marker size is over 0.5 V.

Variable (Dot) Marker (use in line or 10 ms rate) — When used in conjunction with the DC 502 Digital Counter with Option 7, the variable (dot) marker will stop the sweep wherever the marker is positioned. This in turn gates the counter on to read the frequency. At the end of the counter gate, the SW 503 resumes sweeping. The accuracy of the variable marker is limited to the counter accuracy and the display resolution, i.e.: reduced sweep width gives greater resolution.

Remote Programming — Front-panel jacks provide connections for the remote control of frequency, sweep width, and the 20 dB vernier output control. A jack is also provided to externally trigger the sweep circuit when the instrument is in a single sweep mode. Provisions are also available on the front panel for external frequency and amplitude modulation. External fm: the full frequency range can be modulated at rates up to 4 kHz. With reduced deviation and linearity, modulation rates to 100 kHz are possible. Modulation sensitivity is approx 50 MHz/V. Input impedance 10 kΩ. External am: 90% modulation can be obtained at modulation frequencies up to 25 kHz. Note: the output level must be reduced at least 6 dB by the vernier output control to obtain 90% modulation. Modulation sensitivity is 1 volt p-p/10% am. Input impedance 10 kΩ.

Note 1. Increased accuracy can be obtained using the crystal markers or the variable (dot) marker in conjunction with the DC 502, Opt 07.

Note 2. After ½ hour warm-up at a constant ambient, and allowing a 5 minute stabilization period after a frequency change.

Included Accessory — 50 Ω Termination 118-0065-00. Required for AUX RF output.

ORDERING INFORMATION

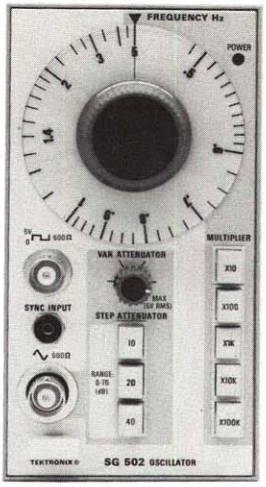
SW 503 RF Sweep Generator (50 Ω Output) $1450

Option 01 (75 Ω Output) . . . . . No Charge

Needs external detector.

SUGGESTED ACCESSORIES

TM 515 Option 07 Power Module $350
DC 502 Option 07 550 MHz Freq. Counter $1195
DM 502 Digital Multimeter $375
SC 502 15 MHz Dual Trace Oscilloscope $1200
50 Ω Precision Detector for SW 503 (118-0070-00) $55
75 Ω Precision Detector for SW 503 Opt 01 (118-0071-00) $55



SG 502

RG 501

5 Hz to 500 kHz Sine and Square Waves

Extremely Low Distortion Sine Wave

5 V Rms Open Circuit—600 Ω Source

0-40 dB Output Variable Plus 0-70 dB in 10 dB Steps

SINE WAVE

Frequency Range — 5 Hz to 500 kHz in 5 decade steps. Accurate within 5% of dial setting from 5 Hz to less than 50 kHz; within 10% of dial setting from 50 kHz to 500 kHz.

Amplitude Response — Flatness is 0.3 dB over entire range (1 kHz reference).

Attenuation — Selectable from 0 dB to 70 dB in 10, 20, and 40 dB steps with pushbuttons. Accurate within 2% for each step selected, additive. An uncalibrated control provides continuous variation from 0 dB to 40 dB.

Harmonic Distortion — Less than 0.035% from 20 Hz to 50 kHz. Less than 0.1% over the remaining frequency range.

Hum and Noise — Less than 0.1% of rated output.

Max Output Voltage — 5 V rms open circuit; 2.5 V rms into 600 Ω.

Output Impedance — 600 Ω, single ended.

SQUARE WAVE

Frequency Range — Same as sine wave. The square wave switches on the 0° phase of sine out.

Rise and Fall Time — 50 ns or less.

Amplitude — +5 V, fixed, open circuit.

Output Impedance — 600 Ω, single ended.

SYNC INPUT

Oscillator can be synchronized to external signal. Sync range, the difference between sync frequency and set frequency, is a linear function of sync voltage.

Input Impedance — 10 kΩ.

Measurements made at rated output and terminated in 600 Ω.

SG 502 Oscillator $395

10 μs to 10 s Ramp Duration

Plus or Minus Output

10-V Amplitude

Scope-type Trigger Functions

Gate Out, TTL Compatible

RAMP

Ramp Duration — Decade ranges of 10 μs to 1 s, extends to 10 s with 1-10 duration multiplier. Accurate within 3% when multiplier is at X1 (multiplier not calibrated).

Ramp Amplitude — Continuously variable from 50 mV or less to at least 10 V, either polarity. Dc level between ramps, 0 V within 20 mV.

Gate — From a low state of 0 V, within 100 mV, the ramp gate rises to +3 V, within 0.6 V, in 100 ns or less. Fall time is 100 ns or less. Gate source impedance is nominally 160 Ω.

Ramp Output Characteristics — Minimum load resistance, 3 kΩ; max load capacitance, 300 pF.

TRIGGERING

Auto Triggering — Provides free-running signal in absence of trigger. Locks automatically to trigger with a frequency above 20 Hz and at least 200 mV amplitude.

External Triggering — Sensitivity is at least 200 mV p-p, dc to 100 kHz. Input impedance approx 9.5 kΩ. 50 V (dc + peak ac) max input.

Internal Triggering — Same as external except that the trigger source is via the rear interface.

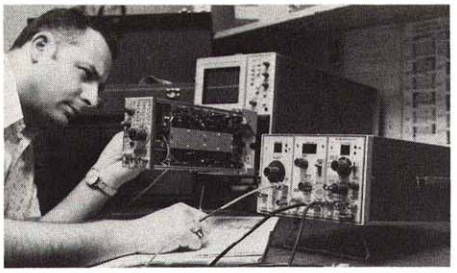
Line Trigger — Triggers at line frequency.

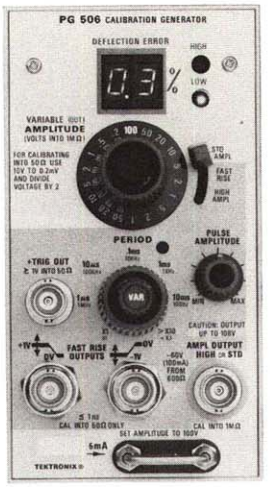
Trigger Level Range — ±1 V.

RG 501 Ramp Generator $295

Optional Accessory — Manual (One-Shot) Trigger Generator.

Order 016-0597-00 . . . . . $40





PG 506
CALIBRATION GENERATOR

Three Square-Wave Output Modes

10 Hz to 1 MHz

Direct Readout of Oscilloscope Deflection Error

TEKTRONIX TM 500 Oscilloscope Calibration Instruments set the state-of-the-art in every respect in oscilloscope calibration. These instruments provide the widest range of standard amplitude square waves, fastest rise times, lowest aberrations, fastest time marks, and widest frequency range of leveled sine waves available from any calibration equipment.

Furthermore, the TM 500 Oscilloscope Calibration Instruments simplify and speed up verification procedures, assuring a high level of performance and minimum costs. For example, the TG 501 provides a variable mode in addition to its crystal-controlled mode. In the variable mode, the time mark spacing can be quickly adjusted to exactly align with the oscilloscope graticule marks. The resulting percentage timing error is then read directly off the TG 501 digital display. The superior multi-instrument portability of the TM 500 concept lets this rapid verification take place at the oscilloscope usage location, since the entire calibration facility now occupies one small package with a single handle. This on-site verification increases accuracy and time-savings still further.

The PG 506 is a calibration generator for oscilloscopes with three modes of square-wave output, selectable dc outputs, and a variable-amplitude output with front-panel digital indication of oscilloscope deflection error. For checking attenuator performance and transient response of oscilloscopes, simultaneous plus and minus low-level, fast-rise (1.0 ns) square waves or high amplitude (60 volt), extremely clean square waves are available at frequencies from 10 Hz through 1 MHz. A 5 milliamp calibration current loop is useful for current probe calibration. In the amplitude calibration mode, a 1 kHz square wave is generated whose amplitude may be varied around the calibrated level until the square wave aligns with the oscilloscope vertical graticule divisions; scope deflection error is then read directly off the PG 506 digital display in percentage high or low, permitting rapid verification of oscilloscope performance.

AMPLITUDE CALIBRATOR MODE

Period — Fixed at approx one millisecond or dc.

Amplitude — From 100 V p-p to 200 microvolts p-p in 1-2-5 sequence, accurate within ±0.25% into 1 MΩ. 5 V p-p to 100 microvolts p-p into 50 Ω.

Error Readout Range — ±7.5%.

Error Readout Resolution — 0.1%.

PULSE MODES

Period — One microsecond to 10 milliseconds (within 5%) in decade steps with the VARIABLE control in CAL position. VARIABLE extends period to at least 100 milliseconds.

Symmetry — Approx 50% duty cycle.

HIGH AMPLITUDE OUTPUT

Rise Time — Unterminated: 100 ns or less. Terminated into 50 Ω: 10 ns or less.

Amplitude Range — Unterminated: 6 V or less to at least 60 V. Terminated into 50 Ω: 0.5 V or less to at least 5 V.

Leading Edge Aberrations — Within 2% or 50 mV p-p, whichever is greater, when terminated into 50 Ω.

Polarity — Positive going from a negative potential to ground.

Output Resistance Source — 600 Ω within 5%.

FAST RISE OUTPUTS

Rise Time (Terminated into 50 Ω) — 1.0 ns or less.

Amplitude Range (Terminated into 50 Ω) — 100 mV or less to at least 1.0 V.

Leading Edge Aberrations — 2% or 10 mV p-p, whichever is greater, during first 10 ns.

Flatness — Within 0.5% after first 10 ns.

Polarity — Simultaneous positive and negative going. Positive going is from a negative rest potential to ground. Negative going is from a positive rest potential to ground.

Output Resistance Source — 50 Ω within 3% at + and — output connectors.

Trigger Output (Terminated into 50 Ω) — Positive-going signal of at least 1 V.

PG 506 Calibration Generator **$1350**

TUNNEL DIODE PULSER

The Tunnel Diode Pulser (067-0681-01) provides a clean, fast-rise pulse for adjusting the transient response of high-frequency oscilloscopes and other instruments. The Tunnel Diode Pulser can be driven by the PG 506 Calibration Generator at repetition rates exceeding 50 Hz. Output amplitude of the pulse is approximately 250 mV into 50 ohms, while rise time is ≤125 ps; aberrations are <1% in a 1 GHz system.

Order 067-0681-01 . . . . . **$110**

PRECISION VOLTAGE DIVIDER

Designed for use with the PG 506 in the STANDARD AMPLITUDE mode, this 0.4 divider allows your oscilloscope to display a constant 4 divisions when checking amplitude calibration from 20 μV/div through 1 V/div. It also allows the PG 506 to be more conveniently used with oscilloscopes that cannot display 5 divisions of amplitude.

Input Z — 50 Ω with output load ≥100 kΩ.

Max Input — ≤5 V rms.

Output — 0.4 x PG 506 Amplitude.

Voltage Accuracy — ±0.4%.

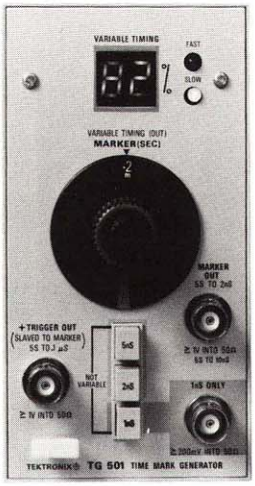
Order 015-0265-00 . . . . . **$50**

OSCILLOSCOPE CALIBRATION INSTRUMENTS CHART

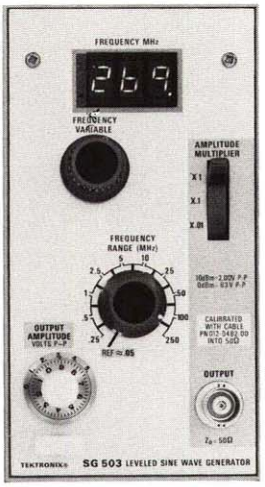
The following chart is a comparison of the four instruments making up the Oscilloscope Calibration Instruments.

A complete list of specifications appears on the following pages.

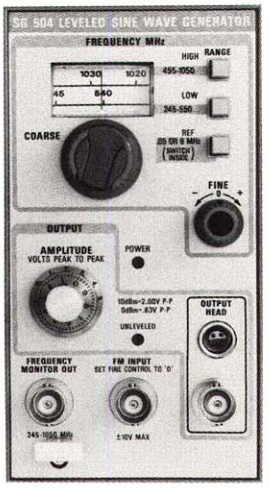
	PG 506 Calibration Generator	TG 501 Time Mark Generator	SG 503 Signal Generator	SG 504 Signal Generator
Primary functions	Amplitude calibration 200 μV to 100 V	Time-base calibration 1 ns to 5 s	Bandwidth calibration 250 kHz to 250 MHz	Bandwidth calibration 245 MHz to 1050 MHz
Secondary functions	Rise time and transient response testing, attenuator compensation testing	Testing oscilloscope nonlinearity	General leveled rf signal source	General leveled rf signal source with frequency modulation capability



TG 501



SG 503



SG 504

TIME MARK GENERATOR

Marker Outputs, 5 s to 1 ns

Direct Readout of Oscilloscope Timing Error

External Trigger Output

The TG 501 Time Mark Generator provides marker outputs from five seconds to one nanosecond. A unique feature on the TG 501 is a variable timing output with a front-panel two-digit LED display which indicates percentage of timing error between the normal time interval and a variable interval set to line up the marker pulse with graticule or division mark on the display. This feature not only provides direct readout in terms of percent error, but also helps eliminate errors associated with visually estimating error from a display.

Markers — 1 ns through 5 s in a 1-2-5 sequence.

Marker Amplitude — ≥1 V peak into 50 Ω on 5 s through 10 ns markers. ≥750 mV p-p into 50 Ω on 5 ns and 2 ns markers. ≥200 mV p-p into 50 Ω on 1 ns markers.

Trigger Output Signal — Slaved to marker output from 5 s through 100 ns. Remains at 100 ns for all faster markers.

Internal Time Base	Standard	Option 1
Crystal Frequency	1 MHz	5 MHz
Stability (0° to 50° C) after ½ hour warm-up	within 1 part in 10^5	within 5 parts in 10^7
Long-term Drift	1 part or less in 10^5 per month	1 part or less in 10^7 per month
Settability	adjustable to within 1 part in 10^7	adjustable to within 5 parts in 10^9

External Reference Input — Available with internal changes. Acceptable frequencies, 1 MHz, 5 MHz, or 10 MHz. Input amplitude must be TTL compatible.

Timing Error Readout Range — To ±7.5%.

Timing Error Measurement Accuracy — Device under test error is indicated to within one least significant digit (to within one displayed count).

TG 501 Time Mark Generator **$995**

Option 01, 5 MHz Time Base . . . . . **Add $150**

SIGNAL GENERATOR

Leveled, Variable Output

250 kHz to 250 MHz

Digital Readout of Frequency

The SG 503 Signal Generator is a general-purpose leveled sine-wave oscillator. It provides a leveled output amplitude which is variable from 250 kHz to 250 MHz. The selected frequency is indicated by a built-in autoranging frequency counter with a three-digit LED read-out on the front panel. Accurately calibrated output voltage into 50 ohms is variable from 5 mV to 5.5 V peak-to-peak.

Frequency Range — 250 kHz to 250 MHz, plus 50 kHz reference frequency.

Accuracy — Within ±0.7 of least significant digit of indicated frequency.

Amplitude Range — 5 mV to 5.5 V p-p into 50 Ω termination in three decade ranges.

Amplitude Accuracy — (50 kHz reference) Within 3% of indicated amplitude on (X1) range, 4% on (X0.1) range, and 5% on (X.01) range.

Flatness — (p-p) From 250 kHz to 100 MHz, output amplitude will not vary more than 1% of the value at 50 kHz except that up to +1.5%, −1% variation may occur between 50 MHz and 100 MHz on amplitude multiplier X0.1 and X0.01 ranges only. From 100 MHz to 250 MHz, amplitude variation is within 3% of the value at 50 kHz.

Harmonic Content — Second harmonic at least 35 dB down. Third and all higher harmonics at least 40 dB down.

Other — Rear edge card connection available to address the leveling circuit.

SG 503 Signal Generator **$1050**

SIGNAL GENERATOR

Leveled, Variable Output

245 MHz to 1050 MHz

Frequency Modulation Capability

The SG 504 Signal Generator provides a leveled output amplitude that is variable from 245 MHz to 1050 MHz in two bands. Frequency is indicated by a high-resolution tape dial that expands each band over 28 inches. The accurately calibrated output voltage is variable from 0.5 V to at least 4.0 V peak-to-peak into 50 ohms.

Frequency Range — Low band: 245 MHz to 550 MHz. Highband: 495 MHz to 1050 MHz, plus 50 kHz or 6 MHz reference frequency (internally selected).

Frequency Accuracy — ±2% of dial indication.

Amplitude Range — 0.5 V to at least 4.0 V p-p.

Amplitude Accuracy — (at reference) Within 3% of indicated amplitude.

Flatness — ±4% of amplitude at reference frequency.

Harmonic Content — 2nd harmonic at least 25 dB down; 3rd and all higher at least 40 dB down.

Fm Input — Frequency range: dc to 100 kHz. Deviation sensitivity: ±9 V produces from ±0.05% to ±0.4% deviation of carrier, depending on output frequency.

Frequency Monitor Output — ≥0.3 V p-p into a 50 Ω load from 245 MHz to 1050 MHz.

Rear Card Edge Connections — Address fm input, frequency monitor output, and amplitude control.

SG 504 Signal Generator (Includes Leveling Head) **$1995**

Replacement Leveling Head, Order (015-0282-00) **$200**

Direct current is almost invariably required for active devices, transducers, and many electromechanical components. Research, development, and design activities require supply voltages for the experimental or breadboard circuits and devices involved. Troubleshooting and maintenance, particularly when boards, modules, or sub-assemblies are removed for testing, also require versatile sources of direct current. Measurement systems often require dc for the basic transducers. While the possible combinations of voltage and current are infinite, modern semiconductors have decreased the typical maximum power requirements and have also produced some standardization of voltages. Most families of digital integrated circuits operate with a single 5 volt supply. Many operational amplifier ICs and other types of linear ICs operate with supply voltages in the 12 to 15 volt range, frequently requiring both positive and negative supplies. Complementary MOS (CMOS) logic typically can be powered by potentials ranging from a few volts to almost 20 volts.

The TM 500 line of power supplies features versatility and flexibility, with up to three independent voltages available from a single plug-in instrument. Three of the four power supplies feature a fixed 5-volt-at-1-amp supply for logic circuits or indicators plus one or two variable supplies. Two of these units — the PS 501-1 and PS 501-2 — are basically similar except for their means of voltage adjustment and indication. Each features a floating 0-to-20 volt output and adjustable current limiting from 0 to 400 milliamps with constant current operation above the limiting setting. The PS 501-1 precision supply uses a multiturn potentiometer with a mechanical digital readout for precise setting and adjustment of the output voltage. The PS 503A provides a dual −20, 0, +20 volt variable supply plus a 5 volt 1 A independent supply. The −20, 0, +20 volt supply can be varied in a tracked mode, or each part set individually. The two variable outputs each provide up to 1 amp in the high-power compartment of a TM 504 or TM 506, or 400 mA maximum in all other compartments of any TM 500 Mainframe. In the tracking mode, the plus and minus supplies are varied by one knob in proportion to the voltage ratio set on their individual controls. In the nontracking mode each can be set independently to any voltage from 0 to 20 V. Since all three of the variable supply terminals are floating, any one can be grounded or the two outside terminals used as a 0-to-40 volt supply. Both positive and negative variable supplies have their own current limiting.

In the high power slot (the far right-hand compartment of a TM 504 or TM 506) the PS 505 features a floating 3-to-5.5 volt output at up to 4 amperes with adjustable current limiting. In any other compartment, the maximum current available is 1 ampere and the output is nonfloating (negative grounded). A front-panel indicator light shows whether the PS 505 is in a standard or a high-power compartment. The PS 505 is particularly useful for powering TTL and ECL circuitry.

POWER SUPPLIES—COMPARISON OF CHARACTERISTICS

The following is a comparison of the major characteristics of the power supplies. A complete list of specifications may be found on the following pages.

	PS 501-1	PS 501-2	PS 503A	PS 505
Voltage/Current #1	+5 V @ 1 A	+5 V @ 1 A	+5 V @ 1 A	+3 to 5.5 V 4 A*
Voltage/Current #2	0-20 V @ 400 mA	0-20 V @ 400 mA	0 to +20 V @ 1 A*/400 mA**	No
Voltage/Current #3	No	No	0 to −20 V @ 1 A*/400 mA**	No
Current limit	<40-400 mA	<40-400 mA	<100 mA-1 A* 400 mA**	<0.4-4.0 A
Min resolution	1.6 mV	10 mV	10 mV	—
Foldback current	No	No	No	Yes >4.0* A foldback to <1.5 and latches
Over voltage protection	No	No	Yes	Yes
Line regulation	<5 mV††	<5 mV††	<5 mV†††	<10 mV†
Ripple & noise p-p	0.5 mV††	0.5 mV††	0.5 mV†††	3 mV†
Others	Multiturn pot with digital readout	Meter for voltage or current	+ − outputs independent, or dual tracking at ratio set by individual knobs	
Price	**$225**	**$225**	**$325**	**$250**

*In high-power (right-hand) compartment of TM 504 or TM 506.
**In any standard mainframe compartment.

†Refers to output #1
††Refers to output #2
†††Refers to output #2 and #3

CHARACTERISTICS COMMON TO PS 501-1, PS 501-2, PS 503A

20 V FLOATING SUPPLY

Primary Power Input — Determined by power module (TM 501, TM 503, etc).

Output — Floating, isolated from ground, 350 V dc + peak ac.

Stability — (0.1% +5 mV) or less drift in 8 hours at constant line, load, and temperature.

Indicator Lights — Voltage variation and current limit.

+5 V GROUND-REFERENCED SUPPLY

Output — 5 V nominal, ±0.2 V at 1 A (20°C to 30°C).

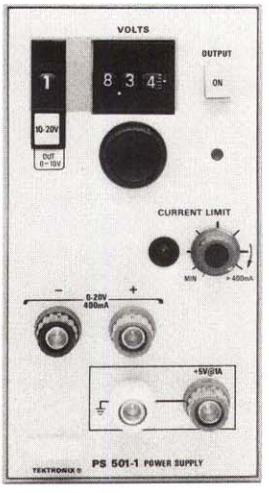
Load Regulation — Within 100 mV with a 1 A load change.

Line Regulation — Within 50 mV for a 10% line voltage change.

Ripple and Noise (1A) — 5 mV p-p or less; 100 μV rms or less.

Stability — 0.5% or less drift.

Overload Protection — Automatic current limiting and over-temperature shutdown.



PS 501-1 POWER SUPPLY

Floating Output, 0-20 V
0 to 400 mA
Precise Regulation
Low Ripple and Noise
Fixed Output + 5 V

Output — 0 to 20 V dc.

Current Limit — <40 to 400 mA.

Line Regulation — Within 5 mV for a ±10% line voltage change.

Load Regulation — Within 1 mV with a 400 mV load change.

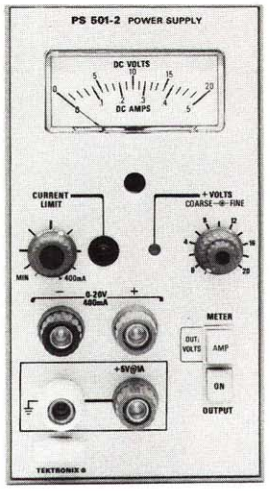
Ripple and Noise — 0.5 mV p-p or less; 0.1 mV rms or less.

Temperature Coefficient — 0.01%/°C or less.

Minimum Resolution — 1.6 mV.
Voltage is selectable within 0.5% by a 10 turn potentiometer with a 3 digit in-line dial and range switch.

Transient Recovery Time — 20 μs or less for a constant voltage to recover within 20 mV of nominal output voltage after a 400 mA change in output current.

PS 501-1 Power Supply $225



PS 501-2
POWER SUPPLY

Floating Output, 0-20 V

0 to 400 mA

Precise Regulation

Low Ripple and Noise

Fixed Output + 5 V

Dual-Range Meter Readout

Output — 0 to 20 V dc.

Current Limit — <40 mA to 400 mA.

Minimum Resolution — 10 mV.

Line Regulation — Within 5 mV for a ±10% line voltage change.

Load Regulation — Within 1 mV with a 400 mA load change.

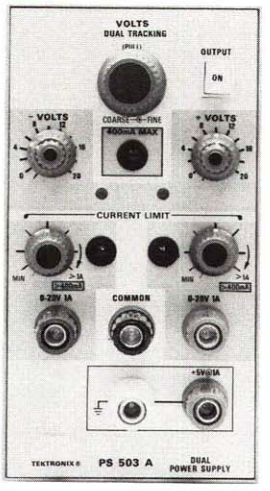
Ripple and Noise — 0.5 mV p-p or less; 0.1 mV rms or less.

Temperature Coefficient — 0.01%/°C or less.

Transient Recovery Time — 20 μs or less for a constant voltage to recover within 20 mV of nominal output voltage after a 400-mA change in output current.

Meter — Dual range, 0 to 500 mA or 0 to 20 V dc. Accuracy, ±2% of full scale.

PS 501-2 Power Supply $225



PS 503A
TRIPLE POWER SUPPLY

Independent + and − Controls

Dual Tracking Voltage Control

0 to ± 20 V at 1 A (in high-power compartment)

Fixed 5 V at 1 A

Remote Resistance Programming

Over-voltage Protection Standard

The PS 503A features superior dual tracking performance, over-voltage protection, and remote resistance programming of voltage. When operated in the high-power compartment of a TM 504 or TM 506 Mainframe, the PS 503A provides up to 1 amp from both + and −, 0 to 20 volt supplies.

±20 V FLOATING SUPPLIES

Output — 0 to ±20 V dc with respect to the common terminal or 0 to 40 V dc across the + and − terminals. Outputs can be varied independently or at a constant ratio.

Tracking Mode Offset Error — If the two supplies are set independently to any given voltage ratio and then varied by use of the VOLTS DUAL TRACKING control, the two supplies will maintain the same voltage ratio as initially set within ±50 mV.

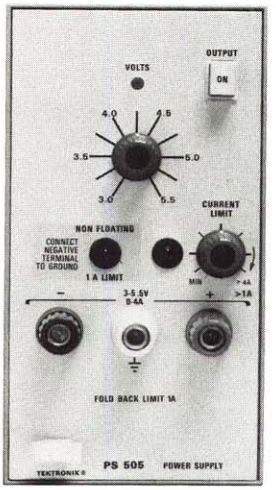
Current Limit — Adjustable from less than 100 mA to 1 A (high-power compartment) or less than 40 mA to 400 mA (standard compartment) on each supply.

Load Regulation — Within 3 mV for 1 A change (high-power compartment) or 1 mV for 400 mA change (standard compartment).

Ripple and Noise — 3 mV p-p or less at 1 A load (high-power compartment). 0.5 mV p-p or less at 400 mA load (standard compartment).

Indicators — Individual voltage indicators and current limiting indicators for both + and − supplies. Non-high-power compartment (400 mA) indicator.

PS 503A Power Supply $325



PS 505
POWER SUPPLY

Floating Output

3 to 5.5 V at 4 A

Overvoltage Protection Standard

Remote Resistance Programming of Voltage

The PS 505 is a variable, low voltage, high current, dc power supply. It is designed to operate in the high-power compartment of a TM 504 or TM 506 Power Module. In the high-power compartment, it provides a floating 3.0 to 5.5 V dc at 4.0 A. Operating in a standard compartment of a TM 500-Series Power Module, the PS 505 will supply at least 1.0 A nonfloating (negative ground).

Line Regulation — Within 10 mV for a ±10% line voltage change.

Load Regulation — Within 5 mV for 0.5 to 4.0 A load change.

Ripple and Noise — 3 mV p-p or less.

Temperature Coefficient — 0.01%/°C or less.

Stability — 0.1% +5 mV of drift in 8 hours at constant line, load, and temperature.

Foldback Current — When output current exceeds 4.1 A, current folds back to less than 1.5 A and latches.

PS 505 Power Supply $250

OPTIONAL ACCESSORY

Terminal Access Adapter Kit — For breadboarding and fixturing. Plugs directly onto front of PS 501-1, PS 503A, or PS 505. See accessory section for more details.

Order 013-0152-00 . . . . . $12

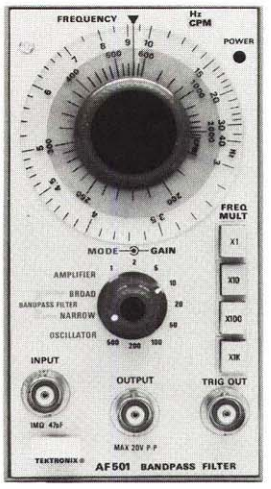
Signal processors are used to alter the characteristics of electrical signals in order to permit improved measurement and analysis. Typical examples include preamplification of low-level signals, addition or removal of dc offset, filtering to remove unwanted noise or signals outside the spectrum of interest, integration, differentiation, summing of multiple signals, impedance transformation, and post amplification to provide higher amplitude drive from low-amplitude signal sources.

The TM 500 line of signal processors includes three versatile instruments, the AF 501 Bandpass Filter/Amplifier, the AM 501 Operational Amplifier, and the AM 502 Differential Amplifier. Each is capable of being used in a variety of applications.

The AF 501 Bandpass Filter/Amplifier is an active filter whose center frequency is one-knob tunable over the entire audio range from 3 Hz to 35 kHz. Broad (Q=5) and narrow (Q=15) bandwidths are switch selectable. Flat amplification to 50 kHz is also available. In both filter and flat modes, amplification from 1 to 500 may be selected in a 1-2-5 sequence. The AF 501 also features an oscillator mode where the output frequency is the same as the center-tuned frequency in the filter modes. A signal output pulse, used for driving counters or oscilloscopes or for triggering stroboscopic lamps in study of mechanical systems, is also provided. The AF 501 selectivity permits individual analysis of the fundamental and harmonic components of complex waveforms, such as signals from vibration transducers.

The AM 501 Operational Amplifier is a high-output unit with front-panel jacks for quick and easy change of configurations by selection of feedback components. The output power available (± 40 volts and ± 50 mA across loads of 800 ohms) is adequate for most electronic and many electromechanical applications. The AM 501 is ideal for classroom instruction and experimental use; it can be conveniently set up for various useful applications, such as differentiation, integration, summing, and impedance transformation. Where a more permanent use in a given configuration is desired, the feedback components may be hardwired inside the instrument.

The AM 502 Differential Amplifier is a highly flexible instrument giving control of gain, dc offset, low-frequency response, and high-frequency response. It may be used with single-ended input or in differential mode for maximum rejection of common-mode noise signals. High amplification may be used even with low-level signals having a dc component up to one volt, since the variable dc offset of the AM 502 can be used to cancel the signal's dc component. Full bandwidth of the amplifier is 1 MHz: switch-selectable high-pass and low-pass filters permit reducing the noise bandwidth when the full frequency range is not required.



AF 501
BANDPASS FILTER

Tunable Bandpass Filtering to 35 kHz
Signal Amplification to 50 kHz
Sine-wave Generation to 35 kHz
Strobe Trigger Synced to Oscillator or Filter Output
Dial Readings in Hz or Cycles per Minute

The AF 501 is a bandpass filter/amplifier, ac-coupled amplifier and sine-wave generator combined in a single TM 500-Series module. Used alone or in conjunction with other TM 500-Series instruments, the AF 501 is a highly versatile and accurate signal analysis tool. Developed primarily for the mechanical

SIGNAL PROCESSORS — COMPARISON CHART

The following is a comparison of the main characteristics of the AF 501, AM 501, and AM 502.
A complete list of specifications appears on the following pages.

	AF 501 **Tunable Bandpass Filter/Amplifier**	**AM 501** **Operational Amplifier**	**AM 502** **Differential Amplifier**
Amplification range	1 to 500 in 1-2-5 steps	Depends on feedback components; open loop gain 10,000	1 to 100,000 in 1-2-5 steps
Input impedance	1 MΩ	Depends on feedback components	1 MΩ normal; FET input by internal jumper
Bandwidth control	Center frequency tunable 3 Hz to 35 kHz; Q=5 or 15	Depends on feedback components; max gain-bandwidth product 5 MHz	Independent switch-selected high-frequency and low-frequency filters
Maximum output	20 V p-p (Bandpass filter)	± 40V, ±50 mA with 800 Ω load	± 5 V, ± 20 mA, output resistance 5 Ω or less
Other features	Functions as audio oscillator, narrow or wide bandwidth tunable filter and flat audio amplifier	Use as inverting or noninverting amplifier, follower, summing amplifier, integrator, differentiator, etc, by appropriate feedback R and C	Coarse and fine control of up to ± 1 V of internal dc offset, ac or dc coupling, single-ended or differential input, 25 μV equivalent input noise at full bandwidth
Price	**$525**	**$325**	**$675**

measurement domain, the AF 501 can be used as a manual-sweep spectrum analyzer for complex sound and vibration signals. Single-frequency tuning facilitates isolation of 1X rpm signals in dynamic balancing, or viewing higher order disturbances on a crt monitor. An output pulse, synced to the filter or oscillator output signal, is available for triggering a stroboscope or oscilloscope and for frequency counting. And, of course, the AF 501 can be used in any application calling for a conventional sine-wave generator, ac-coupled amplifier, or bandpass filter.

BANDPASS FILTER

Center Frequency Range — 3 Hz to 35 kHz in 4 decade steps.

Frequency Dial Error — <5% dial setting between 3-20, <10% dial setting between 20-30.

Frequency Multiplier — X1, X10, X100, X1 k.

Phase Shift — <10° at tuned frequency below 5 kHz.

Dial Range — 3 to 40 Hz/180-2400 cpm.

Max Filter Attenuation — >70 dB.

Filter Selectivity — Broad: Q = 5 ±1.
Narrow: Q = 15 ±5.

Bandwidth at Half-power Points —

$$\Delta F_{-3\,dB} = \frac{\text{center frequency}}{Q}$$

Gain Range — 1-500; 1-2-5 sequence.

Gain Accuracy — ± 3 dB (Broad), ± 5 dB (Narrow).

Input Impedance — 1 MΩ ±1% paralleled by ≈47 pF.

Max Nondestruct Dc Input Voltage — ±100 volts.

Output Voltage — 20 V p-p (max freq times amplitude = 400 V kHz).

Output Current — 20 mA p-p MAX (at 20 V p-p).

Output Impedance — <1 Ω.

AMPLIFIER

Gain — 1 to 500; 1-2-5 sequence.

Gain Accuracy — ±3%.

Bandwidth — <0.5 Hz to >50 kHz (at 3 dB point).

Input Impedance — 1 MΩ ±1% paralleled by ≈47 pF.

Noise — <25 mV rms (referred to output).

Output Voltage — 20 V p-p (max freq times amplitude = 400 V kHz).

OSCILLATOR

Sine Wave Out Range — 3 Hz to 35 kHz.

Dial Range — 3 to 40 Hz/180-2400 cpm.

Output Amplitude — 1, 2, or 5 V p-p ±20%, depending on gain position.

Waveform Distortion — <3%.

Output Current — Max 50 mA p-p.

Output Impedance — <1 Ω (within 50 mA output current limit).

TRIGGER OUTPUT

Pulse Amplitude — >10 volts.

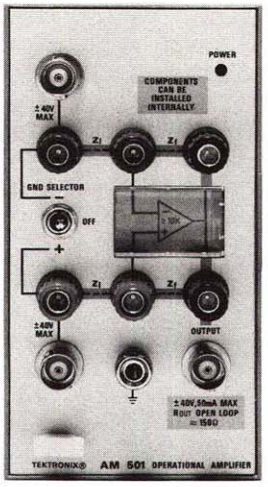
Pulse Duration — 10 ±5 μs.

Min Signal Required — 500 mV, p-p

Rise and Fall Time — <1 μs.

Output Impedance — ≈50 Ω.

AF 501 Bandpass Filter/Amplifier **$525**



AM 501
OPERATIONAL AMPLIFIER

±40 V, 50 mA Output

Open Loop Gain 10,000

50 V/μs Slew Rate

Symmetrical Differential Design

The AM 501 Operational Amplifier features high input impedance (FET), high slew rate, a wide range of input and output voltage, and high output current. Applications include: amplification; impedance transformation; integration; differentiation and summing. It is well-suited as a post-amplifier or offset-generator for signal sources, including the TM 500 modules. Components may be added externally or internally making it ideal for teaching operational amplifier theory.

OPERATIONAL AMPLIFIER

Open Loop Gain — At least 10,000 into 800 Ω load.

Unity Gain Bandwidth — At least 5 MHz into 800 Ω load.

Common-Mode Rejection Ratio — At least 10,000 to 1 at 60 Hz.

Slew Rate — At least 50 V/μs into a 800 Ω load.

INPUT

Common-Mode Input Voltage Range — At least ±40 V.

Input Leakage Current — Less than 500 pA at 20°C.

Equivalent Input Drift — Less than 100 μV/°C.

Equivalent Input Noise — Less than 10μV rms.

Max Safe Differential Input — 80 V.

OUTPUT

Voltage Range — At least ±40 V.

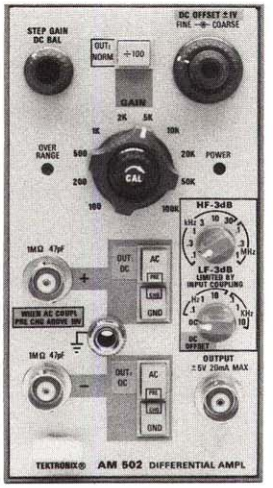
Current Limit — At least ±50 mA.

Open Loop Output R — Approx 150 Ω.

AM 501 Operational Amplifier **$325**

ACCESSORY

Terminal Accessory Adapter Kit (013-0146-00) **$12**



AM 502
DIFFERENTIAL AMPLIFIER

1-to-100,000 Gain

100 dB Cmrr

Selectable Upper and Lower −3 dB Points

Dc-to-1 MHz Bandwidth

Adjustable Dc Offset

The AM 502 Differential Amplifier features: wide bandwidth; high cmrr; and selectable calibrated gain and filtering. Well-suited for general-purpose or laboratory work, it can drive oscilloscopes, monitors, chart recorders, display, or processing devices. In the unity gain mode, it can be used as a signal conditioner. Input dc offsetting to ±1 V is provided.

AMPLIFIER

Gain — 1 to 100,000, 1-2-5 sequence, accurate within 2%.

Frequency Response — From dc (if ac coupled, 2 Hz or less at −3 dB point) to 1 MHz within +25%, −15% with GAIN set to 20 k or less. Upper −3 dB point reduces to 500 kHz at 50 k gain, 250 kHz at 100 k gain.

HF −3 dB POINT — Selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz. (Also limited by frequency response at gains of 50 k and 100 k.)

LF −3 dB POINT — Selectable in 6 steps from 0.1 Hz to 10 kHz.

Dc Offset — At least + or − 1 V to offset signal dc component.

Normal Mode Cmrr — At least 100 dB, dc to 50 kHz, range, ±5 V.

÷ 100 Mode Cmrr — At least 50 dB, dc to 50 kHz, range, ±50 V.

Max Safe Inputs — Normal mode dc coupled: 15 V (dc + peak ac). ÷ 100 Mode dc coupled: 350 V (dc + peak ac). Ac coupled: 350 V (dc + peak ac) with coupling capacitor precharged.

Input R and C — 1 MΩ paralleled by approx 47 pF. Input impedance can be increased to FET input via a simple internal jumper change.

OUTPUT

Max Output — ±5 V, ±20 mA, output resistance is 5 Ω or less.

Min Load Impedance — 250 Ω.

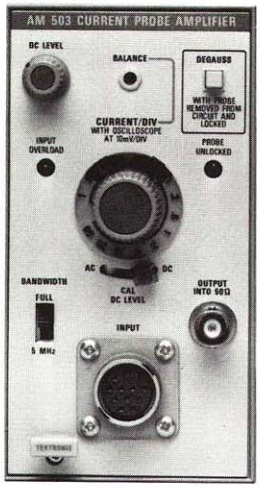
Max Input Gate Current — 50 pA at 25°C.

Max Noise — 25 μV or less (tangentially measured).

Overrange — Front-panel lamp indicates most overrange conditions.

Max Voltage Drift — 100 μV/°C.

AM 502 Differential Amplifier **$675**



AM 503
CURRENT-PROBE AMPLIFIER

Displays current/div signals on an oscilloscope

Current range, maximum current, and bandwidth determined by the probe used

The AM 503 is a plug-in modular current-probe amplifier that operates in TM 500 Mainframes. It allows display of current/division on any oscilloscope with 10 mV/div sensitivity, 50 ohm or 1 megohm input, and (for performance to full specifications) at least 100 MHz bandpass. The amplifier attenuator is calibrated in 12 steps with a 1, 2, 5 sequence, and the knob-skirt is illuminated to indicate current per division. The current range, maximum current rating, and bandwidth are determined by the particular probe in use. Bandwidth can be set to FULL (where it is limited by the probe in use) or to 5 MHz. Coupling may be switch selected to ac or dc. Ac coupling offers a convenient means of measuring low-amplitude ac signals on a high-level dc current. A front-panel indicator warns of input current overload.

P6302
CURRENT PROBE

1 mA/div to 5 A/div

20A (dc + peak ac) max

50 A peak pulse max

dc to 50 MHz

When a P6302 Current Probe is used with the AM 503 Current-Probe Amplifier, the current range is from 1 mA/div to 5 A/div. Maximum current is 20 A peak (dc + peak ac). Peak pulse maximum is 50 A not to exceed a product of 100 A μs. And bandwidth is dc to 50 MHz. The probe operates through inductive coupling with no electrical contact. A flick of your forefinger operates the sliding jaw in the insulated probe tip. Just put the probe tip around the conductor under test for immediate current readings.

ELECTRICAL CHARACTERISTICS
(AM 503 Current Probe Amplifier with P6302 Probe)

Maximum Input Current — Dc + peak ac: 20 A (derated with frequency). Peak pulse: 50 A (for pulse greater than 20 A, the pulse amp-sec product should not exceed 100 Aμs).

Maximum Voltage for Current Under Test (Bare Conductor) — 500 V (dc + peak ac).

Bandwidth (−3dB) — FULL: Dc to at least 50 MHz with P6302 Probe. 5 MHz: 5 MHz ±1 MHz. Ac coupled, lower bandwidth limit: 7 Hz or less.

Rise Time (FULL Bandwidth) — 7 ns or less.

Deflection Factor — 1 mA/div to 5 A/div, in a 1, 2, 5 sequence.

Attenuator Accuracy — Within 3% of indicated CURRENT/DIV.

Power Consumption (Full Load) — AM 503 only: 17 W.

INCLUDED ACCESSORIES

50 Ω cable w/bnc (012-0057-01), 50 Ω terminator (011-0049-01).

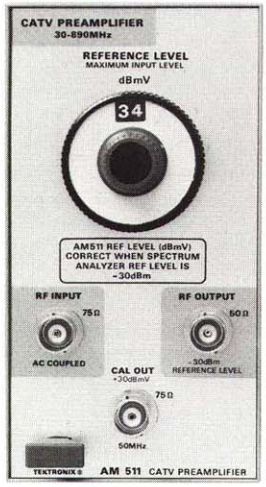
AM 503 Probe Amplifier $640

INCLUDED ACCESSORIES

7 cm ground lead (175-0263-01), 13 cm ground lead (175-0124-01), 2 alligator clips (344-0046-00).

P6302 Current Probe
Order 010-6302-01 . . . . . $305

For additional information on the AM 503 and P6302 see page 240.



AM 511
PREAMPLIFIER

For Use with 7L12 or 7L13 Spectrum Analyzers

Reference Level Selectable in 1 dB or 10 dB Steps

30 to 890 MHz Frequency Range

The AM 511 is a plug-in preamplifier for use with the 7L12 or 7L13 Spectrum Analyzers. It plugs into a TM 500 Power Module to meet the need of those who require a preamplifier for use with the 7L13.

The AM 511 applications include signal to noise, radiation, and field intensity measurements to FCC specifications on CATV, television, and fm installations. It is also useful in servicing and making measurements on radio systems and increasing sensitivity for emi measurements within the 30 to 890 MHz frequency range.

Concentric selectors select the reference level in either 1 dB or 10 dB steps and indicate this level in dBmV via a readout window. This level is also the maximum signal input level for linear operation. A +30 dBmV signal source at the input connector provides −30 dBm (from 50 Ω) signal at the OUTPUT connector. (Reference level readout uses an output of −30 dBm as a reference; therefore the 7L12 or 7L13 Reference Level must be set and calibrated for −30 dBm.) The CAL OUT Connector provides an accurate +30 dBmV, 50 MHz signal source from 75 Ω. This signal provides an absolute reference on the display of the 7L12 or 7L13 to check dBmV readings and calibrate the REFERENCE LEVEL. Harmonics of the 50 MHz provide picket fence markers across the frequency span for accurate frequency and span calibration.

ELECTRICAL CHARACTERISTICS
(with 7L12 or 7L13)

Frequency Range — 30 MHz to 890 MHz.

Display Flatness — (AM 511/7L12) ±1.0 dB, with respect to the level at 50 MHz, over the frequency range of 50 MHz to 300 MHz and +2.0 dB, −2.5 dB over the full frequency range. (AM 511/7L13) +1.0 dB, −1.5 dB, with respect to the level at 50 MHz, over the frequency range of 50 MHz to 300 MHz and +2.0 dB, −2.5 dB, over the full frequency range.

Sensitivity — Signal + noise = 2X noise, in LIN mode. The following characteristics apply at 50 MHz.

Sensitivity	Resolution Bandwidth
−90 dBmV	30 Hz
−80 dBmV	300 Hz
−73 dBmV	3 kHz
−65 dBmV	30 kHz
−55 dBmV	300 kHz
−45 dBmV	3 MHz

Noise figure for the AM 511 is no greater than 5 dB.

Intermodulation Distortion — (AM 511/7L12 or AM511/7L13) Imd products and harmonics from two signals within the frequency span of the AM 511 are 70 dB or more down from the reference level for: 1) Third order intermodulation with two signals at the reference level (full screen), and 2) Second order intermodulation and harmonics, with two signals 10 dB below the reference level.

Reference Level — Calibrated level in 1 dB steps from +79 dBmV to 0 dBmV. Accuracy is referenced to the +30 dBmV Calibrator at 50 MHz. Max deviation from this reference is 0.2 dBmV +0.01 dBmV per dB deviation from the +30 dBmV AM 511 reference level. This is equivalent to: ± (0.2 dBmV ± 0.01 [dBmV Ref Lvl −30 dBmV]).

Input Impedance — 75 Ω with a vswr of 2:1 or better with 10 dB or more attenuation (between 50 MHz and 300 MHz).

Calibrator — 50 MHz ±0.01% with an absolute amplitude level of ±30 dBmV ±0.3 dB, from 75 Ω at 25°C.

AM 511 CATV Preamplifier $575

For more detailed discussion of AM 511, see page 197.

The ubiquitous cathode-ray oscilloscope is the world's most useful and versatile electronics test and measurement instrument. Tektronix, long identified with the oscilloscope, could hardly develop the TM 500 line of modular instrumentation without including crt display capability.

Three choices of performance level and display size are now available to add waveform display to the digital measurement capabilities of the TM 500 Multimeters and Counters.

The new SC 502 is a full-feature dual-trace 15 MHz oscilloscope packaged as a double-width TM 500 Plug-in. It features an exceptionally bright (12 kV) crt with an 8 x 10 division (0.25 in/div) graticule. A delay line allows observation of the full leading edge of waveforms. Vertical sensitivity is selectable from 1 mV/div to 20 V/div in 1-2-5 sequence, and sweep times can be chosen from 1.25 seconds/div to 20 nanoseconds/div. Sophisticated oscilloscope features include enhanced auto trigger for hands-off operation with a wide variety of signals, selectable trigger hold-off for digital circuit applications, trigger view, and an A minus B vertical mode for differential viewing of signals.

The SC 501 is a complete triggered-sweep calibrated time base single-trace oscilloscope. Y channel bandwidth is 5 MHz and sweep rates from 1 second per division to 200 nanoseconds per division are featured. In addition to display and measurement of external signals or waveforms generated by TM 500 signal sources in the same power module, the SC 501 or SC 502 can also be integrated into more complex measurement packages. For example, the horizontal sweep on either oscilloscope also produces a ramp which is available on the rear interface connector, and this signal can be used to control other TM 500-Series instruments. The ramp can be used to sweep the function generator outputs of several TM 500 instruments, or as a delay source for the PG 505 Pulse Generator.

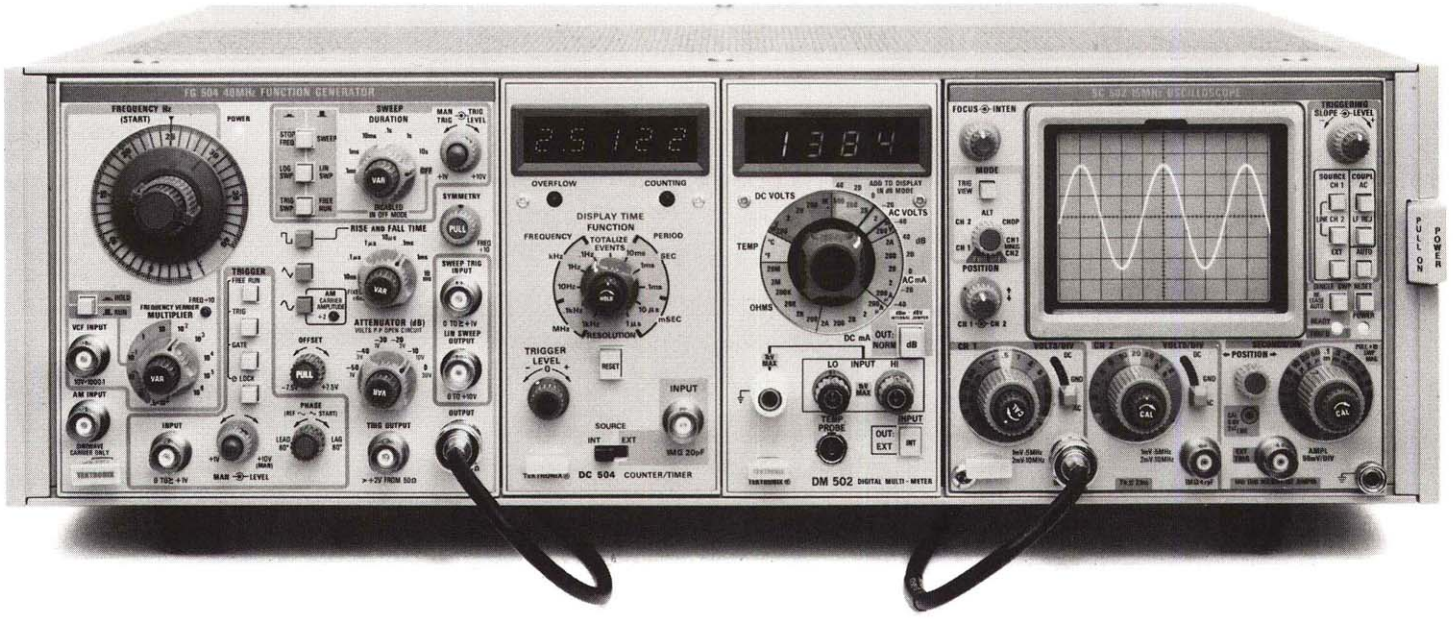
Both the MR 501 and SC 501 have miniature 2.5 inch crt's with an internal 6 x 10 division graticule of 0.203 inches per division. The MR 501 contains no time base and is optimized for X-Y displays. X and Y bandwidths are 2 MHz and the two channels are phase-matched. X, Y, and Z axis inputs all appear on the front panel.

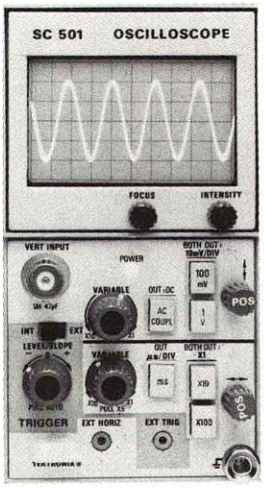
Where a time-calibrated display is required the RG 501 ramp output is compatible for use with the MR 501. Many useful functions, such as frequency sweeps, and delayed pulses or pulse trains, can be obtained by combining the MR 501 and RG 501 with a TM 500 Function Generator or the PG 505 Pulse Generator.

OSCILLOSCOPE AND MONITOR COMPARISON CHART

The following is a comparison of the main characteristics of the SC 501, SC 502, and MR 501, A complete list of specifications appears on the following pages.

	SC 502	SC 501	MR 501
Crt	8 x 10 div, 0.25 in/div P31 phosphor	6 x 10 div, 0.203 in/div P31 phosphor	6 x 10 div, 0.203 in/div P31 phosphor
Vertical (Y) axis	Dual-trace, 15 MHz, 1 mV to 20 V/div (5 and 10 MHz bandwidth at 1 and 2 mV) alt, chop, and ch 1 minus ch 2 modes	5 MHz bandwidth, 10 mV/div to 10 V/div	2 MHz bandwidth, 10 mV/div to 10 V/div
Horizontal (X) axis	Triggered sweep 200 ns/div to 0.5 s/div with X10 magnifier, X2.5 variable, normal, enhanced auto, ext/int trig, single sweep, external horizontal input, variable trigger hold off	Triggered sweep 1 μs/div to 1 s/div with X5 magnifier to 200 ns/div, normal/auto trigger, internal/external-trigger, external horizontal input	2 MHz bandwidth, 10 mV/div to 10 V/div, phase matched to Y axis within 1° from dc to 100 kHz.
Other features	Trigger view, 12 kV accelerating potential		
Price	**$1200**	**$725**	**$550**





SC 501
OSCILLOSCOPE

5 MHz Bandwidth

Single Compartment Size

2½ in Crt

Versatile Operating Features

The SC 501 is a single-channel 5 MHz plug-in unit oscilloscope with a 2.5 inch crt display which occupies a single TM 500-Series Plug-in compartment. Oscilloscope capability significantly enhances the application range of the multifunctional TM 500-Series Test and Measurement Instruments.

With the SC 501 a multitude of versatile test systems may be structured from the TM 500-Series to suit specific needs for time and frequency response, modulating waveforms, power for devices under test, stimulus and response studies and voltage, current, and temperature measurements. Since the SC 501 fits any TM 500 Mainframe, it can be used on the bench, in a rack, or on the road.

The single-channel SC 501 has a calibrated vertical deflection range from 10 mV/div to 1 V/div, selectable in decade steps. A variable control extends this range to at least 10 V/div.

Calibrated sweep rates are selected by pushbutton logic in decade steps from 1 μs/div to 100 μs/div (microsecond), and from 1 ms/div to 100 ms/div (millisecond range). A variable control extends the slowest sweep rate to at least 1 s/div and a fixed magnifier extends the fastest sweep rate to 200 ns/div.

A zero to 10 V ramp for all sweep rates (excluding the X5 magnification) is provided at a rear interface connector. This capability may be used for many auxiliary functions such as sweeping a voltage controlled frequency oscillator or obtaining variably delayed pulses from the PG 505 Pulse Generator.

The triggering circuits allow stable triggering from either internal or external sources. An AUTO triggering mode and manual LEVEL/SLOPE selection is combined in a single control. It is useful above 10 Hz and provides a bright baseline at all sweep rates.

An internal switch converts the horizontal deflection system of the SC 501 to an external horizontal amplifier which is internally calibrated for 100 mV/div deflection factor with a bandwidth of 100 kHz.

VERTICAL DEFLECTION

Bandwidth — Dc to >5 MHz.

Deflection Factors — 10 mV/div, 100 mV/div, and 1 V/div. Accuracy, within 3%. Uncalibrated (variable) range, continuously variable between steps (10:1) and to at least 10 V/div.

Input Coupling — Ac or dc.

Input Impedance — 1 MΩ paralleled by 47 pF.

Max Safe Input Voltage — 350 V (dc + peak ac).

HORIZONTAL DEFLECTION

Time Base — Calibrated sweep rates: 1 μs/div, 10 μs/div, 100 μs/div, 1 ms/div, 10 ms/div, 100 ms/div. Uncalibrated (variable) range: extends slowest calibrated rate to ≥1 s/div. X5 magnifier (fixed): extends fastest calibrated sweep rate to 200 ns/div. Accuracy (over center 8 div): ≥5% for all sweep rates. Linearity (any two div portion within center eight div): ≥5%.

External Horizontal Amplifier — Bandwidth: dc to 100 kHz. Input impedance: ≥100 kΩ paralleled by 25 pF. Max input voltage: ±3 V.

TRIGGER

Normal Trigger Sensitivity (Trigger Level/Slope In) — Internal: dc coupled, 0.4 major div of deflection at dc; increasing to 1.0 major div of deflection at 5 MHz. External: dc coupled, 1 V minimum to 5 V max from dc to 5 MHz. External trigger input impedance: 22 kΩ paralleled by approx 150 pF.

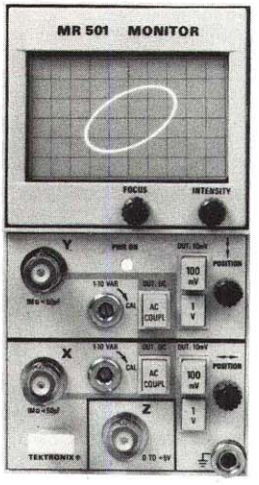
Auto (Trigger Level/Slope Out) — Sweep free-runs in absence of trigger signal or for trigger repetition rates below 10 Hz.

CRT

Crt Type — T2110.

Graticule — Type: internal black lines, nonilluminated. Area: six div vertical by 10 div horizontal. Each div equals 0.203 in. Phosphor: P31 standard.

SC 501 Oscilloscope **$725**



MR 501
MONITOR

2 MHz X-Y Bandwidth

10 mV to 10 V Deflection Factors

Dc to 200 kHz Z-Axis Input

Compatible with RG 501

Small size, 2 MHz X-Y bandwidth and selectable sensitivity make the MR 501 a highly desirable monitor oscilloscope. It may be used with the RG 501 to form a complete oscilloscope having a wide range of sweep rates and full triggering facilities. Six MR 501's will fit in a single RTM 506 Mainframe, allowing easy construction of large or small multiple displays.

VERTICAL and HORIZONTAL AMPLIFIERS

Bandwidth — Dc to at least 2 MHz.

Deflection Factor — 10 mV/div to 1 V/div in decade steps. Accurate within 3%, continuously variable between steps and to at least 10 V/div.

Input R and C — 1 MΩ paralleled by less than 50 pF.

Input Coupling — Ac or dc.

Max Safe Input Voltage — 350 V (dc + peak ac).

X-Y Phase Shift — Within 1° from dc to 100 kHz.

Z-AXIS AMPLIFIER

Bandwidth — Dc to at least 200 kHz.

External Input Voltage — Plus 5 volts turns crt beam on from an off condition (compatible with RG 501 gate output).

Input Impedance — 10 kΩ paralleled by less than 50 pF.

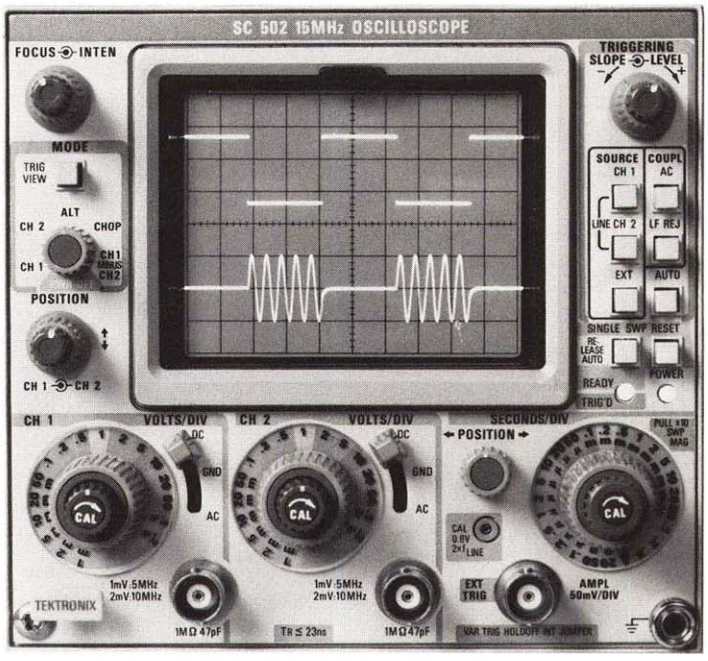
Input Coupling — Dc.

CRT

Graticule — Internal 6 x 10 div, 0.203 in/div.

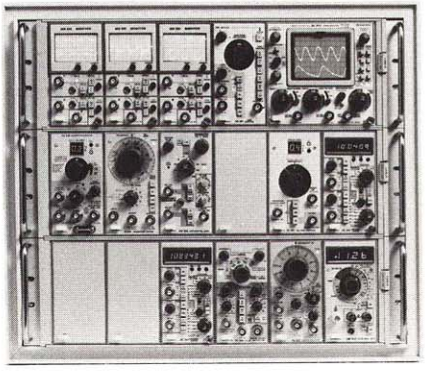
Phosphor — P31.

MR 501 X-Y Monitor **$550**

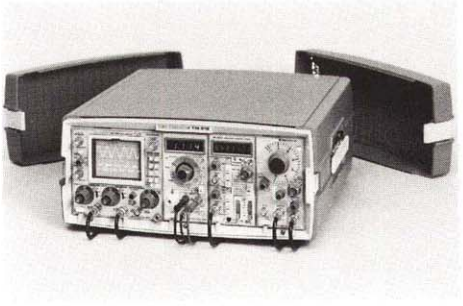


A Full-Featured 15 MHz Dual-Trace Oscilloscope in a Two-wide Plug-in
20 ns/div Max Calibrated Sweep Rate
1 mV/div Max Sensitivity
Delay Line
Trigger View
Variable Trigger Hold-off
Enhanced Automatic Triggering

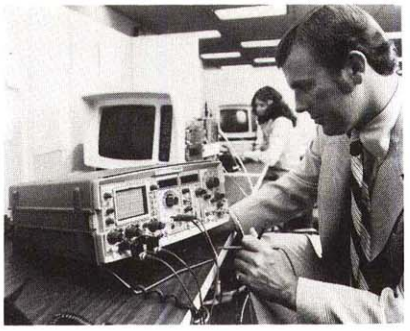
The SC 502 is a general-purpose 15 MHz dual-trace oscilloscope designed to operate in any two adjacent compartments of TM 500 Power Module/Mainframes. It has a high writing speed, a wide range of sweep rates, a wide range of deflection factors, and versatile triggering, including trigger view and enhanced automatic triggering.



The SC 502 makes many new instrumentation systems feasible, especially in the areas of QA, production testing, maintenance, and field servicing. The rear interfacing capability of the SC 502 and all TM 500 instrumentation suggests exceptional applicability to systems of built-in test equipment or rack-mounted installations. And the TM 515 Traveler Mainframe with the SC 502 form a nucleus for sophisticated, compact field service "packages."



As with many TEKTRONIX Products, the SC 502 features circuits, sub-circuits, and components designed and built by Tektronix to fulfill the special design capabilities of the instrument. Among its many recommended uses, the SC 502 is intended to be a powerful tool in the field servicing of digital equipment, where it would be used in association with disc memories, key-to-tape, printers, plotters, punches, readers, and terminals. The crt of the SC 502, for example, is of new design, offering a high writing speed as an advantage in the display of digital information, while stable, clean triggering is assured by incorporating well-proven circuits. Thus, the SC 502 offers the engineer a unique combination of performance, compactness, and systems capability.



This instrument offers the features most often identified with more expensive monolithic or plug-in oscilloscopes, such as complete dual-trace modes, delay-line, trigger view, 1 mV sensitivity, sweep speeds from 0.5 s/div to 200 ns/div in 1-2-5 sequences, plus X10 sweep magnifier for calibrated sweep speeds to 20 ns/div, single sweep, external horizontal input, probe calibrator, variable trigger holdoff, and an exceptionally bright crt trace as a special advantage in field servicing and production areas where high ambient light levels are often encountered.

The probe recommended for use with the SC 502 is the P6062A, which has selectable 1X and 10X attenuation.

Here is an oscilloscope that allows industry to apply the same measurement system from product research and development, through production, to field servicing.

SC 502 Oscilloscope

VERTICAL DEFLECTION

Bandwidth at −3 dB points — 5 mV to 20 V/div, dc to at least 15 MHz; 2 mV/div, dc to at least 10 MHz; 1 mV/div, dc to at least 5 MHz.

Rise Time — 5 mV to 20 V/div, 23 ns or less.

Ac Low-Frequency Response (Lower −3 dB point) — Without probe, 10 Hz; with probe (10X), 1 Hz.

Deflection Factors — Calibrated range: 1 mV to 20 V/div, 14 steps in a 1-2-5 sequence. Accuracy: 5 mV to 20 V/div (+15°C to +35°C) within 2%, (0° to +50°C) within 3%; 1 mV and 2 mV/div within 5%. Uncalibrated (variable) range. At least 2.5:1 range. Continuously variable between calibrated steps. Extends max attenuator step to at least 50 V/div.

Modes — CH 1, CH 2, Alt, Chop, CH 1 minus CH 2. Chop rate at least 250 kHz.

Input Impedance — 1 MΩ within 0.5% paralleled by approx 47 pF.

Max Safe Input Voltage — 350 V (dc + peak ac).

Aberrations — Front corner ± 2% or 3% p-p.

Common Mode Rejection Ratios (CH 1 minus CH 2 mode) — At least 50:1 at 1 MHz when using same attenuator setting.

Channel Isolation — Input isolation: at least 80 dB up to 15 MHz; display related: at least 50:1 up to 15 MHz.

Displayed Noise — 200 μV or less of noise tangentially measured.

Position Range — ±6 div.

Calibrator — Voltage, 0.6 V, ±1%. Frequency, twice the power line frequency.

HORIZONTAL

Sweep Generator — Calibrated Sweep Rates: 0.5 s to 0.2 μs/div, 20 steps in a 1-2-5 sequence, plus a X10 magnifier for sweep rates to 20 ns/div. Uncalibrated (variable) Range: the CAL (variable) control provides sweep rates that are continuously variable between the calibrated rates, and extends the slowest sweep rate to at least 1.25 s/div.

Sweep Rate Accuracy — Within 3% unmagnified and within 5% magnified.

Trigger Holdoff — CAL (variable) control, if selected by an internal jumper, increases trigger holdoff time by a factor of at least 20.

External Horizontal Amplifier — Bandwidth: dc coupled, dc to at least 2 MHz; ac coupled less than 50 Hz to at least 2 MHz. Deflection Factor, 50 mV/div within 5%. X and Y Amplifier Phase Difference, less than 3° at 50 kHz or less. Input Impedance, 1 MΩ within 2% paralleled by approx 47 pF. Max Safe Input Voltage, 350 V (dc + peak ac); 350 V p-p at 1 kHz or less.

Enhanced Automatic Triggering

In the automatic mode, the trigger circuit automatically adjusts to spread the p-p signal over most of the range of the triggering level control. This provides more convenient triggering, especially on low amplitude signals.

TRIGGER

Trigger Modes — AUTO (enhanced), NORMAL (auto button out), SINGL SWP.

Trigger Sources — CH 1, CH 2, LINE, EXT.

Trigger Coupling — Dc, ac, ac low freq reject.

Internal Trigger Sensitivity — Dc: 0.4 div of deflection, minimum, dc to 5 MHz; increasing to one div at 5 MHz to 15 MHz. Ac: 0.4 div of deflection minimum, 50 Hz to 5 MHz; increasing to one div at 5 MHz to 15 MHz. Will trigger below 50 Hz with increased deflection. LF REJ: 0.4 div of deflection, minimum, 5 kHz to 5 MHz; increasing to one div at 5 MHz to 15 MHz. Will trigger below 5 kHz with increased deflection.

External Trigger Sensitivity — Dc: 60 mV, minimum, dc to 5 MHz; increasing to 150 mV from 5 MHz to 15 MHz. Ac: 60 mV, minimum, 50 Hz to 5 MHz; increasing to 150 mV from 5 MHz to 15 MHz. Will trigger below 50 Hz with increased signal. LF REJ: 60 mV, minimum, 5 kHz to 5 MHz, increasing to 150 mV from 5 MHz to 15 MHz. Will trigger below 5 kHz with increased signal.

Triggering Level Range — Internal: at least + and −8 div. External: at least + and −1.2 V.

External Triggering Input — Input Impedance: 1 MΩ within 2% paralleled by approx 47 pF. Max Safe Input Voltage: 350 V (dc + peak ac); 350 V p-p ac at 1 kHz or less.

Auto Mode — Sweep free-runs in the absence of a triggering signal. TRIGGER LEVEL range is reduced to approx the p-p range of the triggering signal.

Single Sweep — Triggering requirements same as for normal sweep. When triggered, sweep generator produces one sweep only. AUTO pushbutton must be in the OUT position for operation and for setting triggering controls.

CRT

Phosphor — P31.

Deflection — Electrostatic.

Acceleration Potential — 12 kV.

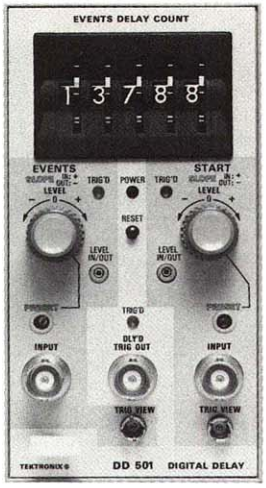
Graticule — Scale, 8 x 10 div with 0.25 in/div.

ENVIRONMENTAL CAPABILITIES

Temperature — Operating, 0°C to +50°C. Storage, −40°C to +75°C.

Altitude — Operating, to 15,000 ft. Storage, to 50,000 ft.

SC 502 Oscilloscope $1200



DD 501 DIGITAL DELAY

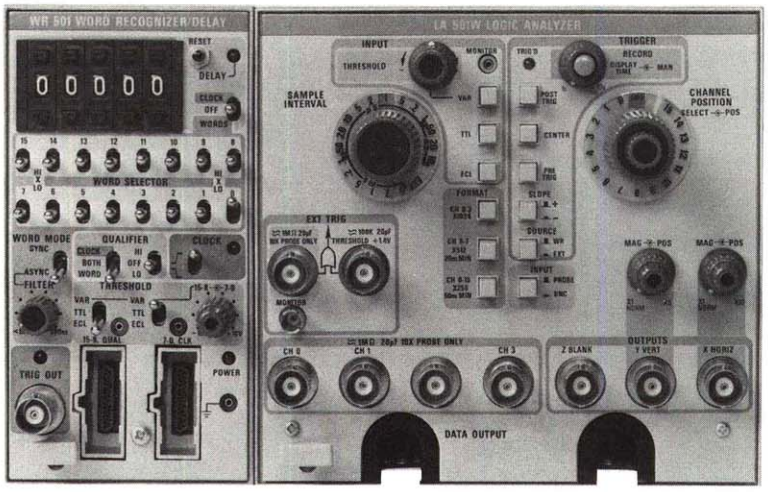
Digital Events Delay for Scope Trigger
Delay to 99,999 Events
Divide by N up to 20 MHz
Pulse Counting to 65 MHz
Time Delay with Ext Clock
Compatible with Most Attenuator Probes

The DD 501 is an events count plug-in unit. Separate external trigger signals connected to the EVENTS and START INPUT connectors allow up to 99,999 events to be counted. That is, the unit counts a predetermined number of events, from 0 to 99,999, selected by the front-panel thumb-wheel switches. The last event counted generates a trigger pulse to the DLY'D TRIG OUT connector on the front panel. Delay by event is particularly useful in troubleshooting asynchronous logic systems. The DD 501 can also function as a frequency divider when the same signal is applied to both inputs.

The DD 501 can be used in a "counted burst" mode with pulse or function generators that can be synchronously gated. This provides the ability to dial up the number of pulses you want in a burst for applications with shift registers, memories, data communications, process control, or any system requiring an exact number of pulses or waveforms. A jumper inside the DD 501 converts the DLY'D TRIG OUTPUT to a delay interval (gate) waveform for this application. TEKTRONIX generators capable of being gated by the DD 501 are the FG 501, FG 502, FG 504, and the PG 508.

Other DD 501 applications include ranging for radar, sonar, ultrasonics, or laser. By using the proper frequency clock, the numbers dialed up can represent miles, yards, kilometers, etc. In systems requiring precision timing, several DD 501s and a reference clock can provide precise thumbwheel-selectable repetition rates, delays, pulse widths, or timing intervals.

DD 501 Digital Delay **$725**



LA 501W LOGIC ANALYZER

Acquires 16 Channels Simultaneously
Captures Single-Shot Data
Stores 4096 Bits in 4, 8, or 16 Channel Format
Displays Data Preceding Trigger
16-Bit Parallel Word Recognizer with up to 99,999 Word Delay
Active Probes Minimize Circuit Loading
Samples Data Synchronously and Asynchronously
Selectable Trace Positioning
Tick Marks for Easy Timing Comparisons

The LA 501W Logic Analyzer, made up of the LA 501 Logic Analyzer and WR 501 Word Recognizer plug-ins, operates in any 3, 4, 5, or 6-compartment TM 500-Series Power Module Mainframe. This combination complements virtually any oscilloscope or X-Y monitor to provide a versatile logic analysis system.

4096 bits of storage may be formatted as 4 channels x 1024 bits, 8 channels x 512 bits, or 16 channels x 256 bits to best fit your application. With a selectable asynchronous sampling rate of up to 100 MHz (4-channel operation only), the LA 501 provides timing resolution to 15 ns. Data can also be synchronously (externally) clocked to 50 MHz. Pre, center, or post-trigger data can be recorded at a sample rate from 10 ns to 5 ms.

Two active P6451 probes feature a high input impedance — 1 MΩ paralleled by 5 pF. They provide a total of 18 inputs to the WR 501 — 16 data input channels, one clock input, and one qualifier input. There are separate threshold controls (TTL, ECL, and variable ±10 V) for each probe.

The stored data is displayed as a timing diagram in groups of four. Each trace displays high and low logic states. Vertical and horizontal position and magnifier controls provide the capability to zoom in on any segment of the timing diagram. Biphase timing tick marks on each channel provide excellent visual resolution and also indicate whether an inactive line is high or low. Channel-to-channel timing comparisons are easy because any trace can be moved vertically and thus positioned next to any other.

The WR 501 16-bit parallel word recognizer with digital delay produces triggers when it recognizes a preselected parallel word. This gives you fast access to almost any location in the data stream. The WR 501 can be operated as an independent trigger source or interfaced with the LA 501.

The LA 501W Logic Analysis System may be combined with counters, pulse generators, multimeters, and oscilloscopes into a compact package using TM 500 Series Power Module/Mainframes. The TM 500 Series also offers you a choice of benchtop, rackmount, rollabout, or portable configurations to match your application.

LA501W Logic Analyzer

The LA 501W and other logic analyzers are completely described beginning on page 17.

The Mainframes

One of the major elements in the wide appeal of TEKTRONIX TM 500 is its extreme flexibility and versatility of configuration. Most test instrument manufacturers by now have taken advantage of integrated circuits, LED displays, and other aspects of miniaturization technology to make more compact instruments. Tektronix, however, also combined advanced technology with a modular plug-in system to provide highly flexible test instrument configurations for use almost anywhere.

The "classical" benchtop environment is served by 1, 3, 4, and 6 compartment mainframes with tilt bails and handles. These same mainframes can be easily carried about for portable use. The new TM 515 luggage-styled 5-compartment travel mainframe was designed especially for portable applications where ruggedness and resistance against moisture and dust are necessary. Two foam-padded carrying cases allow the 3- and 4-compartment mainframes to be shipped as luggage.

For mobility of an entire "benchfull" of instruments, Tektronix offers the new TEK LAB CART Model 3. This new cart allows you to configure your own rollabout test, maintenance, or calibration station. The TEK LAB CART Model 3 will mount virtually any TEKTRONIX Oscilloscope on the top of the cart and two TM 500 Mainframes, either 3 compartment or 4 compartment, on two under-mounted trays.

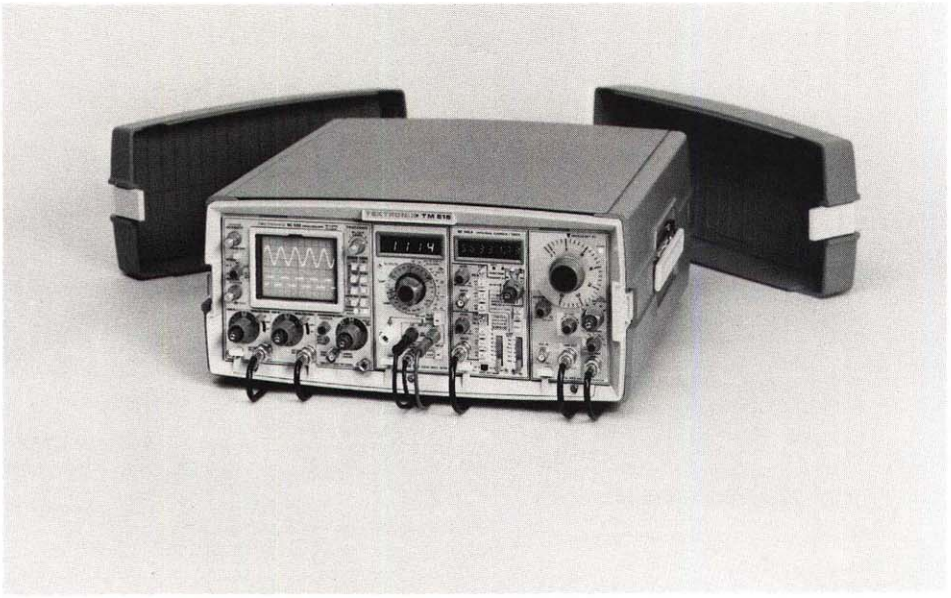
For rackmount applications, TM 500 fits up to six instruments into one standard rack width. Yet, the plug-in feature lets a rack installation be instantly re-configured or permits an instrument to be replaced to keep a critical test facility "on the air" even during maintenance or calibration of individual instruments.

In all configurations — bench, portable, rollabout, and rackmount — TM 500's internal interconnect feature lets commonly used connections between instruments be made only once and then stay hidden for simpler, uncluttered test setups. Then, at the touch of a switch, a counter can monitor the frequency of a signal source or a DMM can measure trigger level setting of a counter or voltage of a power supply.

Benchtop

The four TM 500 benchtop mainframes are the TM 501, TM 503, TM 504, and TM 506.

The TM 500 system concept provides significant benefits when multiple instruments are involved, but the TM 501 was provided for cases when only a single instrument is needed. The TM 503 is the most compact of the multicompartment mainframes; it is only 15.3 inches deep, 6 inches high, and 8.7 inches wide.



The TM 504 and TM 506 are both heavy-duty units. Each features a high power compartment at the right-hand end to also supply greater current to TM 500 instruments that are designed for added performance or higher output power levels. The six-compartment TM 506 also incorporates a quiet fan for optimum cooling. The TM 504 and TM 506 are slightly deeper than the TM 503.

All four benchtop models have feet, tilt bails, handles, and front-panel power switches. All operate from normal 110 or 220 V ac.

Portable

All of the benchtop models can be used for portable operation as well. Carry handles and sturdy rear cord-wrap feet, plus optional accessory protective front covers (available for all but the TM 501) permit them to be used in many moderate applications. However, the new TM 515 was designed from the ground up for superior multi-instrument portability. In its carrying configuration it is a handsome piece of luggage with molded-in feet on the bottom and a comfortable luggage-type carrying handle. It is extremely moisture and dust resistant, and designed to withstand the rigors of transport in car trunks and pickup trucks. Once at the destination, the rear cover pops off to give access to the power cord, power switch, and allow air flow from the built-in fan. The front cover is removed to uncover up to five operating instruments from the broad TM 500 line. The result, a total electronics superlab disguised as a mild-mannered suitcase.

A wire bail stowed in the cover can be snapped into the front feet as a conventional tilt bail for benchtop use, or into the rear feet to support the TM 515 in a nearly vertical attitude on the floor with all instruments visible to a standing operator. Test lead storage is also provided inside the rear cover. The TM 515 operates from nominal 110 or 220 V, 48 - 60 Hz with the standard fan, and 48 - 440 Hz with optional universal fan.

Rollabout

Rollabout test laboratories are combinations of TM 503 or TM 504 Mainframes, TM 500 Instruments, TEKTRONIX Plug-in or Monolithic Portable Oscilloscopes, and the TEK LAB CART Model 3. The TEK LAB CART Model 3 will hold a 5100, 5400, or 3 or 4 Plug-in 7000-Series, or a Portable Oscilloscope such as the 434, 464, 465, 466, 475, or 485. Two TM 503's or TM 504's can be mounted on two adjustable mounting trays beneath the cart. A large storage drawer, which can be padlocked, is provided at the bottom of the cart to hold accessories and plug-ins. In each case, the result is a highly mobile lab on wheels which can be rolled out onto a production floor, over to large installations needing maintenance or calibration, into narrow quarters like x-ray control booths, or down laboratory aisles to aid in conserving bench space.

Rackmount

The RTM 506 Rackmounting Mainframe is electrically identical to the TM 506 benchtop model but features a slide-out assembly and handles, plus a higher power fan than the bench version in recognition of the high ambient temperatures often found in enclosed racks and consoles.

It is also possible to convert two TM 503's into a rackmount assembly with a kit; this kit has the advantage of requiring four inches less depth than the RTM 506 for space-critical applications, but lacks the fan and high power compartment, and requires assembly by the user. Other kits are available to rackmount a single TM 503, or a TM 503 with a 603, 604, or 605 monitor.

The TM 515 Traveler Mainframe accommodates up to five TM 500 Plug-in Modules, yet it is as attractive as quality, fashionable flight luggage. With a typical complement of TM 500 Plug-in Modules it weighs approximately 30 pounds. And it will go under the seat in most commercial aircraft. At last, the engineer on the go can take along a truly portable instrumentation package, one that goes as a unit, that is attractive, and that can be optimized for his instrumentation needs.

A typical application for the TM 515 could be digital field service, in which the likely plug-ins might be: an SC 502 dual-channel, 15 MHz (two-compartment wide) oscilloscope, a DD 501 Digital Delay, and a DC 505A/DM 502 combo, offering universal counter and full-function DMM capabilities plus readout of trigger level at the touch of the INT push-button, once interface connections are made.

All plug-ins in the TM 515 Mainframe can "talk" to each other and work together through a common interface circuit board. A factory-installed option (Option 5) allows TM 515 users to interconnect the plug-in instruments within the mainframe without making soldered junctions.

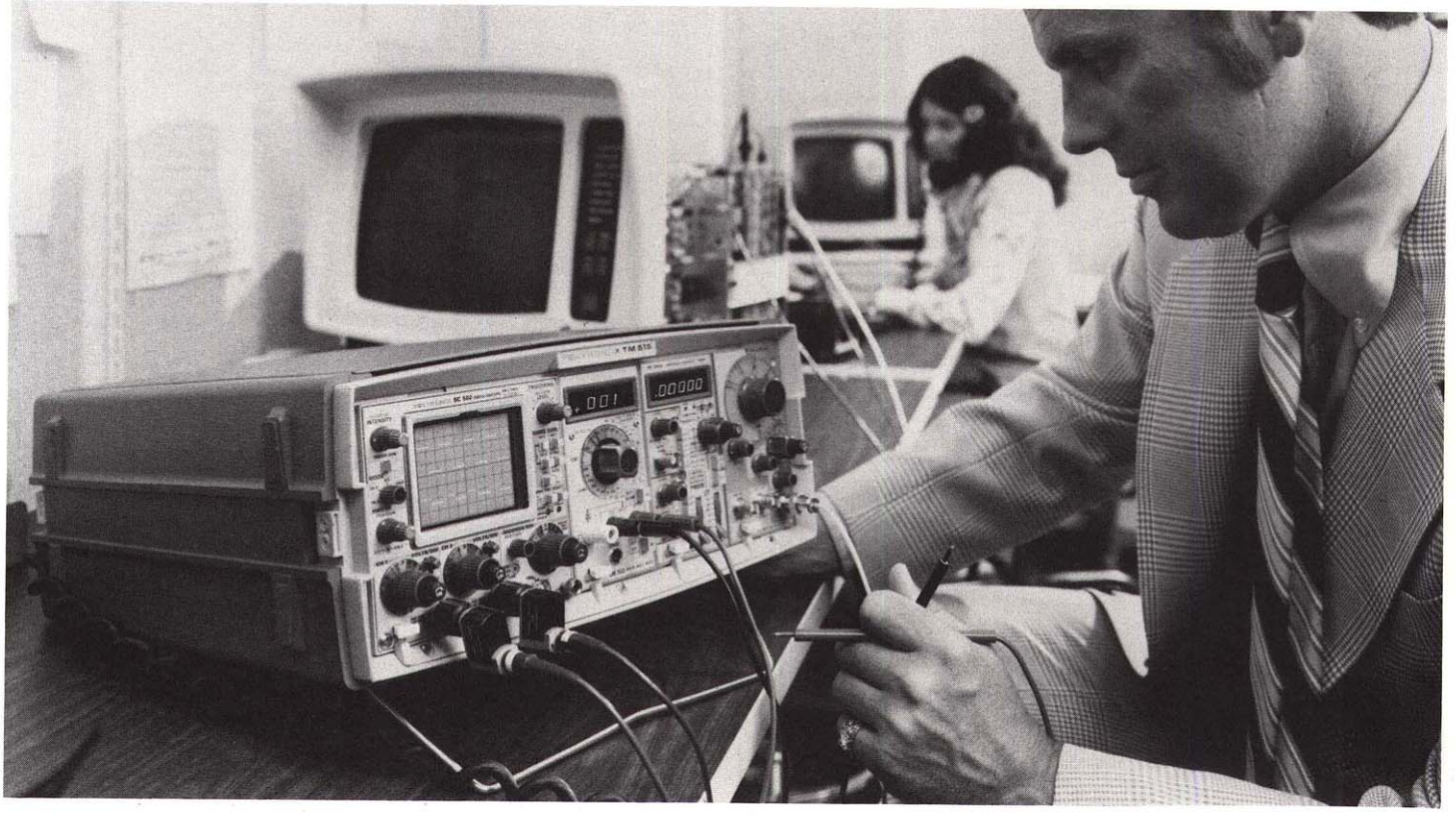
As in all TM 500 Power Module/Mainframes, the power transformer of the TM 515 Mainframe accommodates 100, 110, 120, 200, 220, and 240 V ac and 48 through 440 Hz. However, the range of line frequencies of the TM 515 (and TM 506) is limited to 48-60 Hz by the electrical characteristics of the ventilating fan. Operating the TM 515 at the various line voltages is accomplished with quick-change line-selector blocks, but operating it at line frequencies outside the 48-60 Hz range requires the optional ventilating fan, since "forced air" is required. An optional 48-440 Hz fan is available.

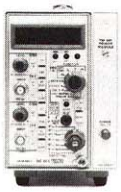
Significant cost savings are available through the use of TM 500 instrumentation systems in place of collections of monolithic instruments, mainly because TM 500 Plug-in instruments share a common power supply and enclosure.

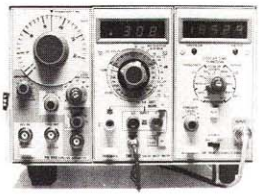
The TM 501 single-compartment, TM 503 three-compartment, TM 504 four-compartment, TM 515 five-compartment, and TM 506 six-compartment power module/mainframes provide the necessary power supply components (transformer, rectifier, and filter) to operate any of the TM 500 modular plug-ins. Low-level regulator circuitry is included in each individual instrument, with high-dissipation power transistors mounted on heat sinks in the rear of the power module, so each instrument is supplied with the exact voltage necessary for optimum performance. All plug-ins are connected in the power unit by a common interface board. A matrix of signal interconnection possibilities produces extensive multifunction capabilities to reduce cabling clutter.

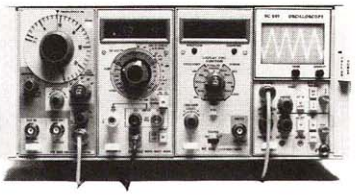
The TM 504 and TM 506 provide one high-power compartment, which is located on the extreme right adjacent to the power switch.

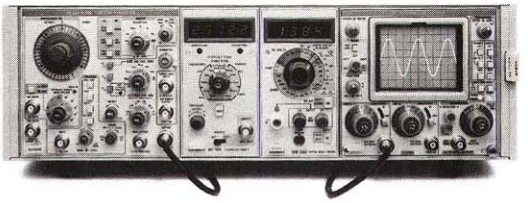
(Typically it is used to accommodate a power supply plug-in, such as the PS 503A, which can provide 1 amp 0 to 40 V dc in the high-power compartment.) The TM 506 is available either for bench use with a carrying handle for convenience, or in a rack-mounting version with mounting ears and slide-out tracks. Factory-installed options add 25-mil square-pin connectors on the rear of the interface circuit board and supply a kit of jumpers with mating square-pin connectors. These allow TM 500 users to easily interconnect the plug-in instruments within the mainframe without making soldered junctions.











POWER REQUIREMENTS

Line Voltage Ranges — Universal Transformer: 100, 110, 120, 200, 220, 240 V ac, all within 10%. Range changing for transformer accomplished with quick-change line-selector block.

Line Frequency Ranges — Universal Transformer: 48 Hz to 440 Hz.

NOTE: The ventilating fans on the TM 506 and TM 515 operate on 48-60 Hz only.

Power Consumption — Max primary power approx: 35 W for TM 501, 120 W for TM 503, 200 W for TM 504, 320 W for TM 506, and 240 W for TM 515. Actual power consumption depends on plug-in selection and operating modes.

SUPPLIES (UNREGULATED)

Shared by All Compartments — +33.5 V dc and −33.5 V dc. TM 501 −500 mA max. TM 503 −1 A max. TM 504 −1.4 A max. TM 506 −2.1 A max. TM 515 −1.8 A max.

Low Power Compartments — Two 25 V ac windings, 500 mA each, supplied to each compartment, independently. 17.5 V ac and +11.5 V dc shared in any combination between these two supplies and among all low-power compartments. TM 501 −1 A max. TM 503 and TM 504 −3.6 A max. TM 506 −6.5 A max. TM 515 −6.5 A max.

High Power Compartments — (nearest to switch in TM 504 and TM 506): Two 25 V ac windings, 1 A each. 17.5 V ac and + 11.5 V dc, 4 A max, shared in any combination between these two supplies.

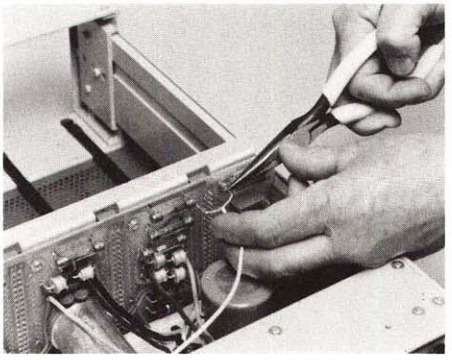
TEMPERATURE RANGE

Operating — 0°C to +50°C.
Nonoperating — −40°C to +75°C.

ALTITUDE RANGE

Operating — To 15,000 ft.
Nonoperating — To 50,000 ft.

OPTIONAL INTERFACE



The TM 500 line is designed so that connections between modules and/or external equipment can be made by the mainframe rear interface board and optional rear-panel connectors.

Each plug-in has selected lines brought to its interface, some parallel to front-panel connections, others present only at the interface. Normally, these lines are left open, but they may be connected by the user to reduce front-panel clutter or to perform functions not otherwise available. For example, digital counters have serial bcd outputs which may be brought out for data logging or processing.

LINES AVAILABLE AT THE MODULE INTERFACE CONNECTOR

Digital Counters

Bcd serial by digit	Reset
Range code (except DC 502)	Time slot zero
Scan clock out	Data good
Scan clock in and internal scan disable	Signal in (selected by front-panel switch) (except DC 502)

These lines allow for external data logging and processing via the bcd output and associated signals. They also allow the external system to initiate the taking of a measurement, and control the rate at which the bcd data is scanned.

Digital Multimeters

Scan clock out	Most significant digit
Decimal point	Data transfer
Bcd serial by digit	Polarity
Least significant digit	

Power Supplies

Supply output through rear connection
Remote sense
Remote analog voltage control
Remote analog current limit control

Amplifiers

Signal Out, Signal In

Monitor

X, Y, and Z inputs

Oscilloscope

Ramp out, Gate out

NOTE: The Option 02 power modules are shipped with a rear-panel multipin connector, a mating cable connector, and one rear-panel BNC connector for each plug-in compartment. The user may wire these to the interface board as required. Option 02 is also supplied with square pin connectors on the rear interface board, and a supply of jumper wires with square pin receptacles.

The Option 05 TM 515 is supplied with the square pin connectors on the rear interface board and the prepared jumper wires.

Pin assignments are common for each "family" of modules (DMMs, generators, counters, etc). Each family has its own pattern of circuit board notches at the interface. Interface terminal barriers may be inserted in the mainframe so that it accepts only plug-ins of one family. A supply of barriers (and square-pin jumpers) is shipped with the power module if Option 02 is ordered.

A typical example of interface connection between modules is to connect the ramp output of the RG 501 to the vcf input of the FG 502 for frequency sweep. The output of a power supply can be measured with the interface feature of the DM 501 for voltage monitoring.

POWER MODULE DIMENSIONS & WEIGHTS (without Plug-ins)

CABINET

	TM 501		TM 503		TM 504		TM 506		TM 515	
Dimensions	in	cm	in	cm	in	cm	in	cm	in	cm
Height	6.0	15.2	6.0	15.2	6.0	15.2	6.0	15.2	6.8	17.3
Width	3.9	9.9	8.7	22.1	11.0	27.9	17.4	44.2	15.0	38.1
Length	15.3	38.9	15.3	38.9	20.0	50.8	20.0	50.8	20.0	50.8
Weight (approx)	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
Net	5.4	2.4	9.5	4.3	20.5	9.3	29.0	13.2	22.5	10.2
Domestic Ship	13	5.9	17	7.7	26.0	11.8	41.0	18.6	30.0	13.6

ORDERING INFORMATION (Plug-ins not Included)

TM 501 Power Module **$130**
with Option 02 Interface . . . . . add $55
TM 503 Power Module **$160**
with Option 02 Interface . . . . . add $75
TM 504 Power Module **$180**
with Option 02 Interface . . . . . add $100
TM 506 Power Module **$240**
with Option 02 Interface . . . . . add $150
RTM 506 Power Module (rackmount version) **$325**
with Option 02 Interface . . . . . add $150
TM 515 Traveler Mainframe **$325**
with Option 05 Interface . . . . . add $75
with Option 06 48-440 Hz fan . . . . . add $150

Option 07 — For operating TR 502 and DC 502 Option 07 in a TM 503, TM 504, TM 506, or TM 515 . . . add $25

This group of accessories adds to the versatility and performance of the TM 500 test and measurement system. Convenient cases and covers offer mobility and protection. The provision for user options with special purpose hardware adds flexibility. Adapters and blank panels can be supplied, as well as extender cables, coaxial cables, special probes, and devices designed to operate with various plug-ins for specific applications.

P6058 TEMPERATURE PROBE

The P6058 Temperature Probe is used with the DM 501 for sensing temperature from −55°C to +150°C. The temperature sensing element consists of a transistor and is installed in the probe's nose tip. Temperature is measured by applying the flat surface of the probe's tip to the device being measured. P6058 probes are interchangeable among all DM 501's without requiring recalibration since probes and DM 501's are held to tight tolerances. Besides measuring temperature, the P6058 can function as an electrical probe for resistance, current, and voltage measurements to 500 V. To obtain the full probe kit with ground lead and push-on electrical contact tip, order 010-0260-00 below. A simple modification of the DM 501 is also required. For temperature-only measurements, order 010-0259-00.

The temperature probe consists of the temperature sensor, a four-foot, 4-wire coaxial cable, and a connector for attaching to the existing front-panel receptacle of the DM 501. The unit weighs approximately five ounces.

P6058 Temperature Probe,
Order 010-0259-00 . . . . . **$105**

P6058 Temperature Voltage Probe,
Order 010-0260-00 . . . . . **$110**

P6430 TEMPERATURE PROBE

The P6430 Temperature Probe is used with the DM 502 for sensing temperature from −55°C to +150°C. The temperature sensing element consists of a transistor and is installed in the probe's nose tip. Temperature is measured by applying the flat surface of the probe's tip to the device being measured. The probe can be immersed vertically, approximately two inches in a liquid, for temperature sensing and still retain water tightness.

The temperature probe consists of the temperature sensor, a six-foot, 2-wire coaxial cable, and a connector for attaching to the existing front-panel receptacle of the DM 502. The unit weighs approximately five ounces.

To meet full accuracy specifications a specific P6430 and DM 502 multimeter must be calibrated as a pair.

P6430 Temperature Probe,
Order 010-6430-00 . . . . . **$110**

HIGH VOLTAGE PROBE FOR USE WITH DMMs

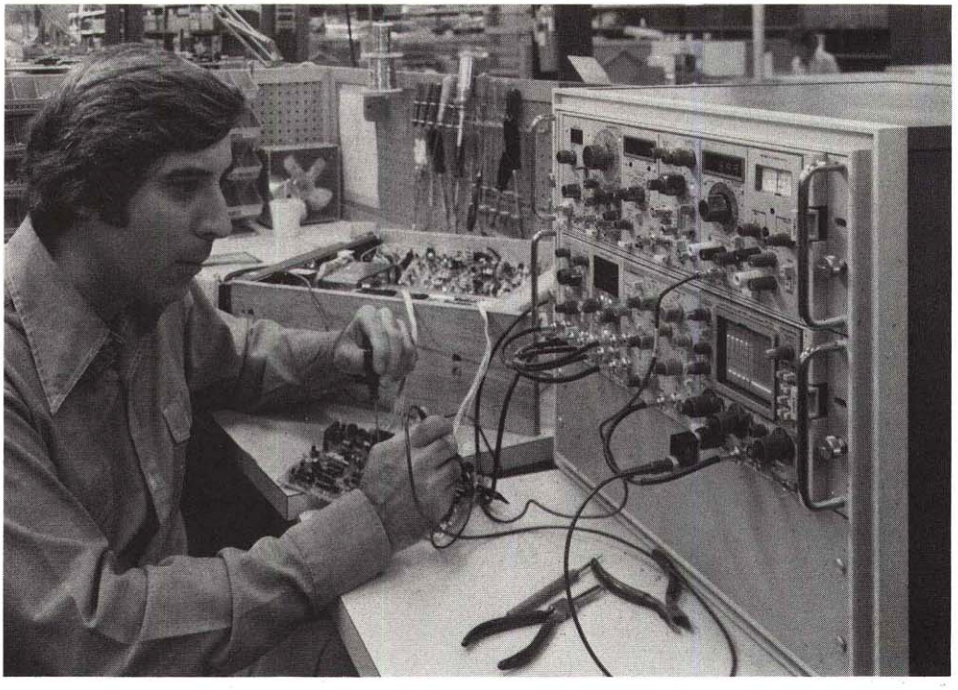
The High Voltage Probe will measure dc voltages from 1 kV to 40,000 volts with an accuracy of 1% at 25,000 volts. The division ratio is 1000:1. Common uses include measuring anode voltages on monitors or oscilloscopes.

This probe plugs directly into the front end of either multimeter.

CHARACTERISTICS

Voltage range	1 kV to 40 kV dc
Input resistance	1000 MΩ
Division ratio	1000:1
Overall accuracy	20 kV to 30 kV 2%
Upper limit accuracy	Changes linear from 2% at 30 kV to 4% at 40 kV
Lower limit accuracy	Changes linear from 2% at 20 kV to 4% at 1 kV
Input Z at meter	10 MΩ required

Order 010-0277-00 . . . . . **$65**



TM 500 CARRYING CASE

These luggage-type carrying cases for TM 500 equipment are molded of high strength glass-epoxy. The TM 503 model weighs 12 pounds empty and measures 23½ inches long by 8½ inches thick by 15½ inches high, including rubber feet, lockable latches, and handle. Inside, the resilient polyurethane foam insert is molded to accept a TM 503 (with or without the protective front cover) plus either a spare TM 500 family module or a 200-Series Miniscope. A third compartment in the foam accepts miscellaneous cables, accessories, or small tools.

The TM 504 case has a molded foam insert which will accept the TM 504 (with or without the protective front cover) but has no provisions for spare modules or tools. It is 24 inches long by 8½ inches thick by 17½ inches high and weighs approximately 14 pounds empty.

TM 503 Carrying Case,
Order 016-0565-00 . . . . . **$130**

TM 504 Carrying Case,
Order 016-0608-00 . . . . . **$135**

PROTECTIVE FRONT COVER

A snap-on front cover, molded of high impact plastic, is available for the TM 503 (shown above), TM 504, and TM 506 Mainframes. While particularly valuable when the TM 503 or TM 504 (full of instruments) is carried into the field or in a vehicle, the cover is also good insurance against damage to instrument knobs and jacks during normal handling in the lab, or when a mainframe full of instruments is stored. The cover adds 1¾ inches to the length of the TM 503, TM 504, and TM 506 Mainframes, and clears the longest knob projections on any of the instruments.

TM 503 Front Panel Cover,
Order 200-1566-00 . . . . . **$11.75**

TM 504 Front Panel Cover,
Order 200-1727-00 . . . . . **$11**

TM 506 Front Panel Cover,
Order 200-1728-00 . . . . . **$14.50**

ACCESSORY POUCH

While the TM 501, TM 503, TM 504, and TM 506 Mainframes were optimized for bench use, they are frequently carried away for service elsewhere. Taking along the probes, cables, terminators, and other accessories usually required can then be a problem. The soft vinyl accessory pouch neatly solves this problem; sturdy snap-around straps let the pouch be secured to the carrying handle of any TM 500 Mainframe or TEKTRONIX Oscilloscope, or the straps may be snapped together to form a carrying handle for the pouch to be used independently. A convenient side zipper lets accessory items be removed or stored without removing the pouch from the mainframe handle. Dimensions approx 9¼ in L x 5¾ in W x 2 in D.

Order Number 016-0351-00 . . . . . **$14.50**

RAIN COVERS

These soft, weather-proof, vinyl-coated Rain Covers come in sizes for TM 503 and TM 504 packages of instrumentation, and include adequate space for protective front covers, as well. They feature heavy-duty zippers that open from either end, and include their own carrying handles, offset to compensate for the off-center balancing point of TM 500 instrumentation packages. The color is Tek blue.

TM 503 Rain Cover
Order 016-0620-00 . . . . . **$25**

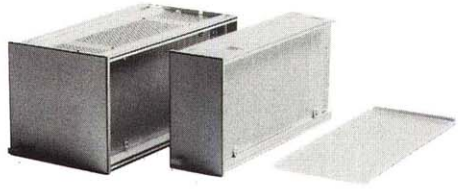
TM 504 Rain Cover
Order 016-0621-00 . . . . . **$30**

TM 500 BLANK PANEL

When operating the TM 500 instruments with less than the full complement of plug-ins, the blank plug-in panel can be used to cover unused compartments.

Blank Plug-in Panel,
Order 016-0195-01 . . . . . **$7.50**

TM 500 CUSTOM PLUG-IN KITS



Single and double compartment sizes

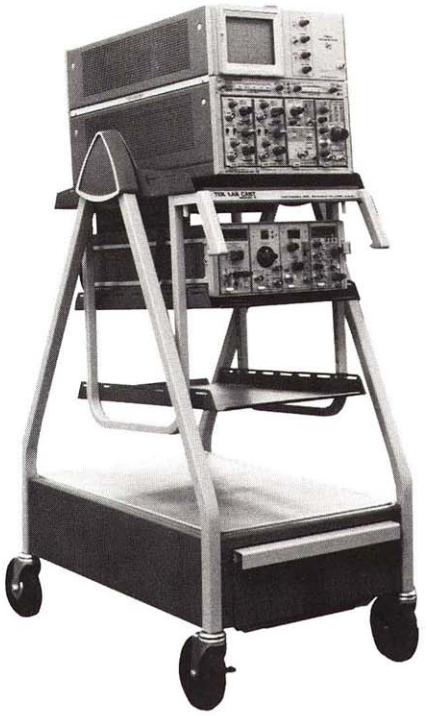
A complete test and measurement set-up for many typical jobs requires at least one non-standard item. Such items commonly include relay circuits or manual switches for routing signals; test oscillators at pre-set frequencies for alignment purposes and markers; digital logic circuits for sequencing, timing, and control; special processors or converters such as log amps, multipliers, and analog-to-digital converters; and a variety of other system elements which are usually not available or economical as complete commercial instruments. The construction and packaging of these special items is always a problem, and the sheet metal work and provision for necessary power supplies often far exceed the cost of the functional elements.

This is why the TM 500 line includes custom plug-in kits. The kits provide perforated main circuit boards which allow rapid construction and wiring of circuits using both discrete components and integrated circuits. Also included are top and bottom rails, side cover, front sub-panel, and a blank dress panel, and the latch mechanism. An instruction sheet details the voltages and currents available in the power module. Standard voltage regulator IC's can be used to provide exact voltages for most individual power supply requirements. The finished special-purpose circuitry or instrument is physically compatible with the other TM 500 instrumentation.

Custom Plug-in Kit (single compartment)
Order 040-0652-02 . . . . . **$28**

Custom Plug-in Kit (double compartment)
Order 040-0754-00 . . . . . **$85**

TEK LAB CART MODEL 3



This Lab Cart is especially designed for rollabout configurations combining TM 500 instrumentation with the TEKTRONIX Oscilloscope of your choice. It features pistol-grip tilt control and a large accessory drawer in the base. The top tray accepts any TEKTRONIX 7000-Series, 5000-Series, or Portable Oscilloscope. The MODEL 3 comes standard with one lower shelf that will support either a TM 503 or TM 504 with plug-ins. Additional shelves are available as optional accessories. Max capacity of the lower shelf area is two TM 503's or TM 504's, stacked, or up to a TEKTRONIX 7000-Series Oscilloscope in size—with TM 500 packages placed on the tray at your option. The power distribution module at rear underside of the top tray provides four power outlets and a 15-foot line cord.

International modification (Option 01) deletes power distribution module.

TEK Lab Cart Model 3 ..... **$295**

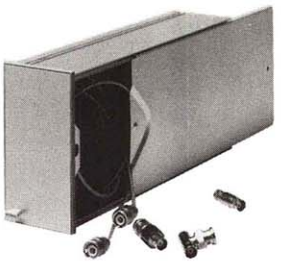
with Option 01 (International Modification) ..... **No Charge**

Additional Lower Shelf, Order 436-0132-01 ..... **$25**

Safety Belt to secure oscilloscopes or TM 500 to top tray or lower shelves (not needed for 5000 or 7000 Series on top tray)

Order 346-0136-01 ..... **$15**

PLUG-IN STORAGE COMPARTMENT



An electronic engineer or technician away from his bench seldom has enough storage space for probes, cables, "tees" and accessories, and small tools. The Plug-in Storage Compartment is a useful adjunct to many rollabout and Travel Lab configurations. If all five compartments in your TM 515 Traveler Mainframe are not used for a particular field application, stuff in a plug-in storage compartment for extra convenience. Even a rackmount TM 500 installation might profit by readily-available terminators or attenuators in a presently unused compartment. Compatible with all TM 500 Mainframes, 5000-Series Oscilloscope Mainframes, and 203 and 204 SCOPE-MOBILE® Cart plug-in storage bins; inside dimensions 9⅞ in L x 2 in W x 4¼ in D.

Order Number 016-0362-00 ..... **$25**

ADAPTER KITS FOR EARLIER SCOPE-MOBILE® CARTS

TM 504 Adapter Kits — Includes hardware to attach TM 504 to 203 or 204 SCOPE-MOBILE® Cart.

For 203, Order 016-0348-00 ..... **$40**

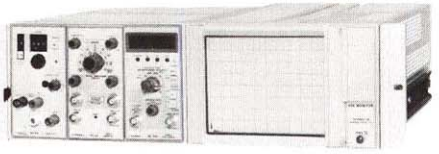
For 204, Order 016-0349-00 ..... **$30**

TM 503 Adapter Kits — Includes hardware to attach TM 503 to 203 or 204 SCOPE-MOBILE® Cart.

For 203, Order 016-0583-00 ..... **$50**

For 204, Order 016-0584-00 ..... **$50**

CABINET-TO-RACKMOUNT CONVERSION KITS AND MONITORS



Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to rackmount two TM 503's side-by-side in a standard rack width.

Order 040-0616-01 ..... **$69**

Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to rackmount a single TM 503 in a standard rack width. This includes securing hardware and a blank front panel when only one instrument is utilized.

Order 040-0617-01 ..... **$100**

Rackmount-to-cabinet conversion kit equipped to convert a rackmount TM 503 to a cabinet style.

Order 040-0618-01 ..... **$30**

Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to rackmount a TM 503 and a 603, 604, 605, 606, or 607 in a standard rack width.

Order 040-0624-00 ..... **$65**

Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to convert a TM 506 (cabinet style) to an RTM 506.

Order 040-0761-00 ..... **$80**

Rackmount-to-cabinet conversion kit equipped to convert an RTM 506 to cabinet style TM 506.

Order 040-0762-00 ..... **$55**

MONITOR ORDERING INFORMATION

603 Bistable Storage Monitor with Option 03 for rackmounting **$1390**

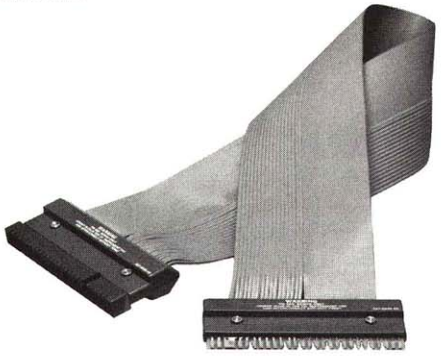
604 Monitor with Option 03 for rackmounting **$915**

606 High Resolution Monitor with Option 03 (for rackmounting) **$1415**

607 Variable Persistence Storage Monitor with Option 03 (for rackmounting) ... **$1790**

See page 217 for more information.

TM 500 FLEXIBLE EXTENDER CABLE



Designed to couple a TM 500 Plug-in with the mainframe rear interface board connection. It provides a completely flexible connecting point outside the mainframe for plug-in operation during test or check-out.

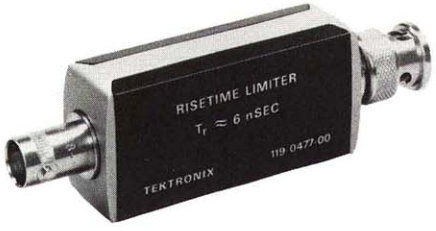
Extender Cable, Order 067-0645-02 . . . . $70

50 Ω PRECISION COAXIAL CABLE

For use with the PG 502, PG 506, and SG 503. These instruments are internally calibrated for use with this 3 ft 50 Ω coaxial cable into a 50 Ω load.

50 Ω Cable, Order 012-0482-00 . . . . . $19

RISE TIME LIMITER



For use with the PG 502 Pulse Generator which has a pulse rise and fall time of less than one nanosecond. In some applications, such as TTL logic where slower rise time is needed, this fast pulse can be limited to six nanoseconds by using the rise time limiter.

Rise Time Limiter, Order 015-0249-00 . . . $45

MANUAL (ONE SHOT) TRIGGER GENERATOR RG 501, PG 501, AND PG 505

The Manual (one shot) Trigger Generator is a self-contained, battery-operated, hand-held device for manually generating a single pulse. This adapter is used to start a pulse, ramp, sweep, or complete sequence of events on instruments which do not have a manual trigger button or where a remote operation capability is desired, such as some oscilloscopes and the PG 501, PG 505, and RG 501.

The internal trigger generator circuitry eliminates contact bounce, but will generate pulses as rapidly as the operator can manually cycle the pushbutton.

The output pulse is nominally two milliseconds in width and three volts in amplitude with a rapid rise and fall. Output impedance is low (50 Ω); the pulse amplitude drops from about 3.6 to 1.8 volts when changed from a high impedance to a 50 Ω termination. Both voltages decrease with battery aging. The battery is a 5.4 V dry cell.

Applications for the trigger generator also include stepping or sequencing of digital systems, analog control systems, mechanical devices, as well as obtaining "single shot" operation from many types and brands of instruments. Biological and physical experiments, where manual triggering is required as a part of the stimuli, are also common applications.

Order Number 016-0597-00 . . . . . $40

FRONT-PANEL CIRCUIT BOARD ADAPTER KIT PS 501-1, PS 503A OR PS 505

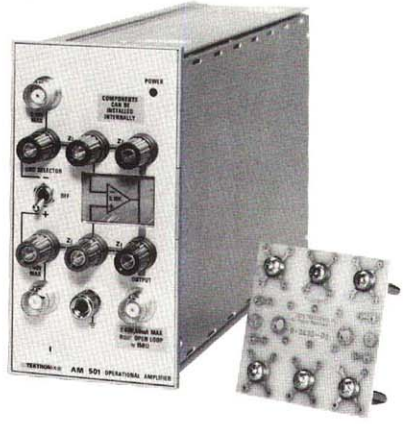
The front-panel circuit-board kit is a convenient way to mount small experimental circuits or fixtures right on the front of a TM 500 power supply.

Typical applications for the adapter are as a device tester (test fixture), educational demonstrator (especially IC's), and in temporary systems functions, e.g., OR'ing and AND'ing two signals. This adapter will supplement the blank plug-in kit for simple or temporary applications.

The adapter kit provides a convenient platform for building up circuits; its pin holes are pre-solder-flowed and some are interconnected. Discrete devices can be readily attached to the adapter kit board, stored, and easily reattached to the "banana jack" plugs on the face of the power supply. Circuit clips for interconnected pin holes are available from Tektronix. The adapter kit is 2½ inches wide.

Order Number 013-0152-00 . . . . . $12

AM 501 AUXILIARY CIRCUIT BOARD KIT



The AM 501 Auxiliary Circuit Board Kit attaches to the input and output terminal plugs on the front of the AM 501 Operational Amplifier. The kit is approximately 2½ inches square. The kit is a pc board which has six terminal studs for attachment to the amplifier's banana jacks. This permits the designer to build a circuit of resistors, capacitors, and other components for use in conjunction with the AM 501's input, output, or feedback circuits. With several boards, the AM 501 Op Amp circuit can be changed instantly in configuration from integrator to differentiator to amplifier.

An additional advantage of the kit is that it does not interfere with the other connectors on the face of the AM 501.

Order Number 013-0146-00 . . . . . $12

Fast-rise Pulse Generators

250-ps Rise Time Pulses

Alternate Pulses of Equal or Different Time Duration

0-55 V Calibrated Variable Amplitude

Selectable Polarity

The 109 is intended for use with fast-rise sampling or conventional oscilloscopes that generate their own internal sweep trigger. The 109 is transistorized and requires no warmup time before operating.

PULSE CHARACTERISTICS

Characteristics	Performance
Risetime	Less than 250 ps
Amplitude	Adjustable from 0 through 50 V
Repetition Rate	Preset between 550 p/s and 720 p/s (using two charge lines)
Pulse Duration	0.5 ns to max of 100 ns at full rep rate; 300 ns at half rep rate
Decay	approx 10% in 300 ns
Polarity	Positive or negative
Output Impedance	50 Ω

Charge Lines — Either one or two charge lines can be used to provide alternate equal or unequal pulses as desired. Equal charge lines produce a repetition rate of 550 pulses per second to 720 pulses per second.

External Dc Charge Voltage Inputs — Use of external charge voltages allows alternate pulses to be of different amplitude and polarity. Maximum external charge voltage is 600 volts. With up to 100-volt input, the output amplitude will be half the external input amplitude. At voltage inputs over 100 volts, the output amplitude will be less than half the input amplitude. At pulse outputs over 50 volts, irregularities may occur.

Power Requirement — Wired for 105 to 125 V, may be ordered with the taps connected for 210 to 250 V. 50 to 800 Hz, 60 watts maximum.

Dimensions and Weights

Height	≈8 in	19.7 cm
Width	≈5 in	12.2 cm
Length	≈12 in	30.2 cm
Net weight	≈8 lb	3.8 kg
Shipping weight	≈13 lb	≈5.9 kg

Included Accessories — Charge network (017-0067-00); three 5-ns 50-Ω RG123 cables (017-0502-00); 3-conductor power cable (161-0010-03).

109 Pulse Generator **$875**

Pulse Output With 70-ps or Less Rise Time

Sinewave and Squarewave Outputs

Compact, Solid-State Design

The 284 Pulse Generator provides the facility for verifying the performance of Sampling Oscilloscopes. This generator offers, in one small instrument, all of the signals required to check the rise time, vertical deflection factors, and horizontal sweep rates. A pretrigger output is also provided.

In addition to checking the transient response of sampling oscilloscopes, the fast-rise step of the pulse output is an excellent 50-Ω signal source for TDR measurements. The 284 is available in a cabinet version, or modified for rackmounting in a standard 19-inch rack using the optional Rack Adapter.

OUTPUT CHARACTERISTICS

Pulse Output — 70 ps or less rise time with a pulse width of more than 1 μs and a repetition rate of approx 50 kHz. Aberrations immediately following positive-going transitions are less than ±3%, 3% total peak-to-peak; after 2 ns less than ±2%, 2% total peak-to-peak. Pulse amplitude is more than +200 mV into 50 Ω. Source resistance is 50 Ω.

Squarewave Output — Periods of 10 μs, 1 μs, or 100 ns. Output amplitude is 10 mV, 100 mV, or 1 V into 50 Ω.

Sinewave Output — Periods of 10 ns or 1 ns. Output amplitude is 100 mV into 50 Ω.

Trigger Output — Squarewave, sinewave, or pretrigger pulse output, depending on the selected main signal output. Amplitude is 200 mV, accurate within 40%. When PULSE OUTPUT is selected, the trigger can be switched to arrive 5 ns ±5 ns, or 75 ns ±5 ns ahead of the main pulse. Rise time is 3 ns or less; pulse width is 10 ns or greater.

Timing and Amplitude Accuracy

Output	Period	Timing Accuracy	Amplitude Accuracy		
			1 V	100 mV	10 mV
Pulse	20 μs	±10%			
Square-wave	10 μs 1 μs	±0.5%	±0.5%	±1%	±1.5%
	100 ns	±0.05%*	±2%†	±2.5%†	±3%†
Sine-wave	10 ns 1 ns	±1%		±20%	

* crystal controlled † 20 ns after transition

OTHER CHARACTERISTICS

Operating Temperature — Instrument operating specifications are valid over an ambient temperature range of 0°C to +50°C.

Power Requirements — 6.5 watts, 48 Hz to 440 Hz. Quick-change line-voltage selector permits operation from 90 V to 136 V or 180 V to 272 V.

Dimensions and Weights

Height	6 in	15.3 cm
Width	≈5 in	11.4 cm
Depth	15 in	38.1 cm
Net weight	8 lb	3.6 kg
Shipping weight	≈14 lb	≈6.3 kg

INCLUDED ACCESSORIES

50-Ω, BNC coaxial cable (012-0057-01); right angle, 3-conductor power cable (161-0024-03) standard; (161-0031-00) with Option 01.

284 Pulse Generator **$1200**
Option 01 ..... **Sub $25**
(less cabinet, for mounting in rack adapter listed on page 252)

TDR Cable Testers

10

Portable—Battery Powered, Self-Contained, Light (18 pounds), Small (5 x 12½ x 18½ in)

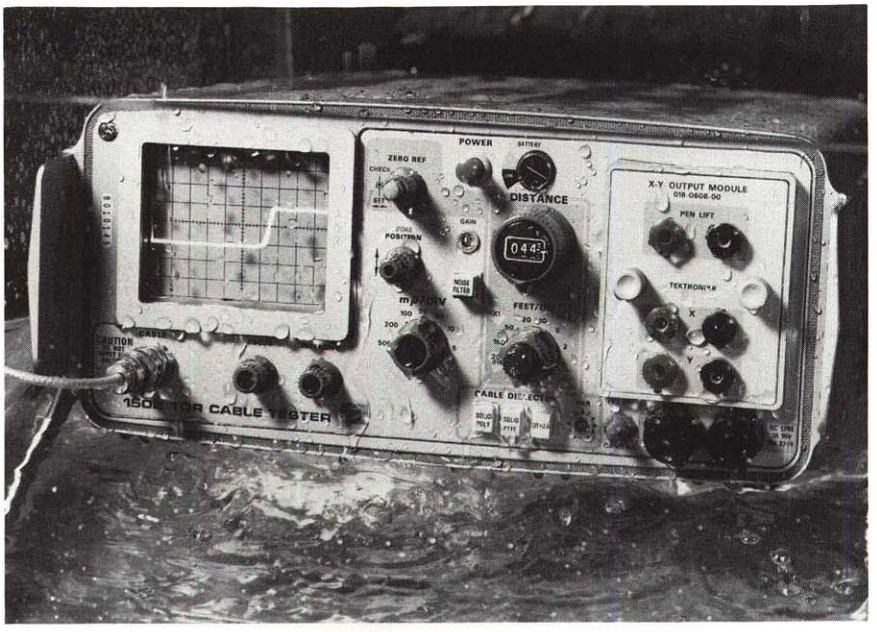
Rugged—Designed to MIL-T-28800, Type II, Class 2, Style A

Versatile—Test Any Type Cable

Easy to Use—Produces Results with Minimum Operator Training

The small, portable, rugged, battery-powered 1502 and 1503 TDR Cable Testers are extremely simple to operate and will test any type cable, from lamp cord to coax, under virtually any conditions, from dust to rain, from desert to sea to mountain top. The high resolution (to a fraction of an inch), moderate range (to 2000 feet) 1502 is appropriate for testing coax and other cables in aircraft, ships, radar sites, etc. The long range (to 50,000 feet), moderate resolution (to 3 feet) 1503 is appropriate for testing long runs of coax or twisted-pair cables in telephone and other communications applications. These units use Time Domain Reflectometry (TDR), a simple, proven, well-established technique, to precisely locate and identify cable faults.

These testers are designed to be field maintenance tools. For carrying ease and operation in tight spaces, the 1502 and 1503 offer an ideal combination of small size, light weight, and portability. Either tester is capable of operation for more than five hours on the internal batteries before recharging is required.



Since permanent records are extremely useful in cable maintenance, the optional plug-in Y-T Chart Recorder is available for self-contained hard copy capability. The standard plug-in X-Y Output Module can drive an external X-Y recorder.

1502

This unit has the high-resolution capability of a laboratory time domain reflectometer. It is directly calibrated in reflection coefficient (rho) and distance and is thus very simple to operate. The 1502 uses ultra-fast (110-picosecond), step-type excitation signals, and provides fault resolution to 0.6 inch. The 1502 performs excellently at distances to 2000 feet, even though rise time and resolution typically degrade with increasing cable length. The 1502 is matched to 50-ohm cables, but may be used on other cables by adjusting the front-panel GAIN control or using optional impedance adapters.

1503

The limited bandwidth and relatively high losses common to long cables (particularly twisted pair) require special high-energy, controlled-bandwidth test signals. For these applications, the 1503 provides 10-volt, ½-sine-shaped pulses and is calibrated in decibels for direct reading of return loss. Range of the 1503, dependent upon cable type, is up to 50,000 feet; resolution capability provides for resolving faults as close together as 3 feet. Impedance levels of 50, 75, 93, and 125 ohms are selectable with the press of a button.

Also see 7S12 TDR/Sampler Plug-in unit on page 83.

NOTE: Where specifications are different for the metric version, Option 05 (in many cases, the metric specification is not a direct conversion from English measure), or where conversion to metric is appropriate, the metric specifications are shown in italics and are set in brackets.

1502 Characteristics

TEST SIGNAL

System Reflected Rise: ≤0.07 ft *[≤2.1 cm]* (≤140 ps).

Aberrations: ±5% during 1st 10 ft *[300 cm]* after rise. ±0.5% peak beyond 10 ft *[300 cm]* NOISE FILTER "out." ±0.2% peak beyond 10 ft *[300 cm]* NOISE FILTER "in."

Jitter: ≤0.02 ft *[0.6 cm]* (≤40 ps) for X.1. ≤0.1 ft *[≤3 cm]* (≤200 ps) for X1.

Termination: 50 Ω, within 2%.

Pulse Amplitude: 225 mV nominal (into 50-Ω load).

VERTICAL SYSTEM

Deflection Factor: 5 mρ/div to 500 mρ/div.

Accuracy: within ±3%.

Gain: ≥3.5:1 from calibrated point.

Displayed Noise: ±5 mρ or less, NOISE FILTER switch "out."

Low Noise Operation: ±2 mρ or less, NOISE FILTER switch "in."

Test Connector:

Type: bnc.

Coupling: dc.

Max Input: DO NOT APPLY EXTERNAL VOLTAGE.

HORIZONTAL SYSTEM

Distance Controls:

Distance Dial:

Range: 0 to 100 ft *[0 to 25 m]* for X.1. 0 to 1000 ft *[0 to 250 m]* for X1.

Accuracy: within ±2% of reading ±0.05 ft *[±2% ±0.05 m]* for X.1. Within ±2% of reading ±0.5 ft *[±2% ±0.5 m]* for X1.

FEET/DIV Control:

Range: 0.1 to 20 ft/div *[0.025 to 5 m/div]* for X.1. 1 to 200 ft/div *[0.25 to 50 m/div]* for X1.

Accuracy: within 2% of full crt screen.

Dielectric Scales:

SOLID PTFE $\frac{V_p}{V_{air}} = 0.70$

SOLID POLY $\frac{V_p}{V_{air}} = 0.66$

VAR-OTHER $\frac{V_p}{V_{air}} = 0.55$ to 1

VAR is calibrated for air when turned fully cw. Accuracy is within ±2%.

Sweep Repetition: 35 ± 5 Hz with NOISE FILTER switch "out." 4 Hz within ±20% with NOISE FILTER switch "in."

1502 Included Accessories: Watertight front cover, TDR Slide Rule — 003-0700-00, 50-Ω BNC Terminator — 011-0123-00, Precision 50-Ω Cable — 012-0482-00, Viewing Hood — 016-0297-00, X-Y Output Module — 016-0606-00, Replacement Fuses (for front panel) 117 V ac — 159-0032-00 or 234 V ac — 159-0029-01, Power Cord — 161-0066-00, Mesh Filter (CRT) — 378-0055-00, BNC Female-to-Female Adapter — 103-0028-00.

1503 Characteristics

TEST SIGNAL

Duration: 10 ns, 100 ns, 1000 ns ±20% at half amplitude.

Amplitude: 10 V ±20% unterminated. 5 V ±20% terminated.

Shape: ½ sine ±20%.

Termination: 50 Ω, 75 Ω, and 93 Ω, within 1%; 125 Ω within 3%.

Jitter: 0.2 div max.

VERTICAL SYSTEM

Display:

Range: +6 to −18 dB from reference.

Accuracy: ±3%.

Display Reference:

Range: 0 to 60 dB, 7 steps, 10 dB increments.

Accuracy: ±0.1 dB.

Variable: 0 to 18 dB additive to step increments.

Displayed Noise:

Aberrations: −30 dB p-p.

Random: −80 dB rms.

Low-Noise Operation: −86 dB rms, random.

Test Connector:

Type: bnc.

Coupling: ac.

Max Input: ±400 V (dc + peak ac at max frequency of 440 Hz).

HORIZONTAL SYSTEM

Distance Control:

Range: 0 to 50,000 ft *[0 to 10,000 m]*.

Scales: 5 ft/div to 500 ft/div *[1 m/div to 100 m/div]*, at X10 *[X1]*.

Accuracy: ±2% of full crt screen.

Scale Multipliers: X10 and X100 *[X1 and X10]* within 2%.

Distance Dial:

Range: 0 to 2500 ft at X10 setting *[0 to 500 m at X1 setting]*. 0 to 25,000 ft at X100 setting *[0 to 5000 m at X10 setting]*.

Accuracy: ±2% + of reading 1 digit on dial.

Dielectric Scales:

SOLID POLY $\frac{V_p}{V_{air}} = 0.66$

FOAM $\frac{V_p}{V_{air}} = 0.81$

VAR-other $\frac{V_p}{V_{air}} = 0.31$ to 1.0

VAR is calibrated for air when turned fully cw. Accuracy is within ±2%.

Sweep Repetition: 35 ± 5 Hz with NOISE FILTER switch "out." 20 s/sweep nominal in chart recorder mode (dependent upon chart recorder).

1503 Included Accessories: Watertight front cover, Replacement Fuses (for front panel) 117 V ac — 159-0032-00 or 234 V ac — 159-0029-01, Power Cord — 161-0066-00, Viewing Hood — 016-0297-00, 50-Ω BNC Terminator — 011-0123-00, X-Y Output Module — 016-0606-00, Mesh Filter (CRT) — 378-0055-00, 9-ft BNC-to-Clip-Lead Cable — 012-0671-00.

Common Characteristics

POWER SYSTEM

Line Voltage: 117 V ac ±20%, 48 to 410 Hz. 234 V ac ±20%, 48 to 410 Hz.

Battery Pack:

Operation: At least 5 hr (+20°C to +25°C charge and discharge temperature) including 20 chart recordings.

Full Charge Time: 16 hr.

Typical Charge Capacity:

Charge Temperature	Discharge Temperature		
	−15°C	+20°C to +25°C	+55°C
0°C	40%	60%	50%
+20°C to +25°C	65%	100%	85%
+40°C	40%	65%	55%

EXTERNAL RECORDER INTERFACE (STANDARD X-Y MODULE)

Horizontal: 0.1 V/div, source impedance is 10 kΩ.

Vertical: 0.09 to 0.13 V/div (adjustable), source impedance is 10 kΩ.

PHYSICAL CHARACTERISTICS

Weight: 18 lb *[8.2 kg]* with front cover and standard accessories. 16 lb *[7.3 kg]* without front cover and accessories.

Domestic Shipping Weight: 24.4 lb *[11.1 kg]*.

Export Shipping Weight: Approx 36 lb *[16.3 kg]*.

Height: 5.0 in *[12.7 cm]*.

Width: 12.4 in *[31.5 cm]* with handle. 11.8 in *[30 cm]* without handle.

Depth: 16.5 in *[41.9 cm]* including front cover, handle not extended. 18.7 in *[47.5 cm]* handle extended.

ORDERING INFORMATION

1502 TDR Cable Tester (NSN 6625-01-003-5561) $3200

Option 04 (with recorder) . . . . . add **$575**
Option 05 (metric version) . . . . . no extra charge
Option 06 (234-V version) . . . . . no extra charge
Option 76 (P7 phosphor) . . . . . no extra charge

1502 Optional Accessories

Chart Recorder — 016-0506-02 . . . . . **$575**
Chart Paper (roll) 006-1658-01 . . . . . **$4.30**
Chart Paper (100-roll case) 006-1658-02 . . . . . **$350**
Accessory Pouch — 016-0351-00 . . . . . **$14.50**
Impedance Adapter —
50/75 Ω — 017-0091-00* **$55**
50/93 Ω — 017-0092-00* **$55**
50/125 Ω — 017-0090-00* **$55**

*Should be purchased with following two parts:
Connector, BNC Female-to-GR — 017-0063-00 **$18.50**
Connector, BNC Male-to-GR — 017-0064-00 . . . **$18.50**

1503 TDR Cable Tester (AN/USM-437 (v)) $2985

Option 04 (with recorder) **(AN/USM-437 (v)1)** . . . . . add **$575**
Option 05 (metric version) . . . . . no extra charge
Option 06 (234-V version) . . . . . no extra charge
Option 76 (P7 phosphor) . . . . . no extra charge

Also available is a modified **1503 TDR Cable Tester** with calibrated pushbutton selection for telephone L-carrier cables . . . . . **request quote**

Also available is a modified **1503 TDR Cable Tester** with calibrated pushbutton selection of any cable dielectric . . . . . **request quote**

1503 Optional Accessories

Chart Recorder — 016-0506-02 . . . . . **$575**
Chart Paper (roll) 006-1658-01 . . . . . **$4.30**
Chart Paper (100-roll case) 006-1658-02 . . . . . **$350**
Isolation Network (for balanced lines) — 013-0169-00 . . . . . **$140**
Adapter Cables (BNC-to-Clips) —
9-foot — 012-0671-00 . . . . . **$38**
30-foot — 012-0671-01 . . . . . **$53**
Accessory Pouch — 016-0351-00 . . . . . **$14.50**

J16 Photometer/Radiometer (Fig 1)

3½-Digit Light-Emitting Diode Readout

Portable

Complete Probe Interchangeability without Recalibration

Available with Metric Readout

The J16 is a portable photometer/radiometer that is equally at home in the lab or in the field. It weighs 3.3 lb, measures 2.4 x 4.6 x 8 inches, and comes with a shoulder strap and rechargeable nickel-cadmium batteries. The J16 has excellent long-term calibration stability. It is environmentalized to operate from −15°C to +40°C and meet MIL specs for humidity.

Available for the J16 are eight quickly interchangeable, precalibrated silicon probes, an ac power supply, probe cable (for separate operation of the probes), and analog and bcd outputs.

All J16 Probes

Rugged, Stable Silicon Sensor and Glass Spectral-Correction Filter

Hold Switch to Store Reading

Calibration Accuracy of Reading 5% ± One Digit

No Fatigue or Saturation Effects

Excellent Calibration Stability

J6511 Illuminance Probe (Fig 2)

Accurate Photopic (Color) Correction

Accurate Cosine Correction (180° Field of View)

Measures 0.001 to 1999 Footcandles (0.01 to 19,999 Lux*)

Resolution 0.0001 Footcandles (0.001 Lux*)

5% Accuracy Even with Low-Pressure Sodium Lighting

25-Ft Cable Attached

Built-in Bubble Level

Use for OSHA Standards, Office Lighting, Highway Lighting, Automotive Lighting, Medical Lighting

J6523 1° Luminance Probe (Fig 3)

1° Acceptance Angle

Optical Sighting and Viewing System

Accurate Photopic (Color) Correction

Measures 0.1 to 19,990 Footlamberts (1 to 199,900 Nits*)

Resolution 0.01 Footlamberts (0.1 Nits*)

Measures a Spot as Small as 0.23 Inches at 18-In Distance (0.035″ with Commercially Available Standard Photographic Close-up Lenses)

Focus Range of 18 Inches to Infinity

5% Accuracy Even with Low-Pressure Sodium Lighting

Use for Highway Lighting, Television, Photographic Equipment, Cathode-Ray Tubes

**Metric version.*

Fig 1 Fig 2 Fig 3 Fig 4 Fig 5

J6502 Irradiance Probe (Fig 4)

Flat Spectral Response within ±7% from 450 to 950 nm

Measures 1 nW/cm² to 1.999 mW/cm² (0.01 to 19,900 mW/M²*)

Resolution 0.1 nW/cm² (0.001 mW/M²*)

1-cm² Sensor Allows Direct Reading of Laser Power in μW with Detector Underfilled by Beam

Acceptance Angle Approximately 120°

Use for Lasers, Environmental Research, Tv Monitor Color Temperature Adjustment, Ir LED's

J6503 8° Luminance Probe (Fig 4)

Accurate Photopic (Color) Correction

Measures 0.1 to 199,900 Footlamberts (1 to 1,999,000 Nits*)

Resolution 0.01 Footlamberts (0.1 Nits*)

Use for Television, Illumination, Photographic Equipment, Cathode-Ray Tubes

J6501 Illuminance Probe (Fig 4)

Same Characteristics as J6511 Except No Cosine Correction; Construction Similar to J6502. (When Using 014-0047-00 LED Adapter, the Ranges are the Same as Those for the J6505.)

Use for Green and Yellow LED's, Lamp Testing, and Other Point Light Sources

J6505 Red LED Probe (Fig 4 and 5)

Accurately Matches Photopic Curve from 600 to 710 nm

Measures 0.01 Millicandela to 199.9 Candelas at 3.8 Inches (Higher at Greater Distances)

Resolution 0.01 Millicandela

Includes Snap-on LED Adapter to Position LED and Exclude Room Light

Use for Red LED's, Red Automotive, and Aircraft Lights

J6512 Irradiance Probe (Similar to Fig 2)

Same Characteristics as J6502; Construction Similar to J6511

Use for Lasers, Medical, Environmental Research

J6504 Uncorrected Probe (Fig 4)

Spectral Response: Uv-Enhanced Silicon Curve (250 to 1200 nm)

Highest Sensitivity (No Filters Are Used to Modify Spectral Response)

Relative Reading Only

Use for Periodic Tests of Photoresist Exposure Equipment, Uv Light Sources

ORDERING INFORMATION

Photometer/Radiometer without Probes

Readout Units	Power Source	Voltage	Order Information†	Price
US	Battery	115 V, 50-60 Hz battery charger	J16	$710
US	Battery	230 V, 50-60 Hz battery charger	Opt 01	No Charge
US	Ac	115 V, 50-400 Hz	Opt 03	No Charge
US	Ac	230 V, 50-400 Hz	Opt 04	No Charge

Analog and digital outputs available on special order.

†For a J16 with metric readout, specify Option 02 in addition to above ordering information. No additional charge.

Option 02 probes must be used with Option 02 J16.

PROBES

J6511 Illuminance Probe **$350**

J6523 1° Luminance Probe **$980**

J6502 Irradiance Probe **$350**

J6503 8° Luminance Probe **$350**

J6501 Illuminance Probe **$350**

J6505 Red LED Probe **$420**

J6512 Irradiance Probe **$400**

J6504 Uncorrected Probe **$350**

For probes for metric J16, specify Option 02 at no additional charge.

ACCESSORIES

42-in Probe Extension Cable for J6501, J6502, J6503, J6504, and J6505.
Order 012-0414-02 (Longer on Special Order) **$50**

Light Occluder (for Color Tv Monitor Setup).
Order 016-0305-00 ..... **$16**

Filter Holder — Mounts 1-in Diameter Filters to J6501, J6502, J6503, J6504, and J6505.
Order 016-0527-00 ..... **$15**

Filter Holder — Mounts 2-in Diameter Filters to J6512.
Order 352-0380-00 ..... **$1.75**

Tripod, Order 016-0253-00 ..... **$50**

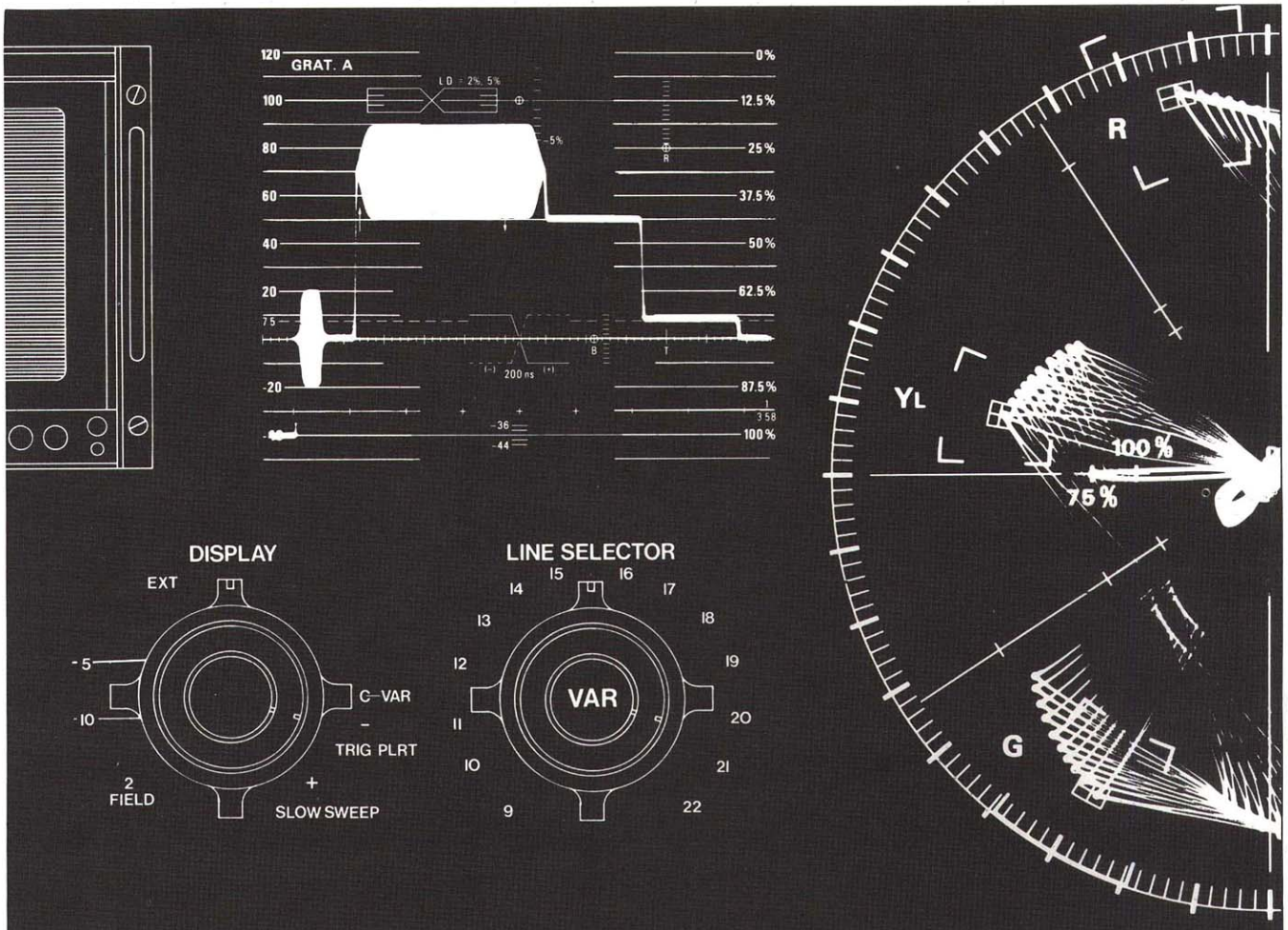
Ac Power Supply, 115 V, 50-400 Hz.
Order 119-0404-00 ..... **$140**

Ac Power Supply, 230 V, 50-400 Hz.
Order 119-0404-01 ..... **$150**

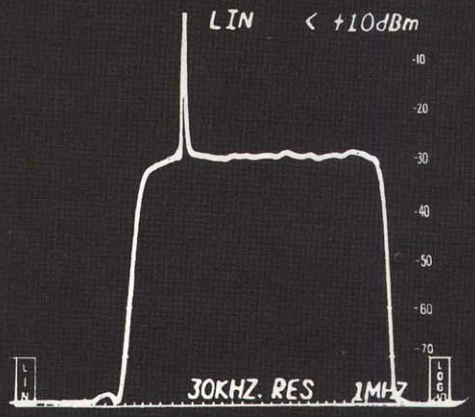
LED Adaptor (Included with J6505).
Order 014-0047-00 ..... **$60**

For a complete brochure and application notes on the J16, please return the reply card attached to the catalog or see your Tektronix field representative.

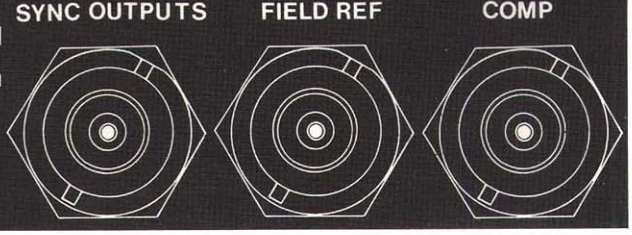
Television Products



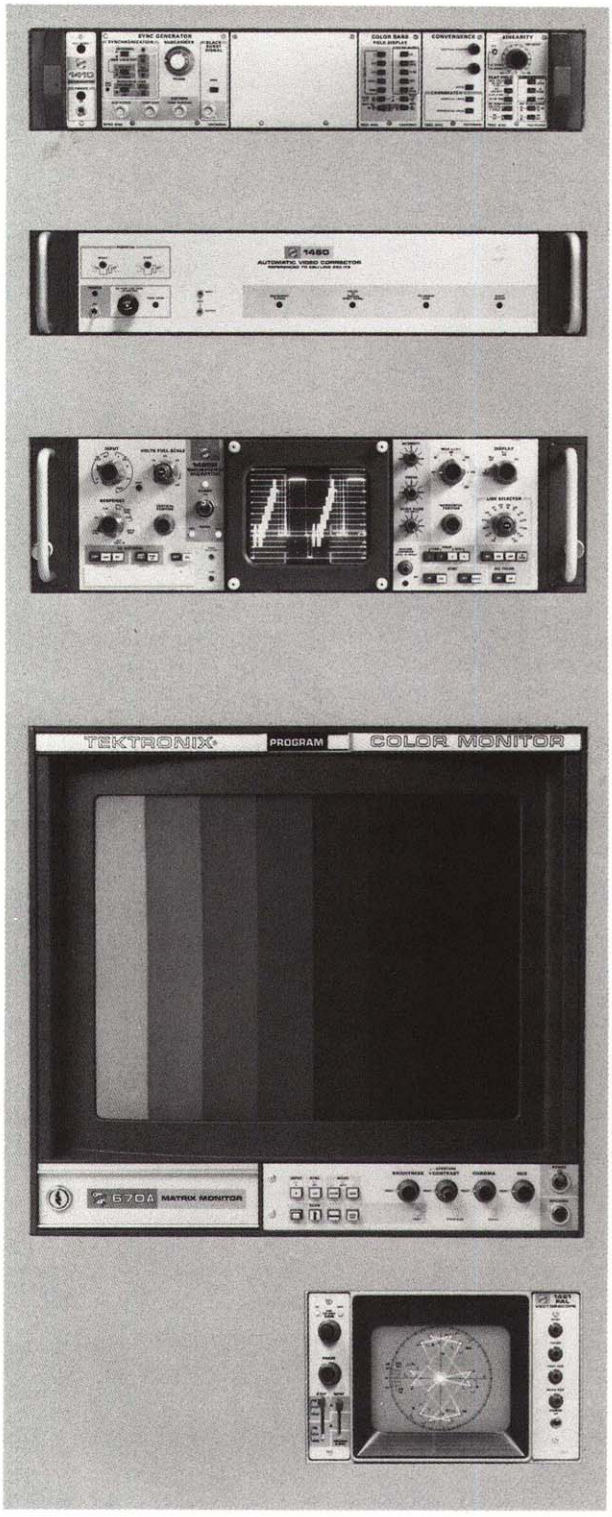
The Television Signal is a very complex signal, requiring precise timing and exacting analysis of its parameters in order to produce high picture quality and maintain it. Since the early days of television, Tektronix has served the industry with many forward-looking instruments designed to help improve picture quality. Our people and their products are industry leaders in the fields of Timing, Testing, Measuring, Correcting, and Displaying the television signal.



An overview of the TEKTRONIX products available to help you achieve and maintain picture quality will be found on the next page. Complete product specifications are available in the TEKTRONIX TELEVISION CATALOG. To get a copy, use the response card in this catalog.



TEKTRONIX Television Products time, test, measure, correct, and display the composite video signal.



The complete reference for data on TEKTRONIX Television Products is the TEKTRONIX Television Catalog. To get it, see the response card in this catalog.

Generators—Sync and test signal for NTSC, SECAM, PAL and PAL-M systems

All of the many signals needed to time and accurately test broadcast and closed-circuit color video equipment are provided by TEKTRONIX Television Signal Generators for NTSC, SECAM, PAL, and PAL-M systems. Most TEKTRONIX Generators provide many signals, rather than just one or two, through an arrangement of fully or partially independent controls. With a variety of inputs and outputs, the TEKTRONIX Generators provide you with signal flexibility to meet your changing timing and testing needs.

Correctors—NTSC and PAL

TEKTRONIX Automatic Video Correctors use a reference signal located in the vertical-blanking interval to correct the video signal. The Corrector samples the parameters of the reference signal in the vertical interval and automatically changes its operating characteristics until correct values for the reference signal are achieved. The full field signal is simultaneously corrected by the same automatic changes that correct the reference signal. Automatic correctors and auxiliary products are available for NTSC and PAL Systems.

Waveform Monitors

The waveform monitor is a specialized oscilloscope designed for the measurement of the composite video signal.

Characterized with sync-selective triggering and precise vertical characteristics, TEKTRONIX Waveform Monitors are designed for quick and accurate measurement of the components of the composite-video signal. There is a selection of TEKTRONIX Waveform Monitors for 525/60 and 625/50 scanning standards and for full- or fractional-width rack installation. Cabinet-style units are also available.

Picture Monitors—SECAM, PAL, PAL-M and NTSC

Picture monitors used in television production and transmission facilities are required to present program material and test patterns for critical evaluation by both engineering and production people. Therefore, consistent high-quality color reproduction is an important requirement. In addition to having stable, consistent color characteristics, TEKTRONIX Color Picture Monitors provide underscan and vertical and horizontal delay functions for detailed examination of the entire picture.

TEKTRONIX Monitors are sized to fit the critical space requirements of your installations. The Trinitron kinescope makes both the 650 Series and the 670 Series simple to converge and contributes to the color stability of both series.

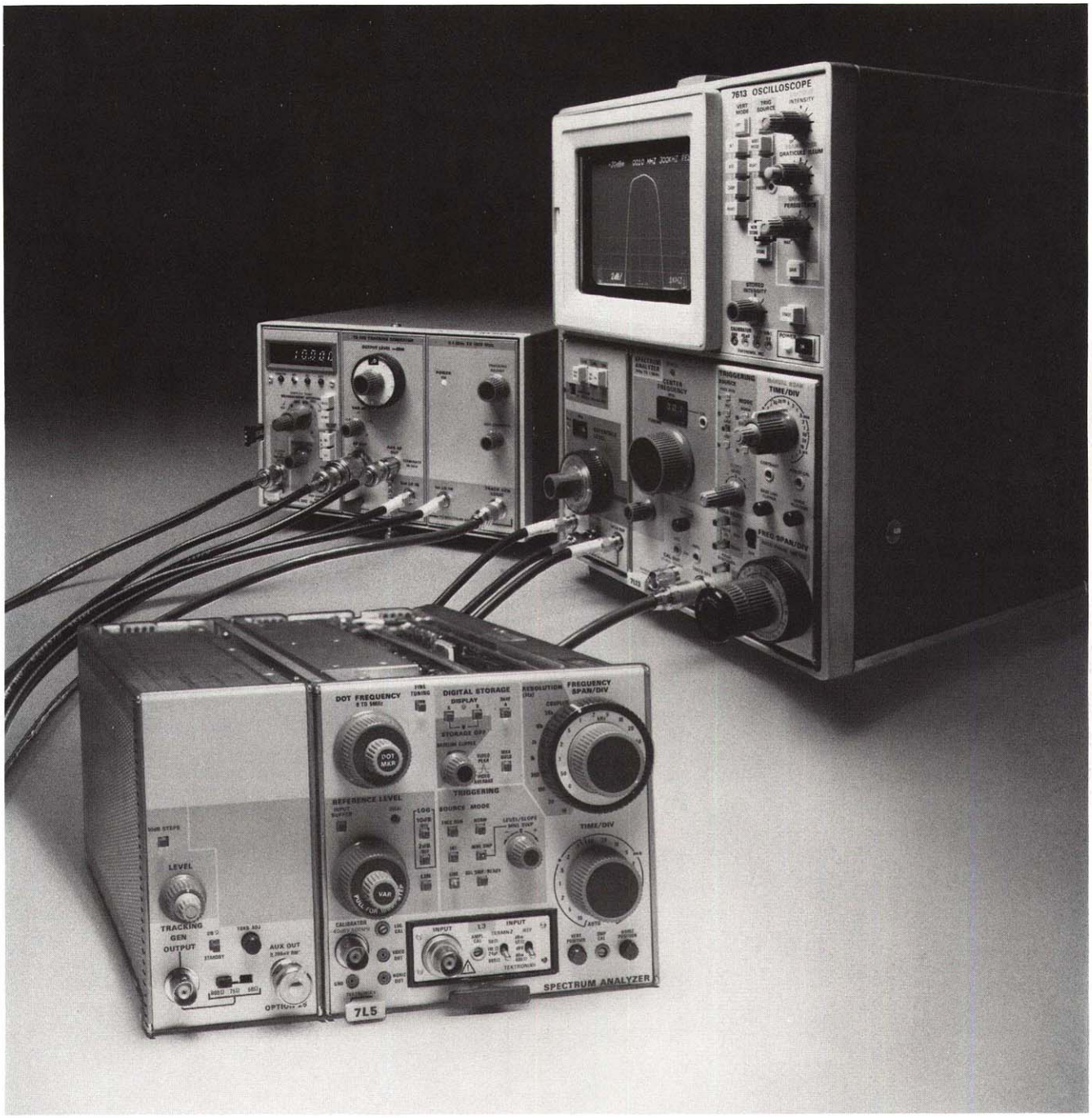
Vectorscopes—NTSC, PAL and PAL-M

Vectorscopes are used to display and examine the chrominance signal. Think of a vectorscope as an oscilloscope with a circular time base. It displays a polar plot with the radius a function of chrominance amplitude and the angle a function of chrominance phase. The chrominance phase is measured with respect to burst or a reference subcarrier. Some Vectorscopes offer linear time-base displays in addition to vector displays. Luminance amplitude, chrominance phase, chrominance amplitude, differential phase, and differential gain are included in the wide variety of specialized measurements for which vectorscopes are used.

Sideband Analyzers and Other Products for Television

The catalog you are reading now lists many products you may find valuable for use in servicing television systems and in general engineering and design — particularly when you are working in impedances other than 75 ohms, or with radio frequencies, or with noncomposite video. Among these products are sideband analyzers, spectrum analyzers, scopes with sync separation features, and the TM 500 Modular Instruments.

Spectrum Analyzers



7L5 with Option 25 Tracking Generator and 7L13 with TR 502 Tracking Generator are part of the high-performance spectrum analyzer family.

20 years ago the spectrum analyzer was a laboratory curiosity. Today the modern spectrum analyzer may well be one of the most powerful tools available to the electronics industry.

Early spectrum analyzers were nothing more than indicators, giving a representation of frequency and amplitude. Often called panoramic indicators, these early units were used with radio receivers to show other signals close to the one being received. The introduction of the amplitude-calibrated spectrum analyzer 10 years ago triggered the development of the instrument into the measurement tool it is today.

What Is A Spectrum Analyzer?

A spectrum analyzer draws a graph, theoretically little more. This graphic representation has 2 axes: frequency and amplitude, much as an oscilloscope graphs time and amplitude.

Various display modes are available such as log and linear amplitude, and various frequency spans can be selected.

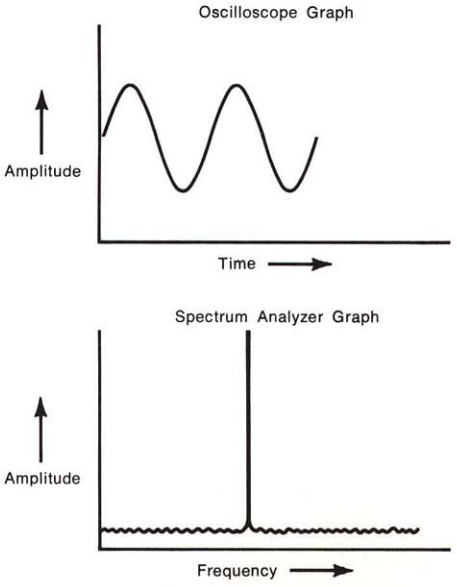


Fig. 1. Difference between oscilloscope display and spectrum analyzer display.

Basically a spectrum analyzer is a tuned receiver, with selectable frequency ranges and spans, selectable if bandwidths, and a linear or log detector — all coupled to a cathode ray type display.

Why Use A Spectrum Analyzer?

Many measurements now performed by more cumbersome and time-consuming means can be best performed with the spectrum analyzer. Measurements of waveforms, distortion, signal to noise, and amplitudes of complex components are easy with spectrum analysis.

The communications industry was first to take advantage of the spectrum display machines because there was just no other way to work with the higher frequencies involved.

In the past, spectrum analyzer cost and complexity encouraged use of the oscilloscope, not only for time domain measurement, but in areas where the spectrum analyzer is 10-, 100-, or even 1000-times more powerful. Some industries developed so many specialized instruments for measurements not then feasible by other means that they have not yet been able or willing to generally apply modern instrumentation.

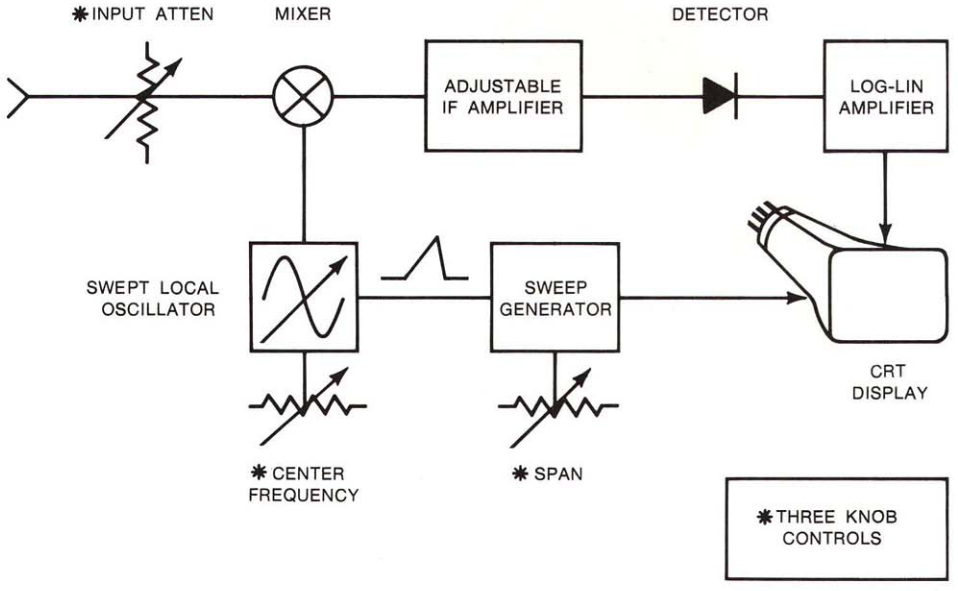


Fig. 2. Simplified block diagram of a modern swept front-end three knob spectrum analyzer.

Spectrum Analyzer Applications

The audio industry offers good examples. Many distortion measurements have been adopted over the past 25 years to analyze the performance of audio equipment. These distortions include harmonic distortion (thd), intermodulation distortion (CCIF, SMPTE, BELL, IHFM, etc), and crossover distortion, among the more common standards. Many specialized test sets have been built to measure each of the different distortions via the many standards. *Yet each distortion can be measured by studying the components of the waveforms.* The modern spectrum analyzer such as the 5L4N can analyze these components and measure any existing (or new) standard. In addition it can measure frequency response, signal-to-noise and virtually any other parameter used in the audio industry.* And the answers not only come out as numbers, but also as pictures.

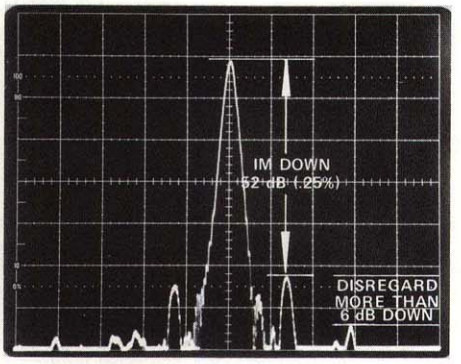


Fig. 3. 5L4N display of the SMPTE Standard Audio Distortion Test.

The picture tells you, for instance, that the harmonic distortion is due to third harmonic components, or that the signal to noise problem is due to 60 and 120 Hz power line components.

A number of old objections to use of the spectrum analyzer as a universal tool are still heard today. Probably one of the prime objections was price.

Through modern technology, the 5L4N audio spectrum analyzer can be purchased for much less than the other equipment normally found in an audio shop, such as two distortion analyzers (thd and im), an ac voltmeter, and an oscilloscope. An oscilloscope is normally part of a TEKTRONIX Spectrum Analyzer. The flexibility and time savings realized with the modern analyzer help make the analyzer less expensive than the crowd of older single-purpose instruments.

**Audio cookbook available*

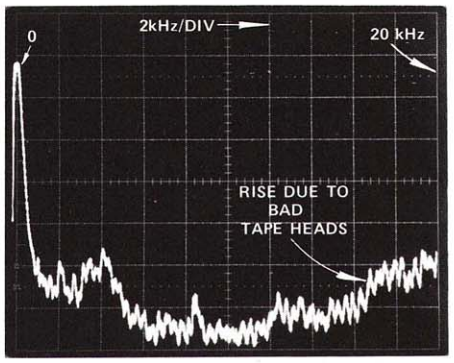


Fig. 4. An audio signal-to-noise measurement on a tape deck.

Another objection was complexity. (One expects a new device to be different.) Many of the complexities of the early spectrum analyzers have been eliminated. High school and college students first learning to make measurements often prefer the analyzer over any of the other instruments. And instruments like the 5L4N provide many real conveniences such as log sweep 20 Hz to 20 kHz, 600-ohm balanced input, automatic controls on some functions, and others.

The Field of Communications

The communications industry still includes the largest users of spectrum analysis. Vital measurements such as occupied bandwidth, frequency separation, percentage of modulation or frequency deviation, signal to noise, harmonics and im distortion are easily handled with the modern analyzer.

Prime users are: the microwave industry, the CATV industry (using analyzers for yearly proof of performance and day-to-day measurements), am and fm broadcasters, avionics shops, two way radio repair shops, radio common carrier services, and military services.

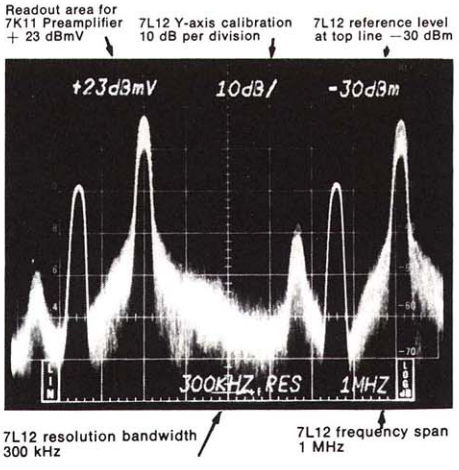


Fig. 5. Display of a standard NTSC color tv signal.

Most radio services have many things in common. Frequency ranges differ, but the transmitting and receiving systems are all characterized with the same requirements. The need to measure oscillator purity and stability, and to measure performance of multipliers, mixers, modulators, amplifiers, and filters, are requirements shared by the communications industry.

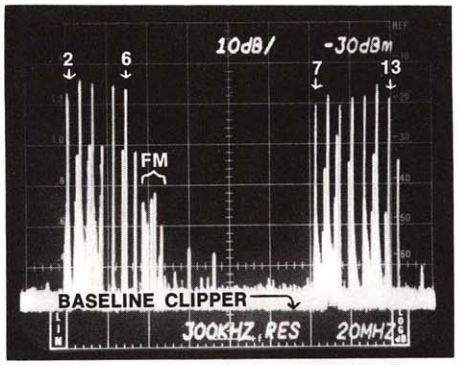


Fig. 6. Display of a 12 channel CATV system.

Even though most of these industries have specialized test sets, the spectrum analyzer is rapidly becoming the universal testing and troubleshooting tool.

Improved instruments mean more capability. As analyzers improve in stability and resolution, theoretical measurements of yesterday become day-to-day practice. Most engineers of today were taught Fourier analysis as a theoretical study of the frequency components of a wave. We believed, almost on faith, the actuality of the phenomenon. Today it is commonplace to check the purity of a square wave by looking at the components with a spectrum analyzer.

In the communication field it is now possible not only to detect carriers, but to analyze the modulation components for modulation percentage, distortion of the transmitted signal, and signal-to-noise ratio, to name a few.

A designer or technician with a modern high frequency spectrum analyzer such as the 7L12 or 7L13 is capable of testing or evaluating practically any radio device up to the 1.8 GHz frequency limit of the analyzer.

The Tracking Generator

The tracking generator is a signal source that follows the tuning of the spectrum analyzer. This instrument combination is ideal for making frequency response measurements. Because of the narrow bandwidth of the spectrum analyzer, the noise floor of an amplifier or system is reduced, allowing measurements with a dynamic range in excess of 120 dB. The tracking generator can also be used for precise frequency measurements, and is especially useful for measuring low-level signals in the presence of other higher level signals. The tracking generator derives its signal from the spectrum analyzer by mixing a local oscillator in the generator with the sweeping oscillators in the spectrum analyzer. A tracking generator is locked to the analyzer and can, by design, be no better than the analyzer in stability or drift.

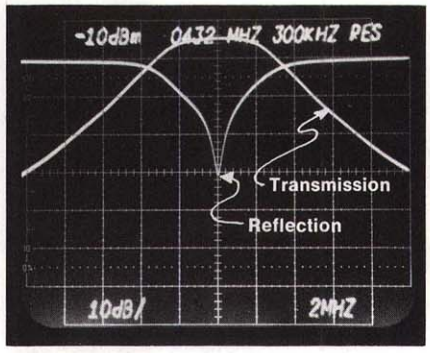


Fig. 8. Interdigital filter, passband response and return loss characteristics.

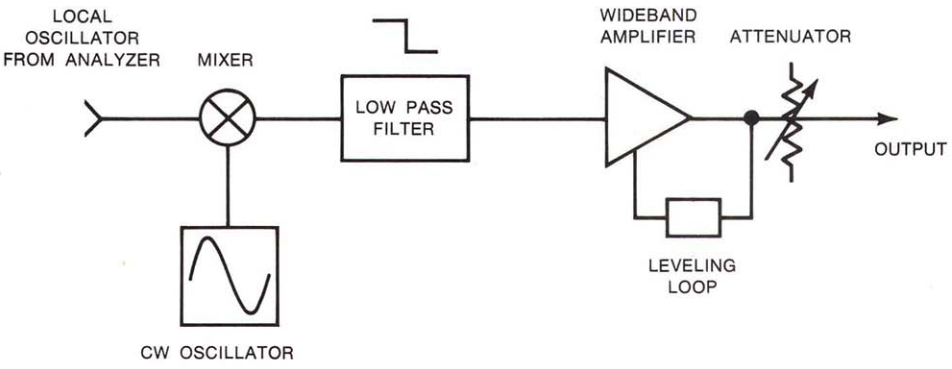


Fig. 7. Simplified block diagram of a tracking generator.

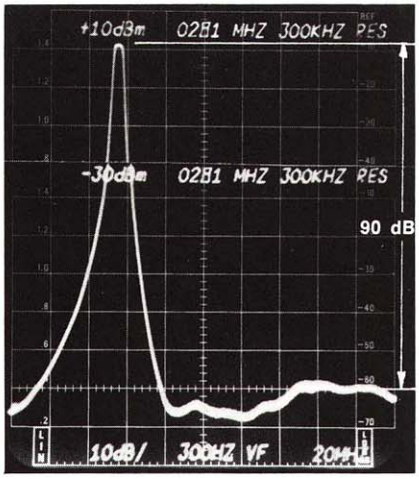


Fig. 9. Composite photo. High dynamic range, filter stop band attenuation measurement.

The New Generation

As spectrum analyzers are becoming more commonplace, they are becoming more useful as well. Many improvements are being made to increase the utility of the instrument. The 7L5 represents some of these improvements.

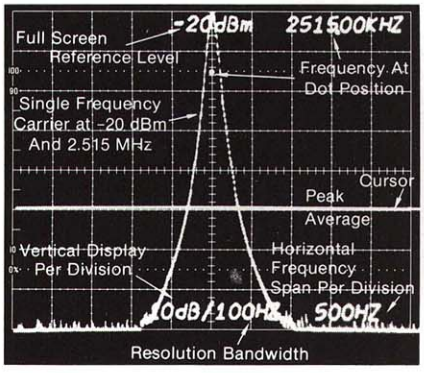


Fig 10. Spectrum analyzer display of unmodulated carrier.

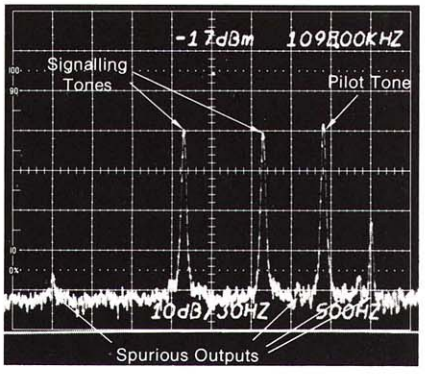


Fig 11. Illustrating pilot tone, signaling tones and spurious outputs.

Direct Frequency readout — the logical step in a truly calibrated instrument would be exact frequency selection. The 7L5 uses frequency synthesis to obtain center frequency readout with counter accuracy.

Digital storage — a true spectrum analyzer would display all frequencies at once without sweep effects such as flicker and distortion. The use of digital storage permits the closest approach yet to true theoretical spectrum displays of time and frequency.

Three-knob control — the true key to simple acceptance of spectrum analysis is simplicity and uncomplicated operation. The 7L5 offers true 3-knob control. Select the frequency, the span, and the input attenuation and the display is ready to view.

Stability — through the use of phase-locked oscillators and/or frequency synthesis, the analyzer can be used to measure the instability of the device under test. An important criterion of any analyzer would be the ability to turn on the unit and instantly, with no drift, be able to tune onto a signal. The 7L5 can be tuned almost immediately after turn-on and will remain tuned to the frequency selected indefinitely.

Choosing Your Analyzer

To be useful as a quantitative measuring tool, your analyzer must have these five major abilities:

1. Capable of calibrated amplitude measurements.

2. Capable of accurate frequency measurements.

3. Able to operate over a wide calibrated dynamic range.

4. Capable of adequate calibrated resolution.

5. Capable of sensitivity adequate for the measurements required.

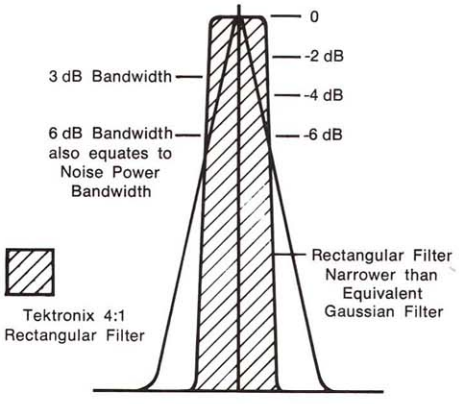


Fig 12. Comparison of the Tektronix exclusive rectangular filter shape factor to the widely used Gaussian filter.

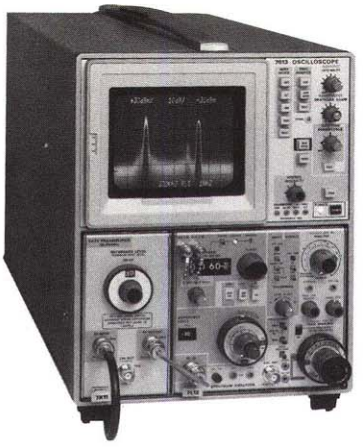


Fig 13. 7K11 Preamplifier Plug-in next to a 7L12 to increase the measurement sensitivity.

Additional important parameters include:
1. Portability
2. Flexibility
3. Method of display.

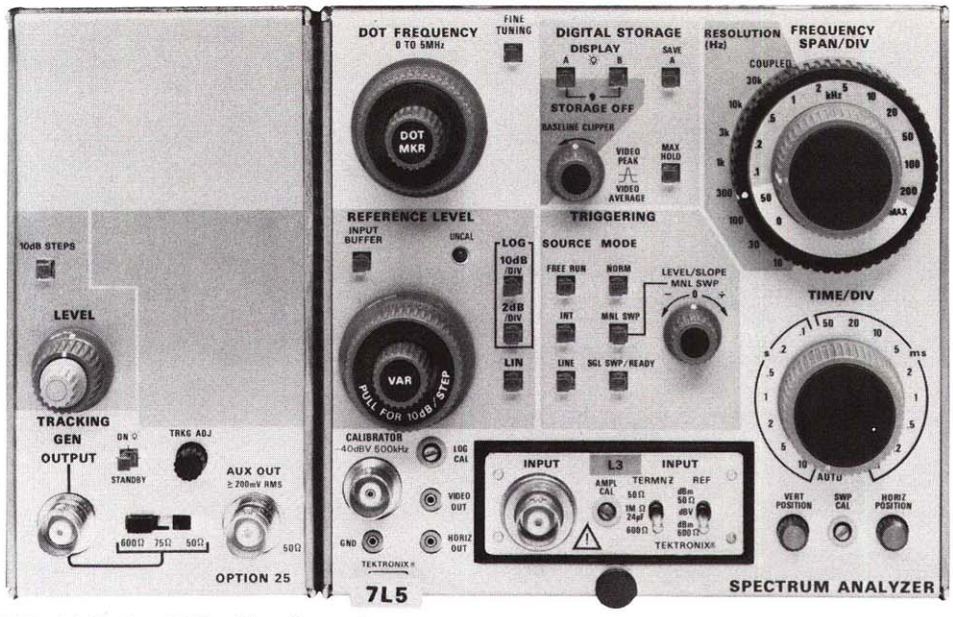
Closing

Spectrum analysis is still in its infancy—not because of present analyzer capability, but because of lack of acceptance as the powerful and universal measuring tool it is.

Tektronix has developed training programs and books to help speed this learning process, and we will continue. Application notes are available on a variety of subjects: Audio, Cable Television, Television, etc. A school lab program based around the spectrum analyzer with a demonstrative approach to Fourier analysis is available to schools to help train students to think in terms of frequency and amplitude.

Other industries are becoming aware of the need for spectrum analysis. One example is the computer industry, long thought of as a digital world. As the data rates increase in speed and system performance must be optimized, square waves and symmetrical pulses no longer behave as at slower speeds. As clocks jitter and transients become critical, a few far-looking pioneers are beginning to apply the long-overdue spectrum analyzers (with a great deal of success) to their problems.

Spectrum analysis is with us to stay, and the sky is the limit as far as applicability. Let a Tektronix specialist show you today how you can better perform your measurements with spectrum analysis.



7L5 with Option 25 Tracking Generator.

THREE-KNOB OPERATION makes the 7L5 the world's easiest-to-use spectrum analyzer.

SYNTHESIZER STABILITY for six-digit accuracy of center frequency setting with virtually no drift.

DIGITAL STORAGE & AVERAGING of display signals.

REFERENCE LEVEL SELECTION in 1 dB steps.

ABSOLUTE CALIBRATION in dBm, dBV or volts/div.

CHANGEABLE INPUT IMPEDANCE MODULES to accommodate any impedance requirement.

TRACKING GENERATOR for swept component measurements.

WIDE DYNAMIC RANGE and nanovolt sensitivity.

PRESET REFERENCE LEVEL for extra input protection.

CRT READOUT of all major parameters.

The 7L5 is a 5-MHz spectrum analyzer with exceptional frequency accuracy, achieved through a unique combination of synthesizer and digital technology.

Synthesizer stability and digital tuning let you set the center frequency with six-digit accuracy immediately after turn-on. There is no need to fine tune the displayed signal.

"Intelligence" makes the 7L5 easy to operate. Built-in processing decodes control settings, processes frequency and reference level information and optimizes sweep time and resolution for the chosen frequency span. At turn-on, the 7L5 is preset to a reference level of +17 dBm and a center frequency of zero. This provides input attenuation to protect the front end and a marker to verify correct operation.

The 7L5 has a full 80 dB spurious-free dynamic range for measuring wide relative amplitudes. Nanovolt sensitivity lets you measure very low-level signals and noise.

The front-panel input buffer control greatly increases front-end immunity to intermodulation, while maintaining a constant reference level.

The 7L5 is fully calibrated in dBm, dBV, or volts/div. The reference level can be set in 1 dB steps, eliminating the need to interpolate amplitude levels.

To accommodate a wide variety of input impedances, the 7L5 uses plug-in modules. Modules now available are the 50 Ω L1, 75 Ω L2, and 1 MΩ L3. The probe-compatible L3 offers selectable internal 50 Ω, 1 MΩ, or 600 Ω impedance. Special modules for any impedance can be provided.

Digital storage allows any 7000-Series Mainframe with crt readout to present clean, easy-to-photograph displays. The entire display is stored electronically and updated during each sweep. Two complete displays can be held in memory for comparison. Two display modes are available: a conventional peak display, or a digitally averaged display. For special measurements, such as signal-to-noise, these two modes can be used simultaneously by setting the continuously adjustable peak/average threshold, indicated with the crt cursor (see figure C). A maximum hold control lets you store maximum signal levels for checking long-term amplitude and frequency drifts.

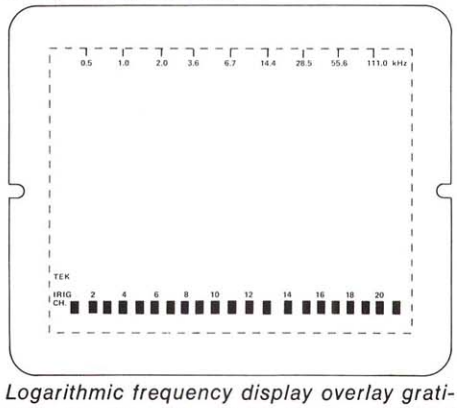
Crt readout displays center frequency, reference level, resolution bandwidth, dB per division, and frequency span.

The 7L5 has a triggerable time base for time-domain displays in zero-span modes.

7L5 Option 25 Tracking Generator

The 7L5 with Option 25 Tracking Generator, provides selectable 50 Ω, 75 Ω, or 600 Ω impedance source that has a calibrated output level for swept frequency tests from 10 Hz to 5.0 MHz. The output frequency can be adjusted so it tracks within 10 Hz of the spectrum analyzer frequency. The frequency span and rates are controlled with the spectrum analyzer. The output level is controlled from the tracking generator. Output level is calibrated and controlled in 10 dB and 1 dB steps over a 63 dB range. An Aux Output may be used to drive a frequency counter. The 7L5 with Option 25 is a three-wide unit for the 7000-Series mainframe.

7L5 Option 21 Logarithmic Frequency Display

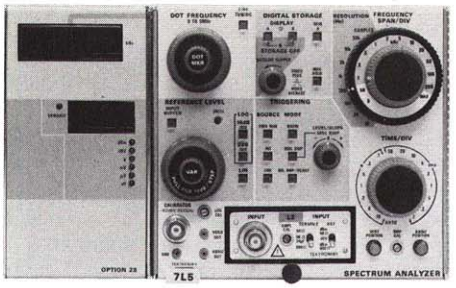


Logarithmic frequency display overlay graticule showing the position and assigned width of the 21 proportional bandwidth IRIG channels.

The 7L5 option 21 is a three-wide version of the normally two-wide 7L5 7000 Series plug-in spectrum analyzer. The additional compartment houses circuitry that generates a logarithmic frequency display covering all 21 proportional bandwidth IRIG telemetry channels. The nominal frequency range is 200 Hz to 200 kHz.

The logarithmic frequency display is generated in the digital storage memory by logarithmically compressing and combining the data from three separate linear sweeps each of which covers one decade of frequency. Consequently, the logarithmic frequency display requires the operation of digital storage. Resolution bandwidth and sweep time are automatically controlled to provide the fastest possible data acquisition consistent with amplitude calibration. A front panel control provides for normal operation of the 7L5.

7L5 Option 28 Front Panel Readout



The 7L5 Option 28 is a three-wide version of the normally two-wide 7L5 7000 Series plug-in spectrum analyzer. The additional compartment houses circuitry to provide LED front panel readout of center frequency and reference level. The front panel LED display is automatically disabled when operating in a mainframe that has CRT readout to avoid mutual interference. Option 28 is recommended for 7000 Series mainframes that have no provision for CRT readout such as 7603N11s.

Combined Options

All three options 21, 25, and 28 can be combined in one instrument. Options 25 and 28 can also be combined. Option 25 is available separately as a field modification kit to be attached to an existing 7L5. Options 21 and 28 can only be installed at the factory.

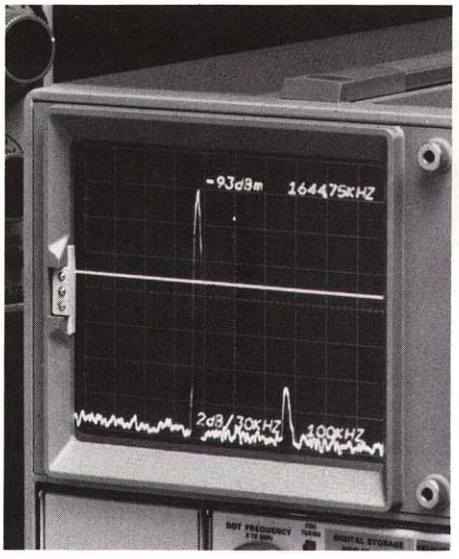


Figure A

Accuracy—The 1644.75-kHz center frequency is identified by crt readout and marked by a dot on crt. Tuning the center frequency to position a signal on the dot marker allows you to read the signal frequency with 6-digit resolution.

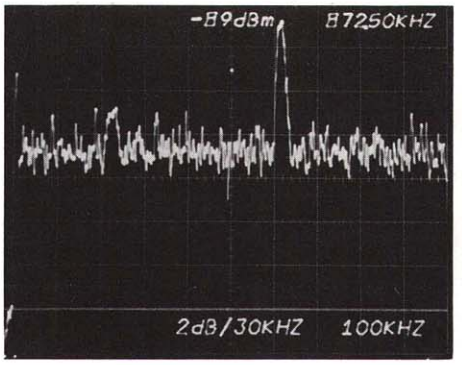


Figure B

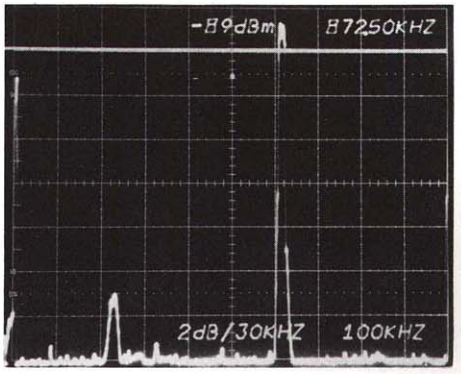


Figure C

Digital Averaging — Figures B and C show two small signals in the presence of noise. In Figure B, both signal and noise are peak detected (peak/average cursor is one division from the bottom of the crt). The smaller signal (which appears to be about —94 dBm) is almost completely obscured because the amplitude of the display is really the level of signal and noise combined. In Figure C the noise is digitally averaged (peak/average cursor is one division from the top of the crt). The noise level is reduced, showing the signals more clearly and giving a true indication of the small-signal amplitude at —102 dBm.

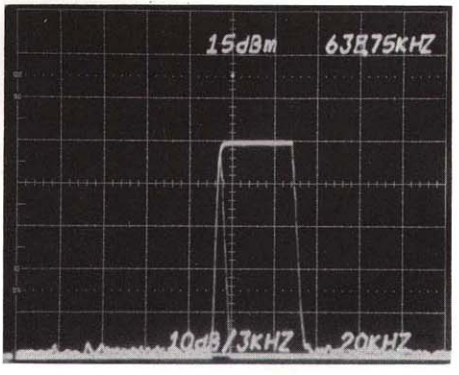


Figure D

Maximum Hold — The 7L5 maximum hold function lets you check for signal drift. It is also useful for detecting short-duration signals. In this mode, the maximum amplitude at any frequency is stored and displayed even if the signal is only there for an instant. Figure D shows a split memory display with MAX HOLD on. The flat top pedestal shows the frequency excursion of an oscillator as it shifted about one and one half divisions across the screen.

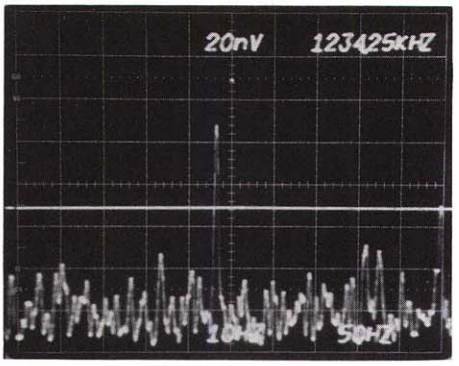


Figure E

Low Noise—The 7L5 has exceptionally low noise. This is illustrated in Figure E which shows the noise floor of the L3 at 1 MΩ input impedance. The 100 nV signal is well above the instrument noise level.

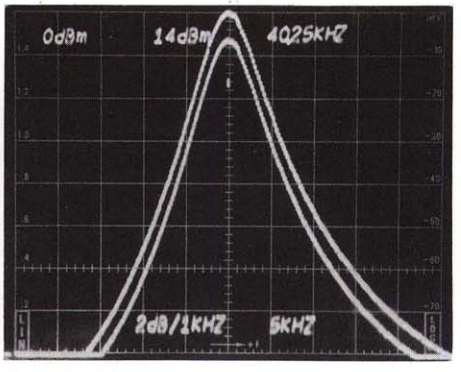
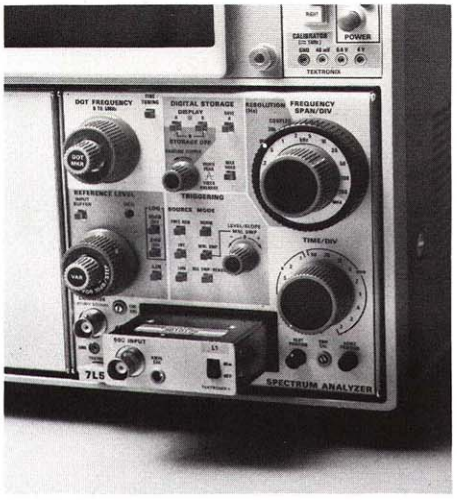


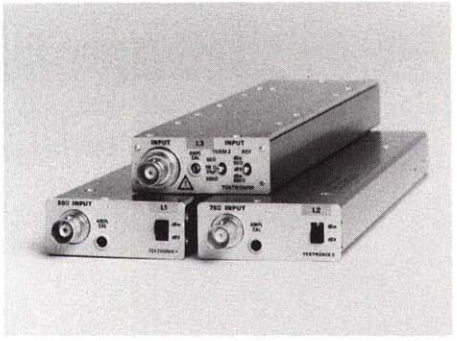
Figure F

Tracking Generator—Here the tracking generator (Option 25) is used in conjunction with split memory storage to align a narrow-band amplifier. A known-to-be-good sample (upper trace) is swept and stored in memory "A". The frequency response of the amplifier under test is displayed on memory "B" (lower trace). The amplifier under test can now be adjusted for the same response as the sample. This would be shown by merging of the two traces. Other data indicated is: tracking generator output level of 0 dBm, amplifier output level is +14 dBm (gain of 14 dB), center frequency is 40.25 kHz.



The 7L5 with L1 50 Ω input impedance plug-in module.

Changeable modules permit the 7L5 user to adapt to new measurement requirements. Modules now available are the 50 Ω L1, 75 Ω L2, and 1 MΩ L3. The probe-compatible L3 offers selectable internal 50 Ω, 1 MΩ, or 600 Ω impedance.



The module you select calibrates displays for the impedance in use.

7L5 CHARACTERISTICS

The following characteristics and features apply to the 7L5 Spectrum Analyzer and its options. They are applicable over the environmental specification criteria for the 7000-Series mainframe.

FREQUENCY CHARACTERISTICS

Range — Input frequency range is 10 Hz through 5.0 MHz. Dot frequency range is 0 Hz through 4999.75 kHz tuned in 250 Hz steps. Dot accuracy: 0°C to 50°C ±(20 Hz + 10^{-5} of dot frequency); 20°C to 30°C ±(5 Hz + 2X 10^{-6} of dot frequency).

Drift — Frequency drift is ≤ 5 Hz/hour.

Residual Incidental Fm — Residual fm is ≤ 1 Hz (p-p) for frequency spans of 50 Hz/div to 2 kHz/div. Residual fm is ≤ 40 Hz (p-p) for frequency spans of 5 kHz/div to 500 kHz/div.

Resolution Bandwidth — 8 resolution bandwidths range from 30 kHz to 10 Hz. COUPLED switch position electronically couples resolution to span/div selection so that both are controlled by the same knob. Bandwidth accuracy @ 6 dB down is within 20% of selected resolution. Shape factor (60:6 dB ratio) is 10:1 or better for 10 Hz to 1 kHz and 5:1 or better from 3 kHz to 30 kHz. Amplitude change between resolution bandwidths is ≤ 0.5 dB for 30 kHz — 100 Hz and ≤ 2.0 dB for 30 kHz — 10 Hz.

SWEEP CHARACTERISTICS

Frequency Span—Provides calibrated frequency spans from 50 Hz/div to max (500 kHz/div) within 4% in 1-2-5 sequence.

Horizontal linearity is within 4% over the entire 10 div display.

A 0-Hz/div position is provided for time domain operation.

Sweep Rate — Time per div is selectable from 10 s/div to 0.1 ms/div in 1-2-5 sequence. An AUTO position permits automatic selection of optimum time/div depending on resolution and span/div settings.

Sweep rate accuracy is within 5% of the rate selected.

Triggering — Provides two triggering sources, INT (internal) and LINE, in addition to a FREE-RUN position.

When INT is selected, ac coupled signal components from the mainframe trigger source (left or right vertical amplifiers) are used.

When LINE is selected, ac coupled sample of mainframe ac line voltage is used.

Three triggering modes are NORM (normal), SGL SWP/READY (single sweep), and MNL SWEEP (manual sweep).

Trigger level is ≥1.0 div of internal signal for both NORM and SGL SWP modes over the approx frequency range of 30 Hz to 500 kHz.

OUTPUT CONNECTORS

Video Out — Front-panel pin jack connector supplies the video (vertical) output signal at an amplitude of 50 mV/div +5% (about the crt vertical center) with source impedance of 1 kΩ. (Analog signal prior to digitization for storage).

Horiz Out — A front-panel pin jack connector supplies horizontal output signal (negative-going sawtooth that varies from about 0 to about −6 V dc with a source impedance of 5 kΩ).

Calibrator — Front-panel BNC connector supplies a calibrated 500 kHz square wave output signal (derived from the analyzer's time base). Output amplitude is within ±0.15 dB of −40 dBV into the plug-in impedance.

OPTION 25 TRACKING GENERATOR CHARACTERISTICS

Frequency Range — 10 Hz to 5.0 MHz.

Output Impedance — 50 Ω, 75 Ω, or 600 Ω selected by a front panel switch.

Amplitude — The output level is calibrated in dBm or dBV and selectable in 10 dB or 1 dB steps. A vernier provides continuous variation between calibrated steps.

Range —
50 Ω, 0 dBm to −63 dBm
75 Ω, −6 dBm to −69 dBm
600 Ω, −17 dBm to −80 dBm

Accuracy — (Max Output calibrated at 500 kHz.)
50 Ω, 0 dBm ±0.25 dBm
75 Ω, −6 dBm + 0.4, −0.2 dBm
600 Ω, −17 dBm + 0.5, −0.1 dBm

Attenuator —
Range: 0 to 63 dB in 10 dB or 1 dB steps.
Accuracy: Within 0.2 dB/dB to a maximum of 0.25 dB/10 dB absolute.

Flatness —
50 Ω and 75 Ω: Within 0.5 dB Peak to Peak.
600 Ω: Within 1.0 dB Peak to Peak.
Total System Flatness (7L5 with Option 25)
50 Ω and 75 Ω: Within 1.0 dB Peak to Peak.
600 Ω: Within 1.25 dB Peak to Peak.

Dynamic Range (7L5 with Option 25) — ≥110 dB.

Residual FM (peak-to-peak) —
Spans to 2 kHz/div: 2 Hz (7L5 with Option 25).
Spans 5 kHz/div or greater: 40 Hz (7L5 with Option 25).

Stability — Within 25 Hz over a one hour period after a 10 minute warmup.

Spurious Suppression, 10 Hz to 5.0 MHz (Harmonic and non-harmonic) — 40 dB or more with respect to the carrier.

Auxiliary Output — ≥200 mV rms into 50 Ω.

OPTION 21 LOG SWEEP (IRIG) CHARACTERISTICS

Logarithmic Display Frequency Range — 250 Hz to 222.25 kHz consisting of three combined linear sweeps.

Combined Linear Sweeps — 250 Hz to 2250 Hz, 2.25 kHz to 22.25 kHz, 22.25 kHz to 222.25 kHz, each displayed over one third the crt.

Nominal Resolution Bandwidth — 10 Hz @ 250 Hz input, increasing to 3 kHz @ 40 kHz to 222.25 kHz input.

Signal Acquisition Time for Full Screen Log Display — 2.5 sec max.

Stability — Drift and incidental fm same as ordinary 7L5 at each frequency.

Dot Frequency Display — Continually changing as linear sweep segments cycle through. The dot feature is not operational.

7L5 Controls — All except the vertical reference and MAX HOLD controls are disabled.

Option 21 Controls —
220 kHz IRIG (On-Off) — Normal 7L5 when "off", log frequency display when "on".

SWP INHIBIT—When "on", the instrument will finish the three linear sweeps to form a log display. Data will stay in memory to provide the equivalent of a single sweep function.

OPTION 28 FRONT PANEL READOUT CHARACTERISTICS

Provides front panel LED display of frequency and reference level when operating in a non-readout mainframe. LED display shuts off automatically when operating in a mainframe with crt readout.

CHARACTERISTICS WITH PLUG-IN INPUT IMPEDANCE MODULE

	L1	L2	L3
INPUT CHARACTERISTICS			
Input Impedance —	50 Ω	75 Ω	1 MΩ/28 pF (also 50 Ω and 600 Ω)
Input Power — Max input power for reference levels:			
above 0 dBm	+21 dBm		+21 dBm
below 0 dBm	+10 dBm		+21 dBm 100 V (peak ac + dc) @ 1 MΩ input z
AMPLITUDE CHARACTERISTICS			
Residual Response — Internally generated spurious signals (referred to input).	−130 dBm or less, −125 dBm for calibrator and harmonics		−143 dBV or less −138 dBV for calibrator and harmonics
Sensitivity — Equivalent input noise for each resolution bandwidth setting is measured in VIDEO AVERAGE mode with 10 s/div sweep rate and INPUT BUFFER control off. Equivalent input noise for resolution bandwidth of:	*(equal to or better than)		*(equal to or better than)
10 Hz	−135 dBm		−148 dBV
30 Hz	−133 dBm		−146 dBV
100 Hz	−130 dBm		−143 dBV
300 Hz	−125 dBm		−138 dBV
1 kHz	−120 dBm		−133 dBV
3 kHz	−115 dBm		−128 dBV
10 kHz	−110 dBm		−123 dBV
30 kHz	−105 dBm		−118 dBV
Sensitivity is further degraded 8 dB with INPUT BUFFER on. Noise level increases approx 10 dB operating in VIDEO PEAK mode.			
Intermodulation Distortion — Within any freuqency span, intermodulation products for two, on screen, signals			
of any input level: 3rd order products	at least 75 dB down		at least 75 dB down
2nd order products	at least 72 dB down		at least 72 dB down
of any input level up to −53 dBv/−40 dBm (50 Ω): 2nd and 3rd order products	at least 80 dB down		at least 80 dB down
of any input level with INPUT BUFFER on: 2nd and 3rd order products	at least 80 dB down		at least 80 dB down
Display Flatness — Peak-to-peak display variation over any frequency span.	0.5 dB max (Add 0.5% quantization error in digital storage)		0.5 dB max (25 Hz to 5 MHz) 0.75 dB max (20 Hz to 5 MHz) (Add 0.5% quantization error in digital storage)
On Screen Dynamic Range —	80 dB (full 8 div)		80 dB (full 8 div)
Reference Level** — In LOG mode, reference level refers to top horizontal graticule line. Calibrated in dB steps.	1-dB and 10-dB steps		1-dB and 10-dB steps
Range — LOG 2 dB/div mode	−128 dBm to +21 dBm		−141 dBV to +8 dBV
LOG 10 dB/div mode	−78 dBm to +21 dBm		−83 dBV to +8 dBV
LIN mode	20 nV/div to 200 mV/div within 5%, in 1-2-5 sequence		20 nV/div to 200 mV/div within 5%, in 1-2-5 sequence
Accuracy — When calibrated @ −40 dBV in LOG mode.	Within 0.2 dB/dB, to max of 0.25 db/10 dB change in reference level		Within 0.2 dB/dB, to max of 0.25 db/10 dB change in reference level

*Note: dBm = dBV −10 Log Z + 30 where Z = impedance
Example: dBV = [dBm (600 Ω) — 2.22]

**Note: A > sign is displayed by the reference level readout when the reference level is not calibrated and the UNCAL light is on. A < sign is displayed when the reference variable is out of its detent.

ORDERING INFORMATION

7L5 Spectrum Analyzer **$4650**
(Spectrum Analyzer Requires L Plug-in Module.)

Option 21 with Logarithmic Frequency Display . . . . . **Add $750**

Option 25 with Tracking Generator . . . . . **Add $1000**
For a separate tracking generator, (One-wide field modification to be attached to an existing 7L5) order 040-0810-00 . . . . . **$1025**

Option 28 with Front-Panel Readout . . . . . **Add $500**

Option 32 combines Options 25 and 28 . . . . . **Add $1300**

Option 33 combines Options 21, 25 and 28 . . **Add $1800**

Included Accessories — Graticule, Spectrum Analyzer 337-1159-02 (7000 Series), Filter, light blue 378-0684-00.

L1 Plug-in Module (50 Ω) **$450**

L2 Plug-in Module (75 Ω) **$450**

L3 Plug-in Module (1 MΩ) **$750**

***7603 Oscilloscope** **$1850**

***R7603 Oscilloscope (Rackmount)** **$2050**

Option 06 Internal S A Graticule . . . . . **No charge**

Option 08 Protective Front Cover (Cabinet Only) . . . . . **Add $100**

***7704A Oscilloscope** **$2900**

***R7704 Oscilloscope** **$3900**

Option 06 Internal S A Graticule . . . . . **No charge**

*Suggested Mainframe. See 7000 Series pages for oscilloscope specifications and options.

OPTIONAL ACCESSORIES

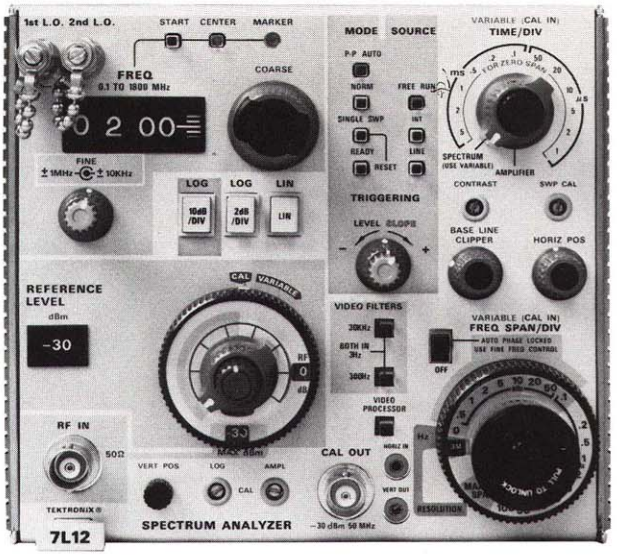
Tracking Generator, one wide field modification kit, to be attached to an existing 7L5 040-0810-00 . . . . . **$1025**

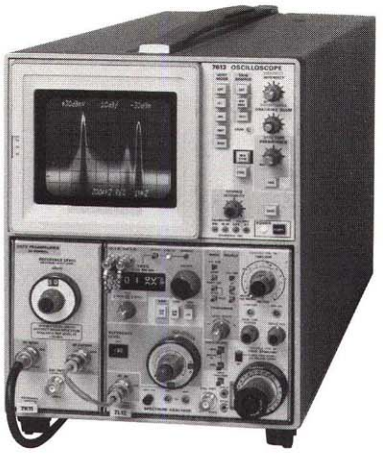
2701 50 Ω Step Attenuator **$260**

2703 75 Ω Step Attenuator **$295**

75 Ω to 50 Ω Min Loss Attenuator (Ac Coupled) 011-0112-00 . . . . . **$35**

P6105 10X Probe, (2m) 010-6105-03 . . . . . **$64**





The 7L12 is shown in a 7613 Variable Persistence Mainframe with 7K11 CATV Preamplifier for extra sensitivity.

100 kHz to 1800 MHz in One Display

Fully Calibrated Displays

300 Hz to 3 MHz Resolution

4:1 Resolution Bandwidth Shape Factor

70 dB On Screen Dynamic Range

IM Distortion 70 dB below Full Screen

Spurious Free Operation

Automatic Phase Lock

—115 dBm Sensitivity

The 7L12 Spectrum Analyzer is a modern, high-performance, swept front-end type of analyzer covering the frequency range up to 1.8 GHz. The unit employs phase lock stability and an ample selection of resolution bandwidths in an economical field or laboratory instrument.

The unit has a 3 MHz resolution mode for accurate measurement of pulse phenomena; the zero-span mode may be used to present a demodulated display of a signal for time domain measurements. A 4:1 resolution bandwidth shape filter introduced by TEKTRONIX permits close-in measurements not possible with conventional filters. Noise measurements are also easily made due to the high sensitivity, video filters, and equivalent resolution and noise power bandwidth of the instrument.

The 7L12 fills two holes in any 3- or 4-hole 7000-Series Mainframe and features a complete time base so that other oscilloscope or time domain plug-ins may be used simultaneously. As with all 7000-Series Plug-ins, CRT READOUT will display the major parameters. For the 7L12, these include: reference level, dB/div, frequency span, and resolution.

7L12 CHARACTERISTICS

FREQUENCY CHARACTERISTICS

Range — 100 kHz to 1.8 GHz. (Useable below 100 kHz with degraded performance.)

Resolution Bandwidth — Resolution bandwidth selections from 300 Hz to 3 MHz. Shape factor 60 dB to 6 dB is 4:1 or better.

Stability — After 2 hour warm-up, within 50 kHz, over a one hour period at a fixed temperature, when phase locked. Within 100 kHz, when not phase locked, over a one hour period, at a fixed temperature.

Incidental Fm — 200 Hz (p-p) max when phase locked. 20 kHz (p-p) max when not phase locked.

AMPLITUDE CHARACTERISTICS

Reference Level Range — Calibrated levels in decade steps from −100 dBm to +30 dBm, within ±2 dB.

Log 10 dB/div:
−70 dB dynamic range. Accuracy ±0.1 dB/dB to a max of 1.5 dB.

Log 2 dB/div:
−14 dB dynamic range. Accuracy ±0.4 dB/2 dB to a max of 1.0 dB.

Linear:
— Provides a linear display, within 10%.

Cw Sensitivity — (Signal + noise = twice noise in LIN mode). −115 dBm at 300 Hz, −108 dBm at 3 kHz, −100 dBm at 30 kHz, −90 dBm at 0.3 MHz, −80 dBm at 3 MHz. Sensitivity may decrease 2 dB at 1.7 GHz and 4 dB at 1.8 GHz.

Flatness — ±1.5 dB over any frequency span.

Spurious Responses —

Residual — (No signal present at input) with input attenuation at 0 dB, ≤−100 dBm.

Intermodulation Distortion — Third order down 70 dB or more from two −30 dBm signals within any frequency span. Second order down 70 dB or more from two −40 dBm signals.

Mixed — All image, harmonic related, and out-of-band mixing responses are ≤70 dB down from a level of −30 dBm to the input mixer (0 dB input attenuation).

Dynamic Range — 70 dB. The VARIABLE control provides gain adjustment between any two 10 dB steps.

INPUT CHARACTERISTICS

Impedance — 50 Ω, nominal.

SWEEP CHARACTERISTICS

Frequency Span — 500 Hz/div to 100 MHz/div. A MAX SPAN position provides approx 1.8 GHz (180 MHz/div of span), and a 0 position provides fixed frequency operation for time domain display.

Sweep Modes and Rate — 10 ms/div to 1 μs/div.

Triggering — Trigger signal source can be external, internal, or line voltage.

OUTPUT CONNECTIONS

Calibrator — 50 MHz comb, −30 dBm at 50 Ω.

Vert Out — Approx 2 V full screen.

Horiz In — For use with chart recorder.

1st LO — For use with tracking generator or 1405 Sideband Analyzer.

2nd LO — For use with tracking generator.

ACCESSORIES

Included — Spectrum Analyzer Graticule. Clear plastic implosion shield with LOG, LIN, REF, and f (frequency) direction markings, 337-1439-01 for 7403N and 7603 Oscilloscopes and 337-1159-02 for other 7000-Series Oscilloscopes. Amber Light Filter: 378-0684-01; 50 Ω Coaxial Cable, with BNC connectors, 6 foot: 012-0113-00; BNC Male to N Female Adapter: 103-0058-00.

ORDERING INFORMATION

7L12 Spectrum Analyzer **$5300**

7603 Mainframe **$1850**

Option 08 Protective Front Cover . . . . . **Add $100**

Option 77 P7 Phosphor and Internal S A Graticule . . . . . **No charge**

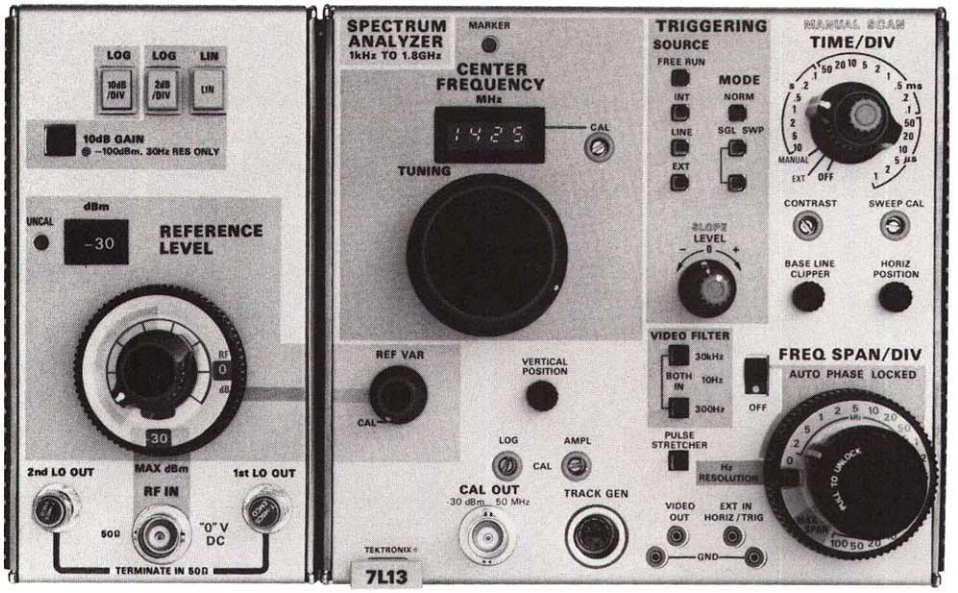
7613 Variable Persistence Mainframe **$2950**

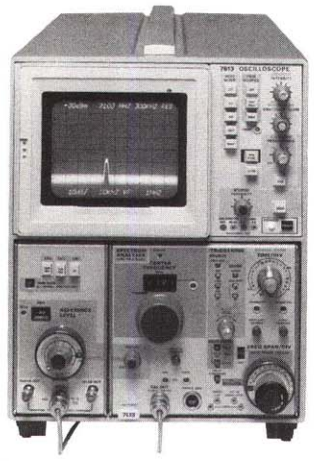
Option 06 Internal S A Graticule . . . . . **Add $50**

Option 08 Protective Front Cover . . . . . **Add $100**

Extended Frequency Range to 2.5 GHz. Ask about the modified 7L12.

7L13 | 1 kHz to 1800 MHz Spectrum Analyzer





The 2.5 GHz modified 7L13 in a 7613, a mainframe featuring variable persistence. Variable persistence is recommended for maximum utilization of the capabilities of the 7L13. Information is available upon request.

1 kHz to 1800 MHz in One Display

Fully Calibrated Displays

30 Hz to 3 MHz Resolution

4:1 Resolution Bandwidth Shape Factor

70 dB On Screen Dynamic Range

IM Distortion 70 dB below Full Screen

Spurious Free Operation

Automatic Phase Lock

−128 dBm Sensitivity

The 7L13 Spectrum Analyzer represents the highest performance possible today in an instrument of this frequency range and price. The fm stability is 10 Hz, making 30-Hz resolution possible across the entire frequency range.

This analyzer is a high quality laboratory instrument. In addition to incorporating the standard features of the 7L12, it has crt readout of the center frequency, and an UNCAL light to indicate incorrect settings of the sweep rate or resolution controls.

7L13 CHARACTERISTICS

FREQUENCY CHARACTERISTICS

Range — 1 kHz to 1.8 GHz.

Resolution Bandwidth — Resolution bandwidth selections from 30 Hz to 3 MHz. Shape factor 60 dB to 6 dB is 12:1 or better for 30 Hz resolution and 4:1 or better for 300 Hz to 3 MHz resolution.

Stability — After a 2 hour warm-up, within 2 kHz, over a one hour period at a fixed temperature, when phase locked. Within 100 kHz, when not phase locked, over a one hour period, at a fixed temperature.

Incidental Fm — −10 Hz (p-p) max when phase locked. 20 kHz (p-p) max when not phase locked.

AMPLITUDE CHARACTERISTICS

Reference Level Range — Calibrated levels in decade steps from −110 dBm to +30 dBm, within ±2 dB. An UNCAL indicator shows when excessive sweep speeds are selected.

Log 10 dB/div:
−70 dB dynamic range. Accuracy ±0.1 dB/dB to a max of 1.5 dB.

Log 2 dB/div:
−14 dB dynamic range. Accuracy ±0.4 dB/2 dB to a max of 1.0 dB.

Linear:
— Provides a linear display, within 10%.

Cw Sensitivity — (Signal + noise = twice noise in LIN mode) −128 dBm at 30 Hz, −115 dBm at 300 Hz, −108 dBm at 3 kHz, −100 dBm at 30 kHz, −90 dBm at 0.3 MHz, −80 dBm at 3 MHz. Sensitivity may decrease 2 dB at 1.7 GHz and 4 dB at 1.8 GHz.

Flatness — +1 dB, −2 dB over any frequency span.

Spurious Responses —
Residual — (No signal present at input) with input attenuation at 0 dB, ≤−100 dBm.

Intermodulation Distortion — Third order down 70 dB or more from two −30 dBm signals within any frequency span. Second order down 70 dB or more from two −40 dBm signals.

Mixed — All image, harmonic related, and out-of-band mixing responses are ≤70 dB down from a level of −30 dBm to the input mixer (0 dB input attenuation).

Dynamic Range — 80 dB when operating with 30 Hz resolution bandwidth. 70 dB with 300 Hz to 3 MHz resolution bandwidth. The VARIABLE control provides gain adjustment between any two 10 dB steps.

INPUT CHARACTERISTICS

Impedance — 50 Ω, nominal.

SWEEP CHARACTERISTICS

Frequency Span — Calibrated steps in 1-2-5 sequence from 200 Hz/div to 100 MHz/div. A MAX SPAN position provides approx 1.8 GHz (180 MHz/div of span), and a 0 position provides fixed frequency operation for time domain display.

Sweep Modes and Rate — Selection of an external sweep source, manual sweep, or calibrated time base, 10 s/div to 1 μs/div.

Triggering — Trigger signal source can be external, internal, or line voltage.

OUTPUT CONNECTIONS

Calibrator — 50 MHz comb, −30 dBm at 50 Ω.

Video Out — Approx 2 V full screen.

Horiz In — (and Trig) For use with chart recorder.

Tracking Gen (Logic) — For use with tracking generator (5 V TTL).

1st LO — For use with tracking generator or 1405 Sideband Analyzer.

2nd LO — For use with tracking generator.

ACCESSORIES

Included — Spectrum Analyzer Graticule. Clear plastic implosion shield with LOG, LIN, REF, and f (frequency) direction markings, 337-1439-01 for 7403N and 7603 Oscilloscopes and 337-1159-02 for other 7000-Series Oscilloscopes. Amber Light Filter: 378-0684-01; 50 Ω Coaxial Cable, with BNC connectors, 6 foot: 012-0113-00; BNC Male to N Female Adapter: 103-0058-00.

ORDERING INFORMATION

7L13 Spectrum Analyzer **$7850**

7603 Mainframe **$1850**

Option 08 Protective Front Cover . . . . . **Add $100**

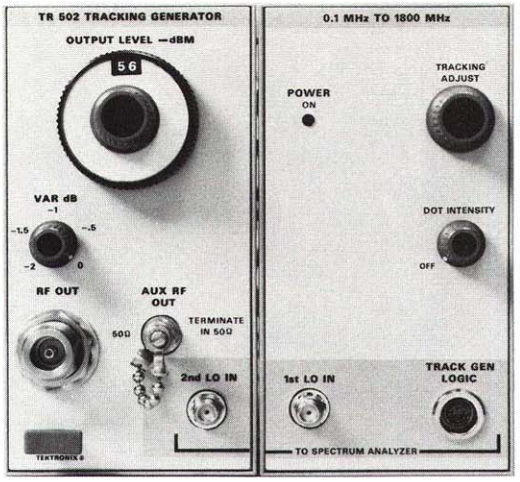
Option 77 P7 Phosphor and Internal S A Graticule . . . . . **No Charge**

7613 Variable Persistence Mainframe **$2950**

Option 06 Internal S A Graticule . . . . . **Add $50**

Option 08 Protective Front Cover . . . . . **Add $100**

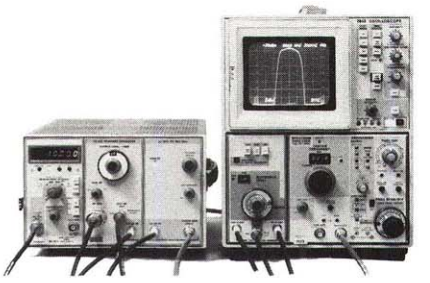
Extended Frequency Range to 2.5 GHz. Ask about the modified 7L13.



TR 502 Tracking Generator.

The TR 501 or TR 502 are capable of the same performance with either the 7L12 or 7L13 Spectrum Analyzer.

The TR 502 is recommended for use with the 7L13 because of the provisions for dot marker function with the 7L13 only. The TR 501 is recommended for use with the 7L12 for cost effectiveness.



The TR 502 Tracking Generator is used with the TEKTRONIX 7L13 Spectrum Analyzer to make swept frequency tests and precise frequency measurements.

Wide Frequency Range — 100 kHz to 1.8 GHz

System Stability
10 Hz (TR 502 w/7L13)
200 Hz (TR 501 w/7L12)

Flatness — ±0.5 dB
±2.0 dB (TR 502/7L13)
±3.0 dB (TR 501/7L12)

Resolution
30 Hz (TR 502 w/7L13)
300 Hz (TR 501 w/7L12)

Plus — TR 502 Has Automatic Counter Dot Marker When Used with DC 502 and 7L13

The TR 502 and TR 501 Tracking Generators work with either the 7L13 or 7L12 Spectrum Analyzers to provide constant level, calibrated rf sources for swept frequency tests to 1800 MHz.

When used as a cw source, with the analyzer in a zero span (nonswept) mode, the TR 502/7L13 system has 10 Hz stability. (The TR 501/7L12 system has 200 Hz stability.) This exceptional stability enhances the dynamic range capability of the analyzer/tracking generator combination.

The Tracking Generator Aux RF output may be used to drive a frequency counter. Frequencies up to 1800 MHz may be measured accurately in the presence of high level adjacent signals to the sensitivity limits of the analyzer. TR 502/7L13 sensitivity is −128 dBm at 30 Hz resolution bandwidth. (TR 501/7L12 sensitivity is −115 dBm at 300 Hz resolution bandwidth.) When the TR 502 is used with the 550 MHz DC 502 Frequency Counter the spectrum display center frequency, indicated by a bright dot, is automatically counted.

The Tracking Generator sweep rates are controlled with the spectrum analyzer, and the output level is controlled from the Tracking Generator. The output frequency of the Tracking Generator is the same as the frequency of the analyzer at any instant of the sweep.

The Tracking Generator is a two-wide unit compatible with the TM 500 Modular Instrument Series. When powered by a TM 503, there is room for a 550 MHz DC 502 or other counter.

CHARACTERISTICS

apply to both the TR 502/7L13 and TR 501/7L12 except where noted.

FREQUENCY CHARACTERISTICS

Range — 0.1 MHz to 1800 MHz.

Resolution Bandwidth — 30 Hz to 3 MHz (TR 502/7L13). 300 Hz to 3 MHz (TR 501/7L12).

Stability — 10 Hz p-p (TR 502/7L13). 200 Hz p-p (TR 501/7L12).

AMPLITUDE CHARACTERISTICS

Rf Output Amplitude — 0 dBm to −59 dBm in 10 and 1 dB steps plus 2 dB vernier (TR 502). 0 dBm to −11 dBm in 1 dB steps plus 2 dB vernier (TR 501).

Auxiliary Output Level — 0.1 rms in 50 Ω.

Flatness — ±0.5 dB (Tracking Generator only). ±2.0 dB (TR 502/7L13). ±3.0 dB (TR 501/7L12).

Spurious Output —
Harmonic: >20 dB below carrier.
Nonharmonic: >40 dB below carrier.

Dynamic Range — >110 dB (TR 502/7L13). >100 dB (TR 501/7L12).

SWEEP CHARACTERISTICS

Frequency Span — 200 Hz/div to 180 MHz/div (TR 502/7L13). 500 Hz/div to 180 MHz/div (TR 501/7L12).

OUTPUT CONNECTORS

Rf Out — 50 Ω nominal impedance, vswr 2:1 or less.

Aux Rf Out — For use with frequency counter.

Note about Mainframes, Phosphors, and Graticules — 7000-Series Mainframes, except storage versions, are normally shipped with P31 phosphor. Slow swept displays sometimes are more easily viewed with P7 phosphor (an option with most mainframes). External spectrum analyzer graticules for 7000-Series Mainframes come with the units (see included accessories). See mainframe specification for availability of crt option with internal spectrum analyzer graticules. Storage mainframe is recommended for high resolution displays or variable persistence.

Included Accessories — Two 50 Ω coaxial cables 012-0649-00, logic interface cable (TR 502 only) 012-0648-00, adapter N male to BNC female 103-0045-00, retainer plug-in 343-0604-00 fixed 10 dB attenuator with 3 mm fittings 307-0553-00 (TR 501 only).

ORDERING INFORMATION

TR 502 Tracking Generator $4650

Suggested Complementary Items

TM 503 Option 07 Power Module $185

DC 502 Option 07 (Includes Option 01 High Stability) Digital Counter $1195
or
016-0195-01 Blank Panel $7.50

TR 501 Tracking Generator $3675

Suggested Complementary Items

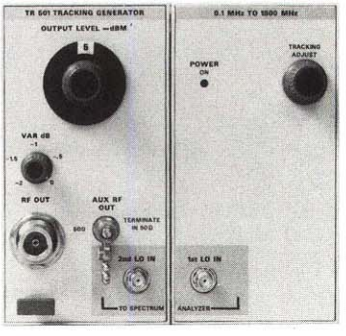
TM 503 Power Module $160

DC 502 Digital Counter $995

Blank Panel 016-0195-01 . . . . . $7.50

14 dB, 3 mm attenuator 015-1002-00
(used in the 2nd L.O. input line to improve TR 501/7L12 isolation) $120

Note: Existing 7L12 Spectrum Analyzers, if not already factory equipped for use with the TR 501, may be modified at a customer cost of $400 FOB Beaverton, Oregon.



TR 501 Tracking Generator.

1405 | TV Sideband Adapter

Response of Transmitter under Test within ±0.2 dB

Frequency Response of Rf and If Circuits for Transmitters with Frequency to 1 GHz

Video Circuits Can Be Swept

For In-service Testing, Use of External Blanking Allows Either Full-field or Single-line Operation

Check Aural Fm Deviation with Built-in Bessel NULL Technique

Flexible Marker System Will Accept Standard Crystals

1405/7L12 Sideband Analyzer

To analyze the sideband response of a television transmitter, the 1405 is used with a spectrum analyzer, such as the 7L12 or 7L13. The 1405 generates a composite video signal, the "picture" portion of which is a constant-amplitude sinusoidal signal that sweeps 15-0-15 MHz. This signal is applied as modulation to a television transmitter; the output is then displayed on the spectrum analyzer, and appears as the response curve of the transmitter under test. The 1405/ spectrum analyzer combination will display the frequency response characteristics of rf and if circuits for transmitters with frequencies to 1 GHz. Video circuits (zero frequency offset) can also be analyzed.

Complete specifications and prices are available in the Television Products Catalog.

ORDERING INFORMATION

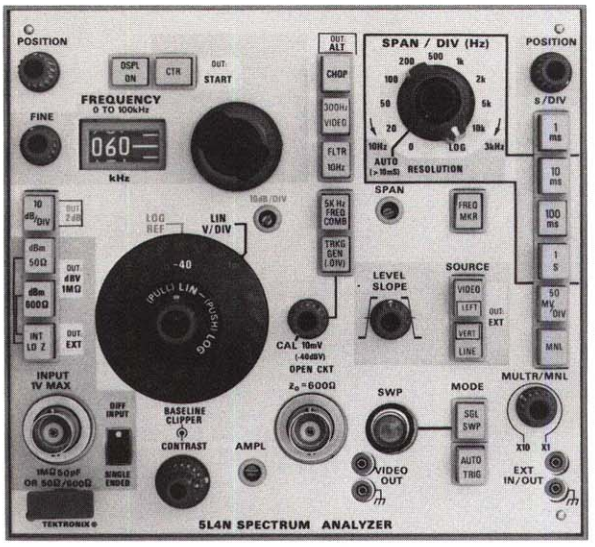
1405 NTSC TV Sideband Adapter $2850

Option 01 PAL TV Sideband Adapter . . . . . Add $100

OPTIONAL ACCESSORIES

Rackmount-conversion kit for mounting 1405 or 1405 Option 01 in std. 19 inch rack. 016-0489-00 . . . . . $120

5L4N | 0 to 100 kHz Spectrum Analyzer



0 to 100 kHz

Selectable Impedance

Calibrated Appropriate to Impedance Selected

Single-Ended Input

Differential (Balanced) Input

On Screen Dynamic Range 80 dB (Full 8 div)

Intermod >70 dB Down

Resolution Bandwidth 10 Hz to 3 kHz

Auto Resolution

Built-in Tracking Generator

20 Hz to 20 kHz Log Sweep*

The 5L4N is a 0- to 100-kHz spectrum analyzer that offers both high performance and economy. The analyzer features selectable input impedances, 80 dB of dynamic range, and a built-in tracking generator.

This analyzer is especially suited for noise and distortion studies in the audio range and comes equipped for 20 Hz to 20 kHz log sweeps.

Many educators prefer this economical analyzer to teach frequency-related theory and demonstrate practical application in the areas of speech, sound, music, vibration, audio, broadcasting, and many others.

The 5L4N can be used with any 5000-Series Oscilloscope Mainframe. Only two compartments are occupied by the analyzer so that, with the addition of a vertical plug-in, basic oscilloscope functions may be obtained. We recommend the use of a 5111 Storage Oscilloscope for maximum utilization of the analyzer.

**100 Hz to 100 kHz also available.*

FREQUENCY CHARACTERISTICS

Range — 0 to 100 kHz. Accuracy ±3 kHz (fine tune control midrange and span/div calibrated for 10 kHz).

Resolution Bandwidth — The resolution bandwidth is continuously variable from 3 kHz to 10 Hz. An AUTO mode provides the best resolution for the frequency scan and sweep rate selected. Signal level change over the resolution bandwidth range is 2 dB or less. Line frequency modulation of 50 Hz or more can be resolved up to 70 dB below the signal level. In the log sweep mode the resolution bandwidth changes with frequency giving an effect similar to octave bandwidth sweeps.

Stability — Within 30 Hz over a 10 min period, at a fixed ambient temperature.

Incidental Fm — 2 Hz (p-p) or less.

AMPLITUDE CHARACTERISTICS

Reference Level Range —

Log 10 dB/div:
from −10 dBm/dBV to −70 dBm/dBV, within 0.4 dB/10 dB to max of 1 dB at −70 dBm/dBV.

Log 2 dB/div:
from −10 dBm/dBV to −130 dBm/dBV within 0.4 dB/10 dBV to max. 1.0 dB at −70 dBm/dBV and 2 dB at −130 dBm/dBV.

Linear:
from 50 mV/div to 20 nV/div within 5% decade.

Cw Sensitivity (Signal Level + Noise = 2X Noise) — The following characteristics are applicable with the input internally terminated, or with a 600 Ω or less source impedance.

	Resolution Bandwidth	
Display Mode	**3 kHz**	**10 Hz**
dBV	−123 dBV	−147 dBV
dBm 50 Ω	−110 dBm	−134 dBm
dBm 600 Ω	−121 dBm	−145 dBm
LINEAR	680 nV	45 nV

Flatness (20 Hz-100 kHz) — Flatness remains within ±0.2 dB, over any selected frequency span, with respect to the level of −40 dBV signal at 5 kHz. Intermodulation Distortion — with two signals, within any frequency span, that are less than or equal to the reference level:

−10 dBm/dBV	≥70 dB down
≤ −20 dBm/dBV	≥75 dB down

Internal Spurious Signals — Equal to or less than −130 dBm/dBV referred to the input. Line related spurii less than −120 dBm/dBV.

Dynamic Range — 80 dB (8 div).

INPUT CHARACTERISTICS

Selectable Impedance — 1 MΩ/47 pF or 600 Ω or 50 Ω (single-ended or differential).

Differential Input Characteristics — Full screen limit is approx 300 mV to 400 mV. Common-mode rejection ratio is 70 dB or more.

Single Ended Input Characteristics — Max single input for linear operation: −10 dBm/dBV or 0.316 V rms.

SWEEP CHARACTERISTICS

Linear Frequency Span — 20 Hz/div to 10 kHz/div, 10-5-2 sequence. 4% accuracy.

Log Frequency Span — 100 Hz to 100 kHz internally reprogrammable from 20 Hz to 20 kHz.

Zero Frequency Span — Analyzer operates as a fixed tuned receiver for time-domain displays.

Internal Sweep Sources — Time base 1 s/div to 1 ms/div (increased up to X10 with multiplier).

Triggering — Internal at least 0.1 div, External at least 250 mV. Slope and level selection are provided. Auto Trigger provides a sweep baseline when a trigger signal is absent. Single sweep provided.

Manual Sweep — Provided.

External Sweep — Requires 0 V to 500 mV ±50 mV; from a 1 kΩ or less source to sweep the full span.

OUTPUT CONNECTIONS

Tracking Generator — 600 Ω source. Calibrated output level is −40 dBV ±0.2 dB (10 mV) open circuit, or −46 dBV when terminated into 600 Ω. Output level can be varied from approximately 0.001 V to 0.1 V open circuit.

5 kHz Freq Comb — 600 Ω source of 5 kHz ±0.005% markers for span calibration.

Video Out — Provides 250 mV ±5% of video signal per display div (0 V to 2 V). Source impedance is about 1.0 kΩ.

Ext In/Out — Provides 500 mV ±25 mV, per div of span, from 0 to 5 V, when using internal or manual sweep.

INCLUDED ACCESSORIES

013-0156-00 Adapter, Floating BNC to Dual BNC. 175-1178-00 BNC to Pin Jack Adapter Cable. 331-0429-00 Log Graticule (20 Hz-20 kHz).

ORDERING INFORMATION

5L4N Spectrum Analyzer $2650

We recommend that the Plug-in 5L4N be ordered with a storage mainframe.

5111 Storage Oscilloscope (Cabinet) $1300

Option 02 Protective Front Cover . . . . . Add $20

R5111 Storage Oscilloscope (Rackmount) $1350

OPTIONAL PLUG-INS FOR TIME DOMAIN USE

5A15N Single Trace Amplifier $175

5B10N Time Base Amplifier $275

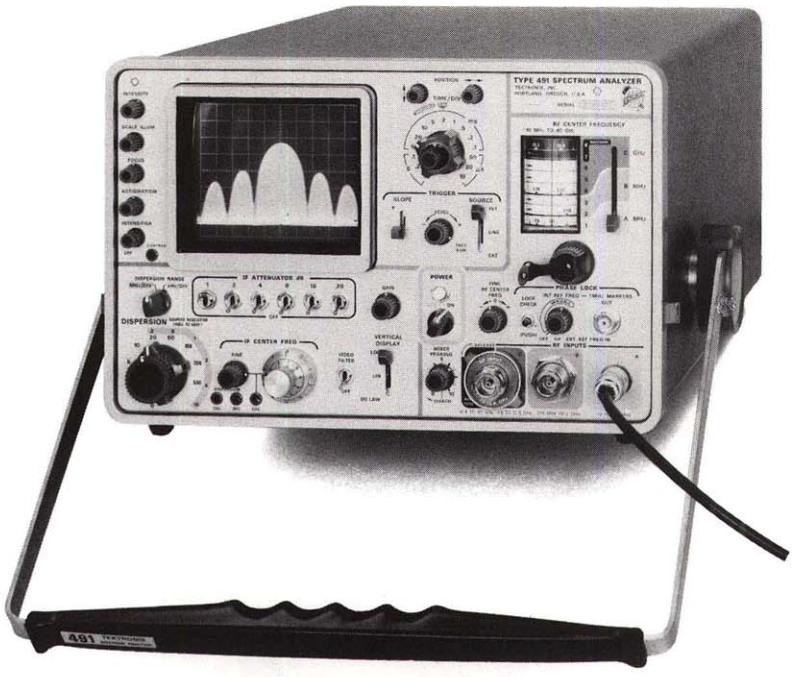
OPTIONAL ACCESSORIES

010-0160-00 10 x Probe P6006 (6 ft.) $42

016-0195-00 Blank Plug-in Panel $7.50

2701 Step Attenuator (50 Ω) $260

011-0093-00 Step Attenuator (600 Ω) $140



10 MHz to 40 GHz 491
10 MHz to 2 GHz . . . . . 491 Option 01
1.5 GHz to 40 GHz . . . . . 491 Option 02

The 491 is a precision, wide-band spectrum analyzer designed for rugged environmental conditions and easy mobility. It is easy to carry, weighing less than 40 pounds complete with accessories. The R491 is electrically identical and requires only 7 inches of rack height.

FREQUENCY CHARACTERISTICS

Range

10 MHz to 40 GHz

Option 01
10 MHz to 2 GHz

Option 02
1.5 GHz to 40 GHz

Resolution — 1 kHz to 100 kHz, coupled with calibrated dispersion positions but separately switchable.

Frequency Stability — ±200 kHz after 1 minute.

Incidental Fm — Less than 300 Hz at fundamental, with Phase Lock.

AMPLITUDE CHARACTERISTICS

Display Flatness — Max amplitude variation over 100 MHz dispersions up to 12.4 GHz is 3 dB or less, except over 50 MHz dispersion in Band 1. Above 12.4 GHz the max amplitude variation (100 MHz dispersion) is 6 dB or less.

Max Input Power — −30 dBm for linear operation, +15 dBm (25 mW) safe diode power limit.

Vertical Display (8 Div) — Log — ≥ 40 dB dynamic range. Linear, Square Law — ≥ 13 dB dynamic range.

If Attenuator — 51 dB in 1 dB steps, ±0.1 dB/dB.

If Gain Control — > 50 dB range.

Sensitivity — Greater than — 100 dBm to 8.2 GHz
Greater than — 90 dBm to 18 GHz
Greater than — 70 dBm to 40 GHz

INPUT CHARACTERISTICS

50 Ω Input

SWEEP CHARACTERISTICS

Sweep Range — The 491 uses a complete triggered oscilloscope type time base with 15 calibrated steps from 10 μs/div to 0.55/div.

Calibrated Dispersion — 1 kHz/div to 10 MHz/div in 1-2-5 sequence, 2 ranges (kHz/div and MHz/div).

CRT AND DISPLAY FEATURES

Crt — 8 x 10 div display area (each div = 0.8 cm); P7 phosphor.

ENVIRONMENTAL CAPABILITIES

The 491 meets MIL-I-6181D specs for EMI, operates up to 15,000 ft with temperatures from −15°C to +55°C and can stand a 30 g shock.

Weight —		
Rackmount	41 lb	18.6 kg
Portable	30 lb	13.6 kg

ORDERING INFORMATION

491 Spectrum Analyzer $7400

R491 Spectrum Analyzer (Rackmount) $7500

Option 01 (10 MHz to 2 GHz) . . . . . Subtract $1395

Option 02 (1.5 GHz to 40 GHz) . . . . . Subtract $1195

1105 Battery Power Supply $795

Additional specifications are available through your local Tektronix Field Office.

1401A
1401A-1

1 MHz to 500 MHz Spectrum Analyzers

50 or 75 Ω Input

1 to 500 MHz

Ac, Dc, or Battery

Portable, Lightweight

Built-in Calibrator

60 dB On Screen Dynamic Range

Gated Mode

The 1401A and 1401A-1 Spectrum Analyzer Modules are used with the SONY/TEKTRONIX battery-operated scope for measurements in the 1 to 500 MHz frequency range.

Because of its battery operation, the 1401A is popular with persons engaged in remote site studies, field maintenance, and applications where power is not convenient. The unit may be used for surveillance measurements by law enforcement officials and for displays and measurements important to radio, TV, and CATV operators, medical personnel, aircraft equipment personnel, shop owners, and others. In addition, the 1401A Module may be connected to any inexpensive scope to form an economical 500 MHz analyzer.

1401A Spectrum Analyzer Module

FREQUENCY CHARACTERISTICS

Range — Continuously selectable with 10-turn digital frequency readout control, 1 to 500 MHz. Absolute accuracy within ±5 MHz (+5% of dial reading). Fine control provides a calibrated variation of up to ±1 MHz, within 10%.

Resolution — 10, 100, 1000 kHz Gaussian-shaped Filter.

Frequency Stability — Within 100 kHz over any 5 minute interval after 25 minute warm-up and measurement at +20°C to +30°C ambient. Temperature coefficient ≤ 0.5 MHz/°C or less.

Incidental Fm — 20 kHz or less.

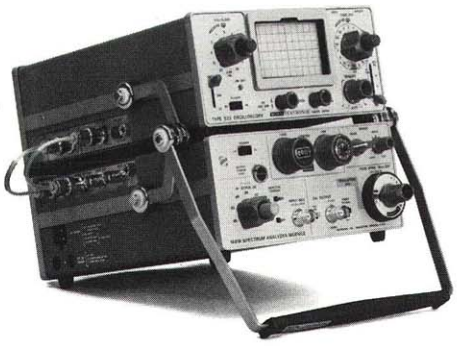
AMPLITUDE CHARACTERISTICS

Rf Attenuator — 0 to 60 dB in 10 dB steps (accurate within +0.2 dB + 1% of dB reading).

If Gain Control — At least 30 dB range.

Vertical Display — Linear and log.

Cw Sensitivity	1401A	1401A-1
10 kHz Resolution	≥ −95 dBm	≥ −40 dBmV
100 kHz Resolution	≥ −85 dBm	≥ −30 dBmV
1000 kHz Resolution	≥ −78 dBm	≥ −23 dBmV



1401A-1/323 Spectrum Analyzer System

Display Flatness — Measured with respect to the level at 50 MHz, ±0.75 dB to 200 MHz and within +0 dB to −3 dB from 200 MHz to 500 MHz.

Intermodulation Distortion — 1401A at least 55 dB down with two signals at −30 dBm (+25 dBmV 1401A-1), 1 MHz apart; 60 dB down with signals at −40 dBm (+15 dBmV 1401A-1).

Dynamic Range — At least 60 dB in log mode at 10 dB/div.

INPUT CHARACTERISTICS

Impedance — 1401A 50 Ω nominally. 1401A-1 75 Ω nominally.

SWEEP CHARACTERISTICS

Sweep Rate — Continuously variable from one sweep per second or less to at least 100 sweeps per second.

Frequency Span (Dispersion) — 50 MHz/div to 100 kHz/div in 9 steps (1-2-5 sequence), accurate within 10% over a 10 div display, plus 0-Hz span. Frequency span can be continuously varied (uncalibrated) from any calibrated value toward zero.

OTHER CHARACTERISTICS

Calibrator — −30 dBm 1401A. +25 dBmV 1401A-1. Accuracy 0.3 dB at 25°C

Power Source — 6 size C NiCd cells for 3½ hours of operation. External dc source: operates from an external dc source of 6 V to 16 V, requires 4.8 W. External ac source: operates from an external ac source of 90 to 136 V, or 180 to 272 V; 48 to 440 Hz, 14 W max 115 V ac.

Weight — 1401A or 1401A-1 and 323 Oscilloscope
15 lb 6.8 kg

ORDERING INFORMATION

1401A Included Accessories — 8 ft power cable assembly (161-0043-02); panel cover (200-0812-00); blue filter (378-0670-01); amber filter (378-0670-02); three 5½ inch, 50 Ω BNC to BNC cable assemblies (012-0113-00); screwdriver (003-0672-00); strap assembly (346-0051-00).

1401A **$3200**

1401A-1 Included Accessories — Same as for 1401A except: two BNC to F adapters (013-0126-00); change 6 ft, 50 Ω BNC to BNC cable assembly to 6 ft 75 Ω BNC to BNC cable assembly (012-0113-01).

1401A-1 . . . . . **$3300**

1401A/323 (P7 Phosphor) Included Accessories — Includes accessories for both the 1401A, 323, and a two-instrument handle conversion kit (040-0563-00).

1401A/323P7, Order 1401A-3 . . . . . **$4500**

1401A-1/323P7, Order 1401A-1-3 . . . . **$4600**

OPTIONAL ACCESSORIES

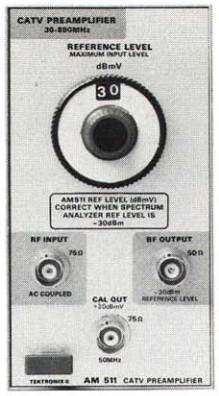
Protective Cover — Waterproof blue vinyl, **016-0112-00** **$15**

Handle Conversion Kit (for Two Instruments) — For combining an existing 323 Oscilloscope with 1401A or 1401A-1, for a system as shown, **040-0563-00** . . . **$65**

Power Pack — Extra power pack, in addition to the one supplied with the 1401A or 1401A-1, allows one power pack to charge while the other is powering the analyzer. An identical power pack is used in the 323.
016-0119-02 . . . . . **$200**

Adapter — BNC 75 Ω to 50 Ω impedance matching network. **011-0112-00** **$35**

Battery Set — Set of 6 NiCd cells **146-0012-01** **$28**



These plug-in preamplifiers are designed for spectrum analyzer applications where extra sensitivity is required. The 7K11 is a 7000-Series Plug-in while the AM 511 fits into the TM 500 Modular Series power supplies.

The amplifiers are tailored to the CATV and field intensity measurement markets providing a 75 Ω input impedance and calibration in dBmV. The low noise figure makes the preamplifiers well-suited for signal-to-noise and low-level radiation measurements.

CHARACTERISTICS
(with 7L12 and 7L13)

Frequency Range — 30 MHz to 890 MHz.

Display Flatness — ±1.0 dB, with respect to the level at 50 MHz over the frequency range of 50 MHz to 300 MHz; increasing to +2.0 dB, −2.5 dB over the full frequency range.

Sensitivity — Signal + noise = 2X noise, in LIN mode at 50 MHz. −90 dBmV at 30 Hz, −80 dBmV at 300 Hz, −73 dBmV at 3 kHz, −65 dBmV at 30 kHz, −55 dBmV at 300 kHz, −45 dBmV at 3 MHz. Noise figure is no greater than 5 dB.

Intermodulation Distortion (with 7L12 or 7L13) — Imd products and harmonics from two signals within the frequency range are 70 dB or more down from the reference level for: 1) third order intermodulation with two signals at the reference level (full screen), 2) second order intermodulation and harmonics with two signals 10 dB below the reference level.

Reference Level — Calibrated level in 1 dB steps from +79 dBmV to 0 dBmV. Accuracy is referenced to the +30 dBmV calibrator at 50 MHz.

Input Impedance — 75 Ω.

Calibrator — 50 MHz ±0.01% with an absolute amplitude level of +30 dBmV ±0.3 dB, from 75 Ω.

Accessories — BNC to BNC 50 Ω Cable, 5½ inch: 012-0057-01; BNC to F Adapter: 013-0126-00; BNC to BNC 75 Ω Cable, 42 inch: 012-0074-00.

7K11 CATV Preamplifier **$600**

AM 511 CATV Preamplifier **$600**

TM 501 Power Module for AM 511 . . . . . **$130**

The 2701 and 2703 Step Attenuators are laboratory quality, bench top instruments for attenuation of large value radio frequency signals. The 2701 50 Ω Attenuator is particularly useful in making receiver sensitivity and distortion measurements. The range of attenuation is 0 to 79 dB, selected in 1 dB steps with tens and units cam switches. A front-panel switch selects DC, AC, or DC TERM (a 50 Ω precision termination).

The 2703 75 Ω Step Attenuator is tailored for television, CATV, telephone, and radio applications. A front-panel switch extends the range to 109 dB, making the attenuator an ideal accessory for wide-range measurements such as cross modulation, signal-to-noise and receiver sensitivity. A dc block has been incorporated for both rear-panel ports to protect the attenuator against accidental burnout from high dc offsets or ac power on center conductors.

The board assemblies and thick-film hybrid attenuation chips used in both instruments are mounted in a sturdy metal housing; solid top and bottom plates provide excellent mechanical and electrical stability. The two cam switches which select individual chips operate through gold-plated switch contacts. Held on a four-layer circuit board with spring clips, the chip substrates can be replaced easily in the field.

The attenuators may be used for frequencies up to 2 GHz, with slight degradation of the attenuation accuracy and vswr characteristics specified at 1 GHz.

CHARACTERISTICS	2701	2703
Attenuation	0 to 79 dB in 1 dB steps	0 to 109 dB in dB steps (Including extra 30 dB range)
Impedance	50 ohms nominal	75 ohms nominal
Frequency	Dc to 1 GHz	3 kHz to 1 GHz*
Accuracy	Units Error +0.1 dB to −0.5 dB Max Error +1.0 dB to −0.7 dB	Units Error 500 MHz +0.1 −0.5 dB; 1000 MHz +0.1 −0.8 dB 79dB +0.9 −0.8 dB; 79 dB +1.4 −1.1 dB 109 dB +1.3 −1.0 dB; 109 dB +1.9 −1.3 dB
Insertion Loss @ 0 dB Setting	−(0.5 dB + 0.14 dB/100 MHz) or better	−(0.2 dB + 0.08 dB/100 MHz) or better
Return Loss	20 dB 10 −300 MHz (1.22 vswr) 17 dB >300 −600 MHz (1.32 vswr) 17 dB @ 1 GHz (1.32 vswr)	20.5 dB 10 −300 MHz (1.22 vswr) 15.5 dB >300 −600 MHz (1.48 vswr) 11.5 dB @ 1 GHz (1.78 vswr)
Max Average Input Power	1.5 W to 65°C	1.5 W to 65°C
Signal Coupling	Dc, ac, and dc terminated at one port only	Ac only both PORTS*
Size	7½ in lg x 4½ in w x 2½ in h	7½ in lg x 4½ in w x 2½ in h
Connector	Type BNC Female 50 ohm	Type BNC Female 75 ohm

**Blocking capacitors may be removed for specialized applications.*

ORDERING INFORMATION

2701 50 Ω Step Attenuator **$260**

2703 75 Ω Step Attenuator **$295**

600 Ω Attenuator. 51 dB in 1 dB steps
011-0093-00 . . . . . **$140**

Pads and Adapters

75 Ω to 50 Ω Minimum Loss Attenuator with dc block **011-0112-00** **$35**

75 Ω to 50 Ω Minimum Loss Attenuator with 11.25 dB conversion factor from dBm to dBmV **011-0118-00** **$43**

Fixed 10 dB attenuator with 3 mm fittings for use with TR 501/TR 502 with 7L12 **307-0553-00** **$25**

Dc Block BNC to BNC max dc potential 50 volts **015-0221-00** **$59**

"F" Female to BNC Male Adapter 013-0126-00.... **$10**

BNC Female to "F" Male 103-0158-00..... **$7.50**

Calibrator Jumper 50 Ω BNC to BNC 5½ in **012-0214-00** **$24**

Jumper Cable BNC to BNC 50 Ω, 42 in **012-0057-01** **$12**

Jumper Cable BNC to BNC 75 Ω, 42 in **012-0074-00** **$12**

"N" Female to BNC Male 103-0058-00..... **$6.50**

Protective Vinyl Covers

For extra protection in field environments, soft vinyl covers are available to fit over the entire cabinet model mainframe or instruments.

7000-Series 3 Hole Mainframe Cover 016-0192-01 ..... **$12**

7000-Series 4 Hole Mainframe Cover 016-0531-00 ..... **$12**

5000-Series Mainframe Cover 016-0544-00 ..... **$12**

491 Analyzer Cover 016-0074-01 ..... **$16**

1401A-323 Protective Cover 016-0112-00 ..... **$15**

Rigid Front Covers

Solid snap on or friction fit covers are available to protect the instruments in transit or field use.

See appropriate spectrum analyzer and mainframe ordering information regarding the Option 08 Protective Front Cover for 7603 and 7613, or the Option 02 Protective Front Cover for 5100 Series Mainframes.

491 Spectrum Analyzer — cover supplied, no charge with instrument.

1401A and 323 Analyzer Combination (2 required) **200-0812-00** **$5.75**

Graticules, Filters

Plastic Implosion Shield and S A Graticule 7613 and 7623 Mainframes **378-0625-07** **$4**

Plastic Implosion Shield and S A Graticule 7403 and 7603 Mainframes **337-1439-01** **$2.20**

Plastic Implosion Shield and S A Graticule All other 7000-Series Mainframes **337-1159-02**... **$3.50**

(Internal graticules are available with most 7000-Series Mainframes)

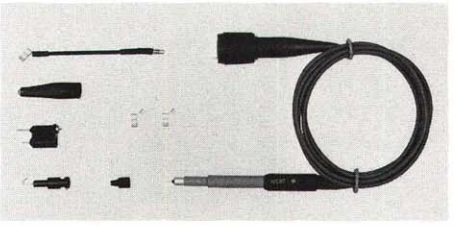
EMI Metal Screen Mesh Filter for 7500-, 7700-Series instruments **378-0603-00** **$25**

EMI Metal Screen Mesh Filter for 7400-Series instruments **378-0696-00** **$25**

Audio 20-20 kHz Log Graticule for 5000-Series instruments — **331-0429-00** **$1**

IRIG Log Graticule for 7L5 331-0421-00 ..... **$1**

Complete selection of colored filters is available in the accessories section.



Probes

A variety of probes is available in varying frequency and impedance ranges that can be used with the 7L12, 7L13, and 1401A Spectrum Analyzers:

FET Probe P6201 to 900 MHz 010-6201-01..... **$680**

FET Probe P6202 to 500 MHz 010-6202-01..... **$350**

Conventional Probe P6056 Dc to 3.5 GHz 6 ft. 010-6056-03 ..... **$99**

Conventional Probe P6057 Dc to 1.4 GHz with Adapter **010-6057-03**..... **$99**

Current Probe P6022 to 150 MHz 015-0135-00.... **$205**

Complete specifications are available in the probes and accessories section.

Cameras

A camera can greatly enhance the versatility of a spectrum analyzer. Many different units are available however, the most popular units for the 5000- and 7000-Series instruments are:

Polaroid Film Back C-59P **$660**

Polaroid Film Back C-5A **$250**

Complete specifications on all cameras are available in the cameras, probes, and accessories section.

Carrying Cases and Mounts

Specialized carrying cases are available in 2 forms to protect your spectrum analyzer.

Metal carrying cases are available for the 7L12 or 7L13 Plug-in units.

Military style fiberglass and foam type transit cases can be custom fitted to many of the instruments.

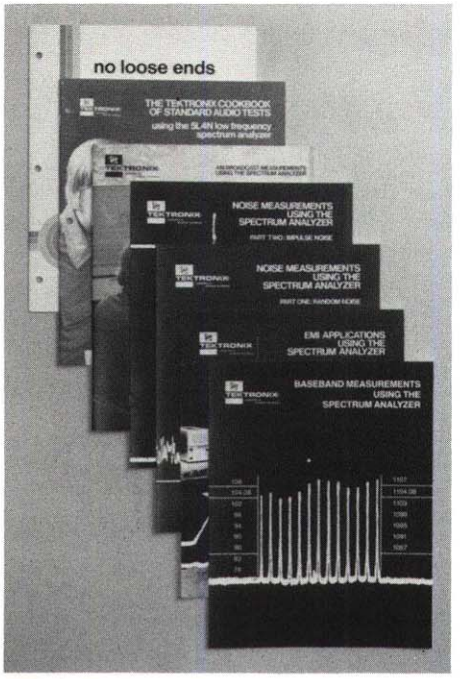
A special mounting bracket assembly can be fitted to bolt the analyzer securely into the mainframe if desired.

3-wide Carrying Case for 7L13, 7L5 Option 25, etc. 016-0626-00 ..... **$175**

2-wide Carrying Case for 7L12, 7L5, etc. 016-0625-00 ..... **$175**

Luggage-type Carrying Case for 7603 Opt 08, 7613 Opt 08 016-0628-00 ..... **$225**

Your local field office can quote prices and availability on any of these accessories.



Numerous application notes and magazine article reprints on spectrum analyzer measurements are available. Notes on baseband, EMI, am, fm, and television measurements, cable television proof of performance, audio amplifier testing, noise and pulse testing, and others have been written to help you with your measurements.

In addition, our staff of specialists stands ready to help you solve any special measurement problems. Contact your local Tektronix Field Office.

Semiconductor Device Test Systems

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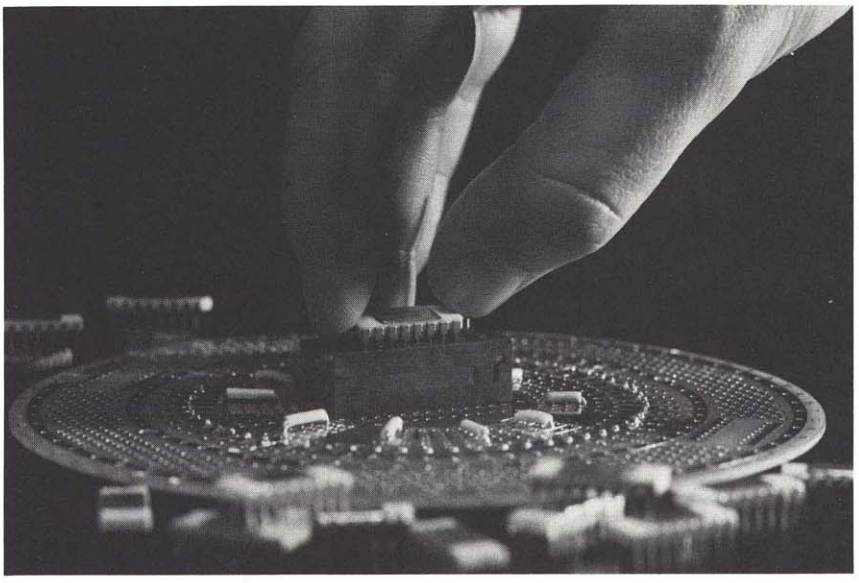
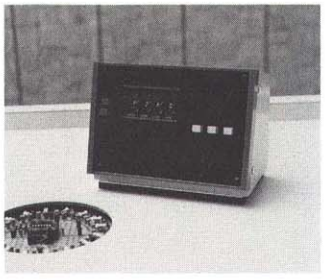
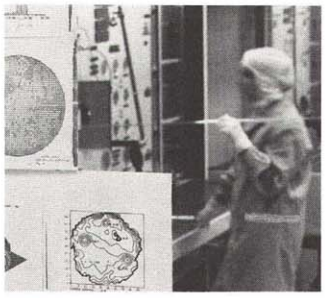
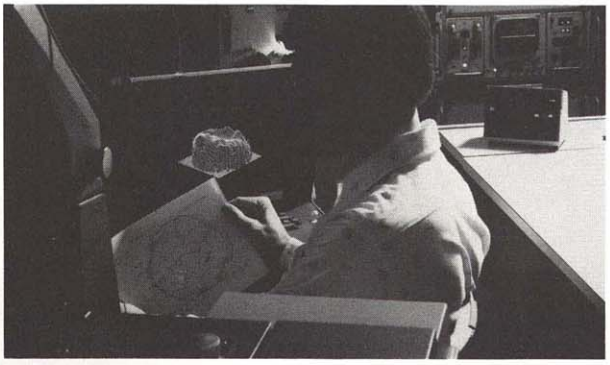




S-3260 Series

Respected around the world as the comprehensive LSI testing solution





When LSI devices graduate from the lab, they are characterized with an S-3260; when samples are received by device users, they are evaluated with an S-3260. When an LSI device goes into production, the production testing is often performed with an S-3260.

Over the last few years, we have seen the IC grow from a collection of gates into general purpose controllers. Now on the horizon are intelligent general-purpose interfaces. Throughout this explosion of IC technology, the TEKTRONIX S-3260 Series has always offered testing capability a step ahead of the testing requirements. That's why the S-3260 Series continues today as the comprehensive LSI testing solution.

For the complete story on the S-3260 Series, request more information by using the reply card inside the back cover; or, for faster action, call your local Tektronix Field Office and ask for the Sales Engineer specializing in Automatic IC Test Systems.

S-3455

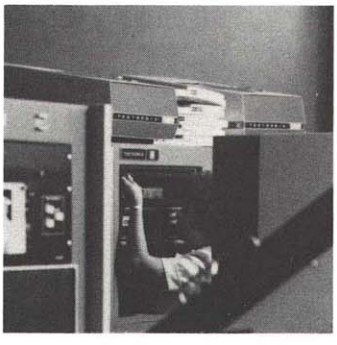
The complete testing solution for RAM's and ROM's

Now, after extensive development, Tektronix is offering a complete testing solution for semiconductor memory devices.

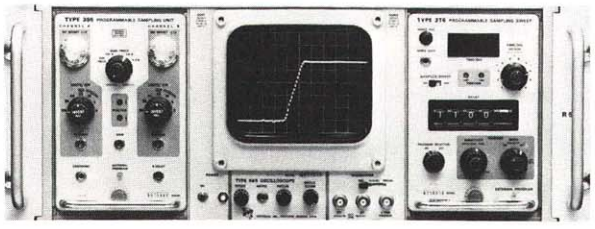
Two years ago, Tektronix design engineers were assigned the task of developing a comprehensive testing solution for semiconductor memory devices. The major manufacturers and users of semiconductor memory devices were consulted, along with our own in-house staff of memory test engineers. The concept, ideas, and techniques collected from these memory testing experts were incorporated in the prototype design of a new test system. Several prototype systems were then sent out for on-site evaluation at memory manufacturers and users, plus our own in-house testing facilities.

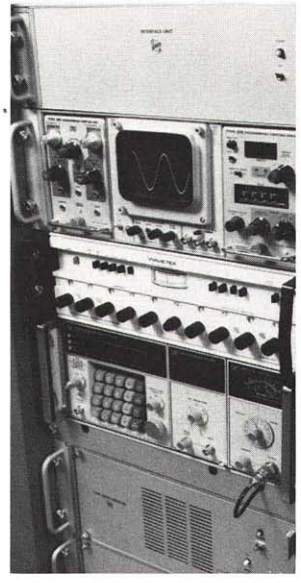
The result of this development activity is the new S-3455 Semiconductor Memory Test System, a system that completely addresses the entire semiconductor memory testing problem.

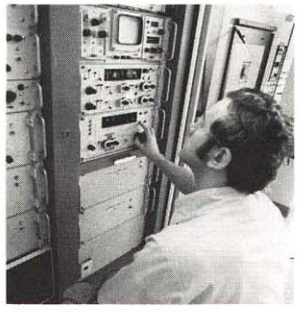
If you are planning to test semiconductor memory devices, especially 4k and 16k RAM's and ROM's, get the complete story on the S-3455. To request more information, use the reply card inside the back cover; or, for faster action, call your local Tektronix Field Office and ask for the Sales Engineer specializing in Automatic IC Test Systems.



S-3100 Series / S-3000 Series







Automated Test Systems in the S-3100 and S-3000 Series readily accommodate measurements such as period, rise and fall times, overshoot, storage time, propagation delay, and many other time-related parameters. They also are capable of amplitude measurements such as peak-to-peak voltage, offset voltage, breakdown voltage, leakage current, etc.

Both the S-3100 and S-3000 Series Automated Test Systems are designed around the TEKTRONIX 568 Programmable Readout Oscilloscope. The 568, along with the available dual-channel vertical plug-ins, delaying sweep time bases, sampling heads, and digital readout unit, performs the basic measurement function. Control, stimulus, and fixturing are available as "building block" components to assemble numerous configurations, each providing a unique solution to specific test and measurement requirements.

To request more information on the S-3100 and S-3000 Series, use the reply card inside the back cover; or, for faster action, call your local Tektronix Field Office and ask for the Sales Engineer specializing in Automatic IC Test Systems.

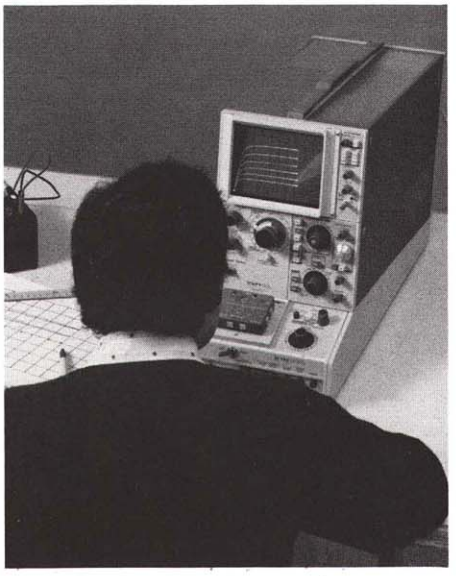
TEKTRONIX CURVE TRACERS

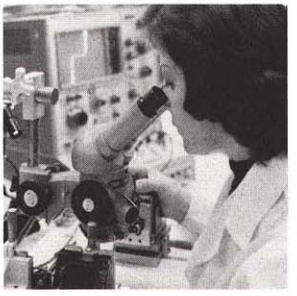
Curve tracers can deliver comprehensive information about a multitude of semiconductor devices and integrated circuits . . . from two- and three-terminal devices through the full range of linear integrated circuits . . . from transistors and diodes to optoisolators, thyristors, and operational amplifiers.

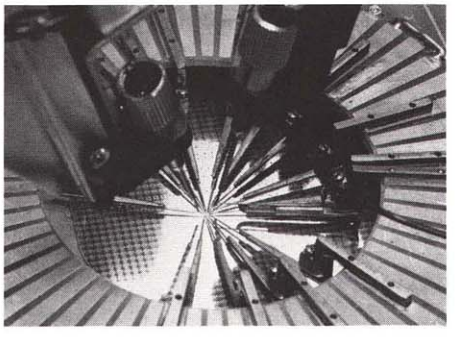
These versatile measurement tools give you more than pinpointed parameters. A curve tracer can show you what happens between specified points in a quickly graphed curve, thus providing the valuable performance data necessary for accurate design, analysis, and evaluation.

If you are well acquainted with Curve Tracers, you will find the Curve Tracer System descriptions (p 204-214) helpful in choosing the system that best meets your requirements. If you would like to receive a brochure, application notes, and other materials to learn more about Curve Tracers and their measurement capabilities, please use the reply card on the inside back cover; or, for faster action, contact a Tektronix Field Engineer at the Field Office nearest you.

CONTENTS **Page**

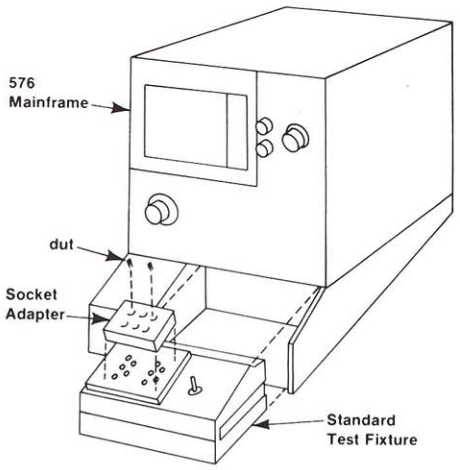






Curve Tracers

General-Purpose System with Digital Readout Available



The TEKTRONIX 576 Curve Tracer System continues to hold the title "standard of the industry". The 576 accepts three different test fixtures: the Standard Test Fixture, 172 Programmable Test Fixture (described on p 206), and the 176 Pulsed High-Current Fixture (described on p 207). The 576 is an excellent general-purpose curve tracer system that performs well in applications where high current testing is required.

With the Standard Test Fixture, the collector supply of the 576 delivers up to 220 watts peak to the dut. The step generators can deliver up to 2 A in both its current and voltage modes of operation. Of course, with the 176, the 576 is capable of pulsed collector operation up to 200 amps peak.

One of the features that sets the 576 apart from the 577 is the display area READ-OUT. Adjacent to the 576's crt are alphanumeric indicators of vertical and horizontal deflection factor, step amplitude, and Beta/div or gm/div. The Beta or gm readout saves the operator from the arithmetic usually necessary to arrive at these parameters. The READ-OUT also provides a permanent record of major knob settings in 576 crt photographs.

Another unique feature of the 576 is the Calibrated Display Offset. Combining a calibrated position control and a display magnifier, the Display Offset increases resolution and allows the operator to make more precise measurements.

Other features of the 576 Curve Tracer are: adjustable current limiting in the step generator, either 300 μs or 80 μs pulse width in pulsed base operation, pushbuttons to check display zero and calibration, and illuminated graticule.

CHARACTERISTICS

COLLECTOR SUPPLY

Modes — NORM: positive or negative full wave rectified ac (line frequency); dc: positive or negative dc; LEAKAGE: emitter current rather than collector current measurements with an increase in the basic vertical deflection factor to 1 nA/div.

Voltages — Peak open circuit voltages within +35% and −5% of indicated range.

Range	15 V	75 V	350 V	1500 V
Max Continuous Peak Current	10 A	2 A	0.5 A	0.1 A
Peak Pulse Mode Current	≥20 A	≥4 A	≥1 A	≥0.2 A

Series resistance is from 0.3 Ω to 6.5 MΩ in 12 steps, all within 5% or 0.1 Ω. Peak power limit setting: 0.1 W, 0.5 W, 2.2 W, 10 W, 50 W, 220 W.

Safety Interlock — Protects operator from 75 V, 350 V, and 1500 V collector voltages.

STEP GENERATOR

Current Mode — Step/offset amplitude range is 5 nA/step (with 0.1X MULT) to 200 mA/step, 1-2-5 sequence. Max current (steps and aiding offset) is X20 AMPLITUDE setting, except X10 (2 A) at 200 mA/step and X15 (1.5 A) at 100 mA/step. Max voltage (steps and aiding offset) is at least 10 V. Max opposing offset current is X10 AMPLITUDE switch setting or 10 mA, whichever is less. Max opposing voltage is limited at 1 V to 3 V.

Voltage Mode — Step/offset amplitude range is 5 mV/step (with 0.1X MULT) to 2 V/step, 1-2-5 sequence. Max voltage (steps and aiding offset) is X20 AMPLITUDE switch setting, 40 V max. Max current (steps and aiding offset) is at least 2 A at 10 V, derating linearly to 10 mA at 40 V. Short circuit current limiting is 20 mA, 100 mA, 500 mA +100%, −0%; 2 A +50%, −0%. Max opposing offset voltage; X10 AMPLITUDE switch setting. Max opposing current; limited at 5 mA to 20 mA.

Accuracy — Incremental; within 5% between steps, within 10% with 0.1X MULT. Absolute; within 2% of total output including offset, or 1% of AMPLITUDE setting, whichever is greater. Offset multiplier; 0 to X10 the AMPLITUDE setting, continuously variable. Polarity AID(s) or OPPOSE(s) the step polarity.

Step Rates — 0.5X, 1X (NORM), and 2X the collector supply rate. The collector supply rate is twice line frequency.

Pulsed Steps — Approx 80 μs or 300 μs width, at NORM or 0.5X rates.

Step/Offset Polarity — The STEP GEN polarity is the same as the COLLECTOR SUPPLY polarity, and positive in the ac position. Step polarity may be inverted by actuating the INVERT pushbutton.

Step Family — REPETITIVE or SINGLE FAMILY (manually actuated).

Number of Steps — Digitally selectable between 1 and 10.

DEFLECTION CONTROLS

Display Accuracies — As percentage of highest on-screen value.

		OFFSET and MAGNIFIED with CENTERLINE VALUE from:		
NORM and DC MODES	**NORMAL**	**100-40 div**	**35-15 div**	**10-0 div**
Vert Collector Current	3%	2%	3%	4%
Horiz Collector Volts	3%	2%	3%	4%
Horiz Base Volts	3%	2%	3%	4%
LEAKAGE MODE Vert Emitter Current/div:				
10 nA-2 mA/div	3% ± 1 nA			
1 nA-200 μA/div (magnified)		2% ± 1 nA	3% ± 1 nA	4% ± 1 nA
5, 2, 1 nA/div	5% ± 1 nA			
Horiz Collector or Base Volts with Emitter Current/div of:				
≥1 μA	3%	2%	3%	4%
100, 10, or 1 nA	3% plus 25 mV/vert div	NOT APPLICABLE		
200, 20, or 2 nA	3% plus 50 mV/vert div			
500, 50, or 5 nA	3% plus 125 mV/vert div			
VERT STEP GEN POSITION	4%	3%	4%	5%
HORIZ STEP GEN POSITION	4%	3%	4%	5%

Vertical Deflection Factor — Collector current is 1 μA/div to 2 A/div, 20 steps in 1-2-5 sequence (0.1 μA/div with X10 magnification). Emitter current is 1 nA/div to 2 mA/div, 20 steps in 1-2-5 sequence. Step generator is 1 step/div.

Horizontal Deflection Factor — Collector volts; 50 mV/div to 200 V/div, 12 steps (5 mV/div with X10 magnification). Base volts; 50 mV/div to 2 V/div, 6 steps (5 mV/div with X10 magnification). Step generator; 1 step/div.

Displayed Noise — 1% or less or:

RANGE	15 V	75 V	350 V	1500 V
Vertical—Collector	1 μA	1 μA	2 μA	5 μA
Vertical—Emitter	1 nA	1 nA	2 nA	5 nA
Horizontal—Base	5 mV	5 mV	5 mV	5 mV
Horizontal—Collector	5 mV	5 mV	20 mV	200 mV

Calibrator (CAL) — Dc voltage (accurate within 1.5%) provided to check and adjust vertical and horizontal gain.

Position Controls — Fixed 5 div increments within 0.1 div. Continuous fine control over 5 div or less.

Display Offset — 21 calibrated positioning increments, vertically or horizontally, of 0.5 div or 5 div with X10 MAGNIFIER.

CRT and READOUT

CRT — 6½ in rectangular with parallax-free, illuminated graticule in centimeters. The calibrated area is 10 cm vertical by 10 cm horizontal (12 cm usable horizontal). P31 phosphor normally supplied.

Readout — The readouts, adjacent to crt, are digital indicators of the following parameters: PER VERT DIV from 1 nA/div to 2 A/div; PER HORIZ DIV from 5 mV/div to 200 V/div; PER STEP from 5 nA/step to 2 A/step, 5 mA/step to 2 V/step; β (BETA) or g_m PER DIV from 1 μ to 500 k calculated from CURRENT/DIV, X10 MAG, STEP AMPLITUDE, and 0.1X MULT.

STANDARD TEST FIXTURE

Description — A plug-in fixture with two sets of 5-pin test terminals, the EMITTER GROUNDED or BASE GROUNDED switch, LEFT-OFF-RIGHT switch, STEP GEN OUTPUT EXT BASE or EMITTER input, and the OPERATOR PROTECTION BOX. The test terminals accept either the 6-pin universal adapters, 3-pin adapters, or the high-power transistor adapters with KELVIN contacts.

OTHER CHARACTERISTICS

Power Requirements — Power Source; operates only with an unbalanced-to-ground power source. For safe operation, the power line neutral (white or "identified" conductor) must be connected to the instrument neutral (unfused), and the power plug safety ground (green conductor) must return to ground through a different path than the power line neutral. Voltage Ranges; the quick-charge line-voltage range selector accommodates 90 Vac to 136 Vac or 180 Vac to 272 Vac (six positions), at 48 Hz to 66 Hz line frequency. Max power consumption is 305 W, standby power is approx 60 W.

Ambient Temperature — Performance characteristics are valid over an ambient temperature range of +10° C to +40°C.

Dimensions and Weights	**in**	**cm**
Height	15.0	38.1
Width	11.5	29.2
Depth	23.0	58.4
	lb	**kg**
Net Weight	70.5	32.0
Shipping Weight	≈107	≈48.5

INCLUDED ACCESSORIES

Transistor adapter (013-0098-02), FET adapter (013-0099-02). TO3 adapter (013-0100-01), TO66 adapter (013-0101-00), axial lead diode adapter (013-0111-00), stud diode adapter (013-0110-00), large in-line adapter (013-0138-00), small in-line adapter (013-0139-00), and protective cover (337-1194-00).

ORDERING INFORMATION

576 Curve Tracer with Standard Test Fixture **$5200**

The 576 Option 01 deletes the parameter readout module but maintains provisions for insertion of the module # (020-0031-00) at any time.

Order Option 01 . . . . . **Sub $400**

Auto Scale-Factor Readout Module Order 020-0031-00 . . . . . **$765**

OPTIONAL ACCESSORIES

Camera — See Oscilloscope/Camera Adapters chart in camera section of this catalog.

Cart — Tek Lab Cart Model 3.
Order Model 3 . . . . . **$295**

Test Set-up Chart — Package of 250.
Order 070-0970-01 . . . . . **$6.50**

172 Test Fixture . . . . . See page 206

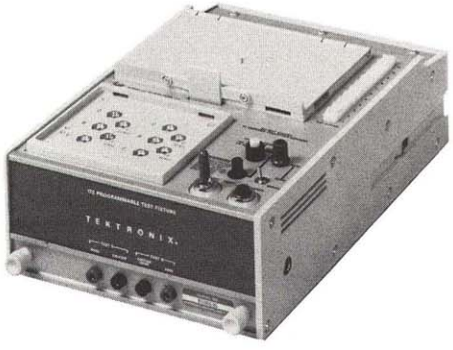
176 Test Fixture . . . . . See page 207

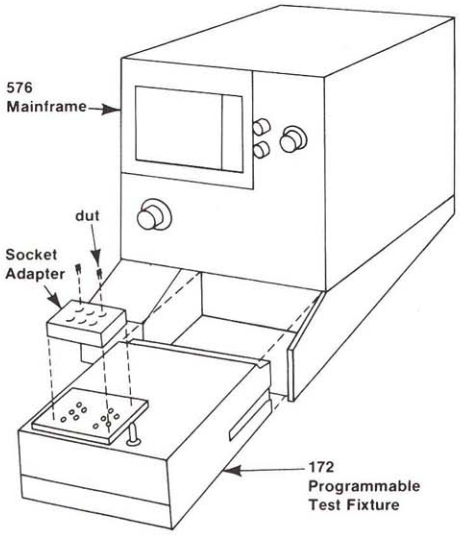
Socket Adapters . . . . . See page 212

The 172 Programmable Test Fixture, when used with the TEKTRONIX 576 Curve Tracer, permits the operator to program a sequence of tests of J FET's, transistors, and diodes.

The 172 can greatly reduce total test time in applications where more than one measurement is made on a batch of many devices. Without the 172 all devices in the batch must be repeatedly inserted in the test fixture, once for every measurement. However, the 172 programmable test fixture performs as many as eleven different tests on each device.

The 172 sequences through the various tests either automatically or manually. A variable RATE control is provided for the operator to set the test sequence at a rate which is best for him. A new operator requires more time per test, but with experience he will want to test at a faster rate. A front-panel switch or an optional foot switch advances the test in the manual mode.





TESTS THAT CAN BE PERFORMED ON:				PROGRAMMABLE CAPABILITIES
Test	Xstr	J FETs	Diodes	
1*	H_{FE}, $V_{CE(sat)}$	V_P	V_F	PEAK CURRENT up to 10 A PEAK VOLTS up to 350 V.
2	V_{BE}			Horiz range is 100 mV/div to 2 V/div (other conditions same as Test 1).
3	H_{FE}, $V_{CE(sat)}$	I_{DSS}, $R_{DS(on)}$		Base Drive: 100 nA to 110 mA. When testing J FET's the base terminal is shorted to the emitter terminal. Collector Sweep: three fixed ranges; 2 V, 5 V, and 20 V peak. Short circuit currents on these ranges are 1.5 A, 2 A, and 150 mA, respectively.
4	Same as #3.			
5	I_{CEO} or I_{CES}, I_{CER} with external short or resistor			Voltage Supply: 1 V to 500 V dc. Leakage current measurements to 0.5 mA. The most sensitive deflection factor is nA/div.
6	I_{CBO}	I_{GSS}		Same as #5.
7	I_{EBO}		I_R	Same as #5.
8	$V_{(BR)CEO}$ or $V_{(BR)CER}$ with external resistor		V_F	Current Supply: 100 nA to 11 mA dc for breakdown voltage measurements to 500 V. Up to 100 mA dc for breakdown voltage measurements to 50 V.
9	$V_{(BR)CES}$			Same as #8.
10	$V_{(BR)CBO}$	BV_{GSS}		Same as #8.
11	$V_{(BR)EBO}$		V_R	Same as #8.

*All of the test conditions for Test 1 are controlled by the 576 front-panel controls. Test 2 has the same conditions as for Test 1 except the horizontal amplifier is connected to the emitter-base terminals, and the horizontal deflection factor is controlled by the programming card.

For the remaining tests the only 576 controls that are functional are the Polarity and crt controls such as INTENSITY, FOCUS, DISPLAY OFFSET.

CHARACTERISTICS

VERTICAL AND HORIZONTAL AMPLIFIERS

Display Accuracies — The same as the 576 Curve Tracer with its included Standard Test Fixture.

Vertical Deflection Factor — Test 1 and 2 (Collector or Emitter Current): 1_C, 1 μA to 2 A/div in 20 steps. Test 3, 4, and 8, 9, 10, 11 (Collector or Breakdown Current): 1μA to 0.5 A/div in 18 steps. Test 5, 6, 7 (Leakage Current): 1 nA to 0.5 A/div in 27 steps. All steps are in a 1, 2, 5 sequence.

Horizontal Deflection Factor — Test 1: 0.05 V/div to 200 V/div in 12 steps. Test 2 (Base Voltage): 100 mV/div to 2 V/div in 5 steps. Input Z for test 2, at least 100 MHz at 100 mV/div and 200 mV/div. 1 MΩ (within 2%) at 0.5 V/div, 1 V/div, and 2 V/div. Tests 3 and 4 (Collector Voltage): 100 mV/div to 2 V/div in 5 steps. Test 5 through 11 (Breakdown or Leakage Voltage): 100 mV/div to 50 V/div in 9 steps. All steps are in a 1, 2, 5 sequence.

Collector Sweep Voltage — At least 2 V open circuit, or 1.5 A short circuit, at 100 mV/div and 200 mV/div. At least 5 V open circuit, or 2 A short circuit, at 500 mV/div. At least 20 V open circuit, or 150 mA short circuit, at 1 V/div and 2 V/div.

Current Supply Accuracy — 0.1 μA to 11 mA, accurate within 2% ±30 nA with up to 500 V compliance. 10 mA to 110 mA, accurate within 2% ± 30 nA with up to 50 V compliance. Increments of current are: 0.1 μA (from 0.1 μA to 11 μA), 1 μA (from 10 μA to 110 μA), 10 μA (from 100 μA to 1.1 mA), 100 μA (from 1 mA to 11 mA), and 1 mA (from 10 mA to 110 mA).

Voltage Supply Accuracy — 1 V to 500 V, accurate within 3% ±300 mV with at least 0.5 mA compliance.

Test Display Time Range (Automatic) — 300 ms or less to at least 2 s continuously variable. Manual operation from a front-panel switch or optional foot switch.

OTHER CHARACTERISTICS

Ambient Temperature — Performance characteristics are valid over an ambient temperature range of +10°C to +40°C.

Dimensions and Weights

	in	cm
Height w/cover	6.5	16.5
Width	7.8	19.8
Depth	12.4	31.5
	lb	**kg**
Net weight	11.5	5.2
Shipping weight	≈18.0	≈8.2

Included Accessories — One protective cover, five programming cards, 250 programming card pins, five crt overlay limit cards.

ORDERING INFORMATION

172 Programmable Test Fixture $2200

OPTIONAL ACCESSORIES

Programming Cards — Package of 25 programming cards without pins or limit cards.
Order 016-0198-01 . . . . . **$65**

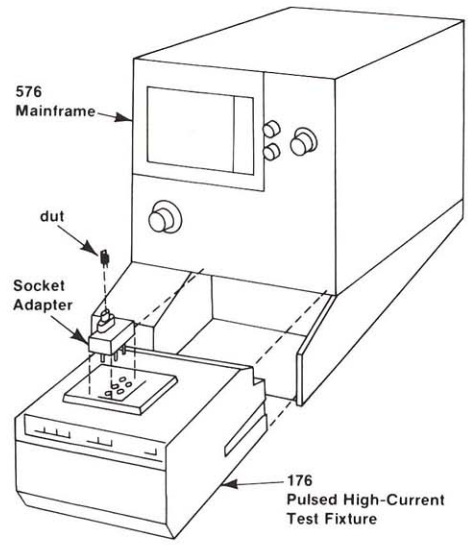
Crt Limit Cards — Package of 25 limit cards without programming cards or pins.
Order 016-0510-01 . . . . . **$30**

Programming Pins — Package of 1000 programming pins without programming or limit cards.
Order 016-0519-01 . . . . . **$40**

Foot Switch — For manually sequencing the programmed test.
Order 260-1189-01 . . . . . **$27**

Programming Accessories Package — Includes one programming card, one crt limit card, and 50 programming card pins.
Order 016-0518-00 . . . . . **$6**

Program Set-up Charts — Package of 250.
Order 062-1615-00 . . . . . **$7**



The 176 Pulsed High-Current Fixture provides the 576 Curve Tracer with pulsed collector operation to 200 amps peak and pulsed base steps to 20 amps peak. The step offset, when selected, is also pulsed. The pulsed operating mode allows many tests previously considered impossible. For example, small signal transistors can be tested under pulsed collector breakdown conditions without over dissipation. The 176 Test Fixture fits in place of the 576 Standard Test Fixture. The collector pulse is slaved to the 576 in regard to width and repetition rate. The pulse width is selected by depressing the 300 μs or 80 μs pushbutton on the 576 mainframe (usually, 300 μs should be selected). The rep rate is automatically set when the 176 is inserted in the mainframe. Rep rate is also dependent on power-line frequency. The five highest VERTICAL CURRENT/DIV (0.1 A/div to 2 A/div) of the 576 can be multiplied X10 by actuation of the X10 VERT pushbutton on the 176. This feature enables viewing of up to a 200 amp peak display. The five highest STEP GENERATOR AMPLITUDE base current steps of the 576 (10 mA to 200 mA) can be multiplied X10 by actuation of the X10 STEP pushbutton on the 176. This feature enables the pulsed base step generator on the 176 to provide up to a 20 amp base step (tenth step). Both X10 VERT and X10 STEP pushbuttons provide inputs to the fiberoptic readout to display actual values.

CHARACTERISTICS

COLLECTOR SUPPLY (PULSED)

Width — 300 μs or 80 μs determined by 576.

Repetition Rate — Power-line frequency.

Polarity — + or − determined by 576 polarity control.

Amplitude — Ranges are 15, 75, 350 V nominal, controlled by MAX PEAK VOLTS switch on 576. Current (minimum available at low line into shorted load) is 15 V range, 200 A; 75 V range, 40 A; 350 V range, 8 A.

Max Peak Watts — Three illuminated pushbuttons select 10, 100, 1000 W max peak power.

STEP GENERATOR

Current Ranges (X10 STEP selected) — Step-Offset Amplitude Range is 100 mA to 2 A, 5 steps in a 1-2-5 sequence. Max Current (Steps and Aiding Offset) is X200 576 AMPLITUDE setting or 20 A, whichever is less. Max Voltage (Steps and Aiding Offset) is at least 5 V up to 10 A and 2 V up to 20 A.

576 Offset Multiplier — 0 to X100 576 AMPLITUDE switch setting.

Step Rate — Power-line frequency.

Pulsed Steps — 300 μs or 80 μs wide.

Step/Offset Polarity — The STEP GEN polarity is the same as the COLLECTOR SUPPLY polarity. Step polarity may be inverted by actuating the INVERT pushbutton.

Accuracy (Current steps including offset) — Incremental is within 5% between any two steps; within 10% with X0.1 STEP MULT. Absolute is within 3% of total output ± 1% of one step or within 3% of one step, whichever is greater.

VERTICAL AMPLIFIER

Deflection Factor (X10 VERT selected) — 1 A/div to 20 A/div, 5 steps in a 1-2-5 sequence.

OTHER CHARACTERISTICS

Ambient Temperature — Performance characteristics are valid over a temperature range of 0°C to +40°C.

Dimensions and Weights

	in	cm
Height	4.6	11.7
Width	7.9	20.1
Depth	11.4	29.0
	lb	**kg**
Net weight	12.8	5.8
Shipping weight	18.0	8.2

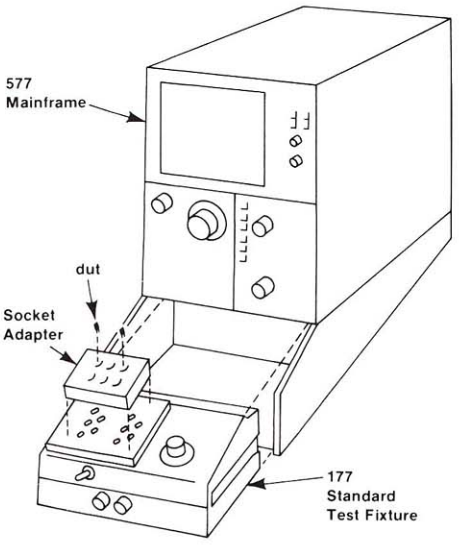
Included Accessories — TO-36 adapter (013-0112-00); stud diode adapter (013-0110-00); protective shield (337-1194-00).

ORDERING INFORMATION

Order 176 Pulsed High-Current Fixture **$2450**

Curve Tracers

General-Purpose System with Storage Display Available



The 577 Curve Tracer System, when used with the 177 Standard Test Fixture, is a smaller and lighter configuration that retains many of the important features and performance of the 576. The 577 also accepts the 178 Linear IC Test Fixture. The major features that separate the 577 from the 576 are storage and the emphasis on low current measurements.

The 577's storage crt may be used to overlay the characteristic curves of one device on top of the stored characteristics of another. Dot displays (generated during high current pulsed testing or during very low current testing under dc conditions) can be transformed into complete characteristic curves by simply moving them across the crt while in the storage mode. A good example of a dot display occurs in op amp testing because the open-loop 3-db bandwidth of many op amps is so low that the curves must be plotted slowly. Linear IC's such as op amps may be tested with the 577 by using the 178 Linear IC Test Fixture (see page 210).

In the 577/177 Curve Tracer System several features facilitate low current measurements; they include: small current sensing resistors (which result in less capacitive looping), current sensing that always takes place in the collector supply lead (which permits measurements on three terminal active devices at the lowest current ranges and eliminates the need for a correction to the horizontal deflection factor), and a display filter (which reduces vertical deflection noise).

Although the 577/177 Collector Supply has lower power capability (the 576 can deliver approximately 2.2 times as much power to the device under test), approximately the same test current is available, 10 A continuous peaks at line frequency. The 577/177 provides its highest currents at a lower voltage than does the 576.

Other innovations in the 577/177 Curve Tracer are an emitter-base breakdown position on the lead selector switch, availability of approximately 95 steps from the step generator, an uncalibrated bias supply, independent magnifiers that increase resolution on either or both crt axes, and a beam finder.

CHARACTERISTICS

All characteristics are for the 577 Curve Tracer Mainframe operating with a 177 Standard Test Fixture.

COLLECTOR SUPPLY

Modes — Five modes of collector supply operation are selectable. These are: ac at line frequency, positive full wave rectified, negative full wave rectified, positive dc, or negative dc.

Voltage — The voltage is variable to the max peak volts selected.

Max Peak Volts Open Circuit	6.5 V	25 V	100 V	400 V	1600 V
Continuous Current, Peak	10 A	2.5 A	0.6 A	0.15 A	0.04 A
Peak Pulse Current	20 A	5 A	1.25 A	0.30 A	0.08 A

Series Resistance — 14 values from 0.12 Ω to 8 MΩ. Coupling of series resistance and voltage controls maintains max peak power to the device-under-test when changing voltage ranges.

Safety Interlock — Protects operator from 100-, 400-, and 1600-volt ranges. Momentary button provides for overriding interlock.

STEP GENERATOR

Current Mode — Step amplitude range is 5 nA/step (with STEP X0.1) to 200 mA/step, in a 1-2-5 sequence. Available current is at least 2 A on the highest amplitude setting with 5 V or more compliance. For opposing offset, available current is at least 10 mA with voltage limited between 1 V and 5 V.

Voltage Mode — Step amplitude range is 5 mV/step (with STEP X0.1) to 2 V/step, in a 1-2-5 sequence. Current is limited between 100 mA and 200 mA. For opposing offset, available current is at least 10 mA (at 0 V) derating to 0 mA at 20 V.

Accuracy — Incremental; within 2% between steps. Absolute; within 3% of total output or AMPLITUDE setting, whichever is greater. When STEP X0.1 is actuated the absolute step accuracy is 4%.

Step Rate — Selectable at 1X (SLOW), 2X (NORM), or 4X (FAST) line frequency.

Pulsed Steps — Steps can be gated for a duration of approx 300 μs for testing at low duty cycle.

Step/Offset Polarity — With NORM POLARITY selected the Step Generator polarity is the same as the Collector Supply polarity, and positive in the ac position. Polarity can be independently inverted with STEP/OFFSET POLARITY control or from the test fixture.

Offset — The amplitude of the entire set of steps can be offset in a continuously variable and calibrated manner to either AID or OPPOSE steps. Max range of offset is 10 full-amplitude steps.

Step Family — Repetitive or single family.

Number of Steps — Selectable from 1 to 10 full-amplitude steps. Selectable up to approx 95 steps when using STEP X0.1 multiplier.

DEFLECTION CONTROLS

Display Accuracies — As a percentage of highest on-screen value.

Display Mode	Normal	Magnified
Vert Collector Current	3% ±1 nA	4% ±1 nA
Horiz Collector Volts	3%	4%
Horiz Base Volts	3%	4%
Horiz Step Gen	4%	5%

Vertical Deflection Factor — Collector current is 2 nA/div to 2 A/div, 28 steps in 1-2-5 sequence (0.2 nA/div to 0.2 A/div with X10 magnification).

Horizontal Deflection Factor — Collector volts; 50 mV/div to 200 V/div, 12 steps in a 1-2-5 sequence (5 mV/div to 20 v/div with X10 magnification). Base volts; 50 mV/div to 2V/div, 6 steps in a 1-2-5 sequence (5 mV/div to 0.2 v/div with X10 magnification). Step generator; 1 step/div (0.1 step/div with X10 magnification).

Automatic Scale Factor Readout — Change in deflection factor is indicated by lights behind the knob skirt when using X10 MAG.

Automatic Positioning — Trace (or spot) is automatically positioned when Collector Supply polarity is changed when using the 177.

Display Invert — Single control inverts display and repositions trace.

Display Filter — Selectable low pass filter reduces vertical noise for easier high sensitivity measurements.

CRT

Crt — Rectangular 6½ in with an 8 x 10 div (1.27 cm/div) parallax-free internal graticule. Two display modules are available for the 577. The D1 display unit has a split-screen storage crt with phosphor similar to P1. The D2 display unit has a nonstorage crt with P31 phosphor. Accelerating potential is 3.5 kV.

Beam Finder — Compresses off-screen trace to within graticule area.

177 TEST FIXTURE

Device Lead Selection — Switch provides six different lead configurations. Three positions for EMITTER GROUNDED measurements provide STEP GEN, OPEN (OR EXT), and SHORT base terminal connections. Two positions for BASE GROUNDED measurements provide STEP GEN and OPEN (OR EXT) emitter terminal connections. One position provides for EMITTER BASE BREAKDOWN or leakage measurements up to 25 volts.

Left-Right Switch — Selects left or right test connections. Off in center position. Test connection area accepts all TEKTRONIX Curve Tracer adapters and protective cover. Kelvin connections are provided for emitter and collector terminals.

Looping Compensation — Reduces display loops due to test adapter capacitance and some device capacitance.

Variable Voltage Supply — Continuously variable bias supply from −12 V to +12 V. Source resistance is 10 kΩ or less.

OTHER CHARACTERISTICS

Power Requirements — 100, 110, 120 V ac or 200, 220, 240 V ac all within ±10%. 50 to 60 Hz, 155 W max at 110 V ac and 60 Hz.

Ambient Temperature — Performance characteristics are valid over an ambient temperature of +10°C to +40°C.

Dimensions and Weights

	577/D1 or 577/D2		177	
	in	**cm**	**in**	**cm**
Height	19.8	50.3	4.0	10.2
Width	8.8	22.4	7.9	20.1
Depth	23.0	58.4	6.0	15.2
	lb	**kg**	**lb**	**kg**
Net Weight	40	18.1	2.5	1.1
Shipping Weight	50	22.7	6	2.7

Note: When the 577 and 177 are ordered together their combined shipping weight is: domestic ≃53 lb or ≃24 kg.

INCLUDED ACCESSORIES

Transistor adapter for most bipolar-transistors and some MOS FET's (013-0098-02), axial lead diode adapter with Kelvin sensing terminals (013-0111-00), protective shield for test connection area (337-1194-00).

ORDERING INFORMATION

577/D1 Storage Curve Tracer Mainframe $2900

577/D2 Nonstorage Curve Tracer Mainframe $2500

Option 10, 10 x 10 cm Graticule; available with either storage or nonstorage mainframe..... **Add $35**

177 Standard Test Fixture $550

OPTIONAL ACCESSORIES

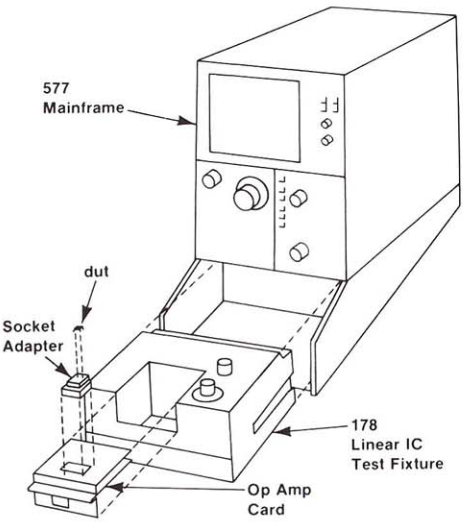
178 Linear Test Fixture; see following page for complete description **$1470**

Camera — C-5A, see pg 234 for complete description **$250**

Cart — Tek Lab Cart, Model 3 (see pg 254)
Order Model 3 ..... **$295**

Test Set-up Chart — package of 250
Order 070-1639-00 ..... **$7.50**

Device Adapter Sockets: see pages 212 and 213 for complete description.



Tests Single, Dual, or Quad:

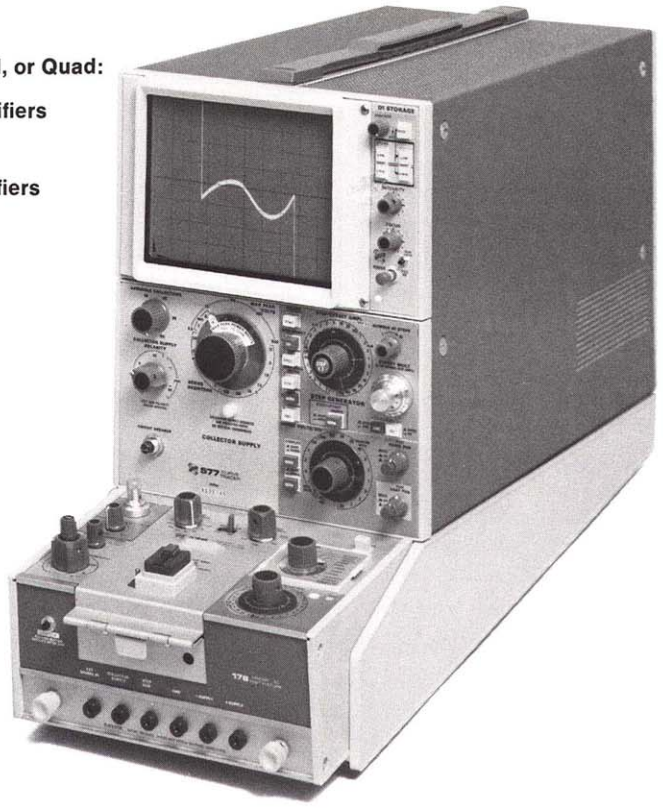
Operational Amplifiers

Comparators

Differential Amplifiers

Regulators

and More



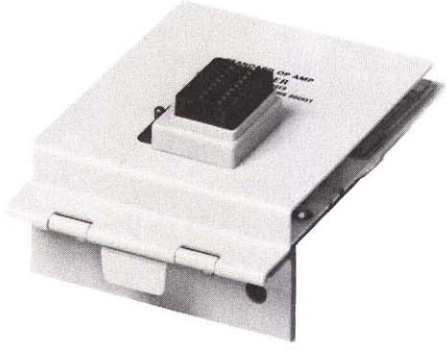
Since linear IC's are typically tested under very low current conditions, the 577/178 Curve Tracer System is ideally suited to the task. The 178 Linear IC Test Fixture provides the necessary accurate low current measurement capability, test cards set up the measurement function, and the 577's storage crt allows the operator to transform the dot display (usually seen under low current dc conditions) into a complete characteristic curve by slowly sweeping the dot across the crt while in the Storage Mode.

A 577/178 Curve Tracer System is composed of a 577 Mainframe, 178 Linear IC Test Fixture, appropriate test cards (choose from three op amp cards and two regulator cards), and the proper socket adapter (see page 181) that interfaces the system to the device-under-test.

Test cards, which slide into the 178, define the measurement function of the 178 Test Fixture. Two families of test cards are available: op amp cards and regulator cards. Op amp cards are used for testing standard and special op amps, comparators, differential amplifiers, video amplifiers, etc. Regulator cards are used for testing positive and negative three-terminal voltage regulators.

OP AMP CARDS

There are three types of op amp cards: the Standard Op Amp Card, Hardwire Card, and the Multiple Op Amp Card.



The **Standard Op Amp Card** is designed to test devices that require single or dual power supplies, have two (differential) high-impedance inputs, and a single output. Common measurements include: offset voltage, positive and negative input current, cmrr, gain, positive and negative psrr, positive and negative supply current, and collector supply current.

The **Hardwire Card** is designed for those applications where there is an advantage in preparing individual cards for specific devices so that they may be quickly switched to accommodate a change in the type of device-under-test. The Hardwire Card also offers a greater degree of freedom to the knowledgeable designer in testing special devices.

The **Multiple Op Amp Card** allows the operator to test up to four devices in a single package by simply operating a four-position switch. The four-position switch selects the op amp (in a multiple op amp package) or the section of a linear IC to be tested. The measurements performed are the same as those available with the Standard Op Amp Card.

Socket Adapters for Op Amp Cards — The device-under-test socket on the Standard and Multiple Op Amp Cards accepts several types of socket adapters using the Amphenol-Barnes adapter system. This system accepts most of the standard package configurations (TO5, DIP, flat pack, etc). Sockets for these cards are shown on page 213.

REGULATOR CARDS

There are two types of Regulator Cards, positive and negative. These cards are used primarily in measuring parameters of three-terminal voltage regulators. Parameters measured include: output voltage, load regulation, line regulation and ripple regulation, and quiescent and common terminal current.

Socket Adapters for Regulator Cards — Socket adapters for both positive and negative three-terminal regulators are the same as the Kelvin Sensing Sockets used on the standard curve tracer (see page 213).

CHARACTERISTICS

VERTICAL DEFLECTION (1-2-5 Sequence)	NORMAL	MAGNIFIED
Input Voltage or Δ Input Voltage	10 μV/div to 50 mV/div	1 μV/div to 5 mV/div
Accuracy	3%	4%
Input Current	50 pA/div to 0.2 mA/div	5 pA/div to 20 μA/div
Accuracy	3% ±50 pA	4% ±50 pA
Power Supply Current	0.1 μA/div to 50 mA/div	10 nA/div to 5 mA/div
Accuracy	3% ±0.1 μA	4% ±0.1 μA
Collector Supply Current	1 nA/div to 50 mA/div	0.1 nA/div to 5 mA/div
Accuracy	3% ±1 nA	4% ±1 nA

Accuracies are a percentage of highest on-screen values.

Power Supplies — Positive and negative supplies are adjustable from 0 to 30 V, available current is at least 150 mA with adjustable current limiting. The voltage of both supplies can be adjusted from a single calibrated control; accuracy is 2% ±100 mV. Negative supply can be independently adjusted by an uncalibrated control.

Sweep Generator — A sinusoidal signal controls the output, common mode input, or the power supply voltages of the device-under-test. The frequency is adjustable from 0.01 Hz to 1 kHz; amplitude is adjustable up to 30 V peak.

Source Resistance — Four input resistor pairs selectable, 65 Ω, 10 kΩ, 20 kΩ, and 50 kΩ, or external resistors may be used. When the vertical deflection factor is in one of the less sensitive positions, 1 mV through 50 mV/div, the input resistance values are 400 Ω greater.

Load Resistance — Six selectable load resistors, 100 Ω, 1 kΩ, 2 kΩ, 5 kΩ, 10 kΩ, 20 kΩ, and 50 kΩ, or external resistors may be used.

Collector Supply — The 25 V and 100 V ranges of the Collector Supply (located on 577 Mainframe) are available to the 178 Test Fixture. Supply output is located on the 178 front-end panel and on the device card. Automatic positioning with supply polarity is inoperative when using the 178 Test Fixture. (See 577/177 characteristics for Collector Supply performance.)

Step Generator — All the capabilities of the Step Generator (located on 577 Mainframe) are available to the 178 Test Fixture. Generator output is located on the 178 front-end panel and on the device card. (See 577/177 characteristics for Step Generator performance.)

DUT Supplies Disconnect — A single switch disconnects all power to the device-under-test: both plus and minus power supplies, Collector Supply, and Step Generator.

Function Switch — Selects vertical and horizontal deflection signals and connection of the test signal to the device under test.

Zero — Single pushbutton provides a zero reference to the crt display and, in certain functions, nulls out offset voltage in order to measure Δ input V on the vertical display axis.

THREE TERMINAL REGULATOR TEST CARD CHARACTERISTICS

Device Under Test Input Supply

INPUT VOLTAGE — Two ranges, 0-30 V and 0-60 V. 0-30 V is within ±2% ±200 mV of dial setting, and 0-60 V is within ±2.5% ±300 mV of dial setting.

REGULATION — Within 200 mV.

INPUT SWEPT FREQUENCY — Dc to 1 kHz.
300 μs PULSED CURRENT — 5 mA to 2 A.

SHORT DURATION DC CURRENT (One minute) —

Supply Voltage	Current
0 - 10	700 mA
10 - 20	350 mA
20 - 40	300 mA
40 - 60	120 mA

Device Under Test Current Load — 5 mA to 2 A within ±3% of 0 to 1.25 mA.

Device Under Test Comparison Output Dc Voltage Accuracy — 0-10 V range within ±1% ±20 mV; 0-100 V range within ±1% ±150 mV.

OTHER CHARACTERISTICS

Dimensions and Weights

	in	cm
Height	4.5	11.4
Width	7.9	20.1
Depth	7.8	19.8
	lb	**kg**
Net Weight	3.3	1.5
Shipping Weight	8	3.6

Included Accessories — Dual-in-line 16 pin IC socket (136-0442-00). Standard Op Amp Card with cover and ten patch cords (013-0149-01), interchangeable nomenclature panel for function switch (333-1770-00).

ORDERING INFORMATION

178 Linear IC Test Fixture $1470

Standard Op Amp Card — (One included with 178)
Order 013-0149-01 . . . . . $100

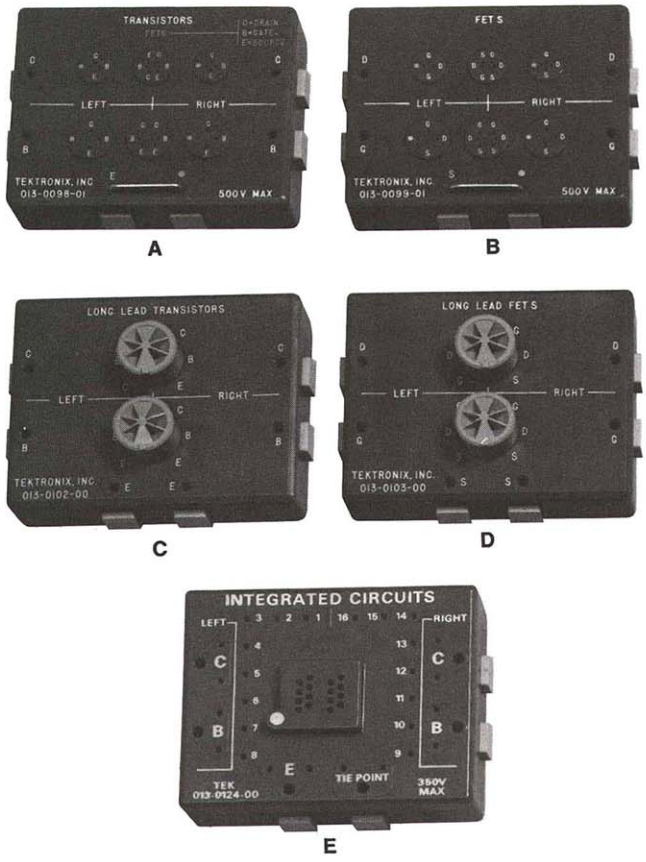
Hardwire Card
Order 013-0150-01 . . . . . $95

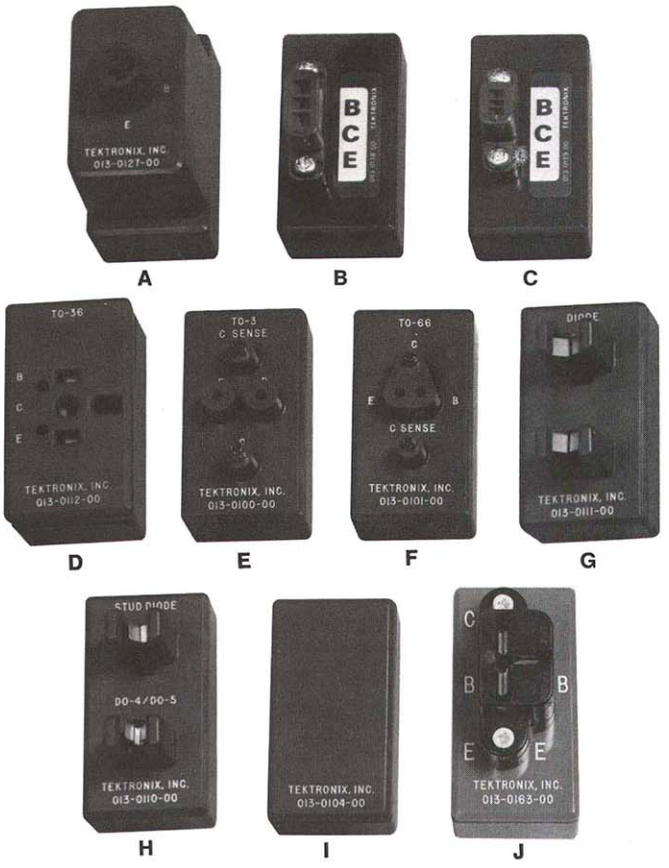
Multiple Op-Amp Card (013-0155-00) $250

Positive Regulator Card
Order 013-0147-00 . . . . . $375

Negative Regulator Card
Order 013-0148-00 . . . . . $375

Socket Adapters





DUAL WIDTH ADAPTERS

The following accessories fit the side-by-side terminals on test fixtures of the 576, 576/172, and 577/177 Curve Tracers.

A. Transistor Adapter — Useful for most single and dual bipolar transistors and some MOS FET's.
Order (013-0098-02) **$70**

B. FET Adapter — Useful for most single and dual FET's.
Order (013-0099-02) **$70**

C. Long Lead Transistor Adapter — Accepts dual or single transistors with untrimmed leads.
Order (013-0102-00) **$55**

D. Long Lead FET Adapter — Accepts dual or single FET's with untrimmed leads.
Order (013-0103-00) **$55**

E. Integrated Circuit Adapter — Allows connection to multipin device packages. The appropriate multilead socket is plugged into the integrated circuits adapter. The pins are then connected to the collector, base, or emitter terminals by means of the patch cord. A tie point is also provided so that an external power supply or signal source may conveniently be patched to the IC pins. Order the appropriate multilead socket listed separately.
Order (013-0124-01) Includes 8 each 4-inch test leads..... **$115**

KELVIN SENSING ADAPTERS

The following accessories fit the test fixtures of the 576, 576/172, 576/176, and 577/177 Curve Tracers.

A. Transistor Adapter — Accepts long or short transistors. Can be rewired to accommodate nonstandard configurations.
Order (013-0127-00) **$35**

B. Large In-Line Adapter — Accepts large transistors with in-line leads. Approx spacing between terminals is 0.18 inch. It is wired for a B-C-E terminal configuration but may be easily rewired for the C-B-E configuration.
Order (013-0138-00) **$40**

C. Small In-Line Adapter — Accepts small transistors with in-line leads. Approx spacing between terminals is 0.09 inch. It is wired for a B-C-E terminal configuration but may be easily rewired for the C-B-E configuration.
Order (013-0139-00) **$40**

D. TO36 Adapter — Order (013-0112-00) **$35**

E. TO3 Adapter — Can be rewired to accommodate nonstandard configurations.
Order (013-0100-01) **$35**

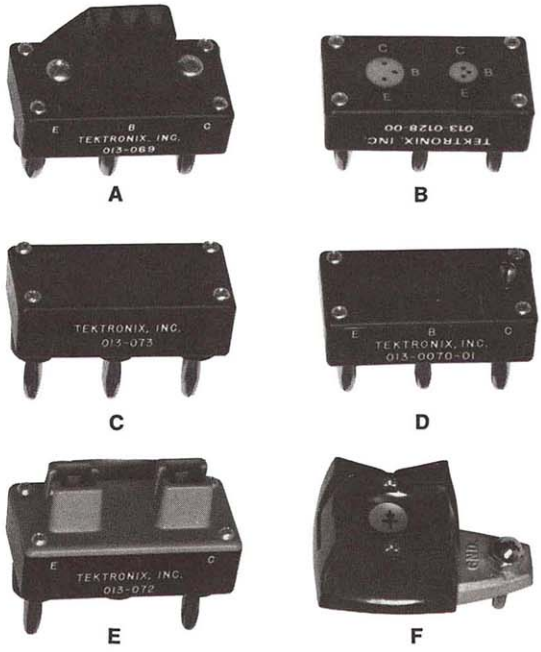
F. TO66 Adapter — Order (013-0101-00) **$35**

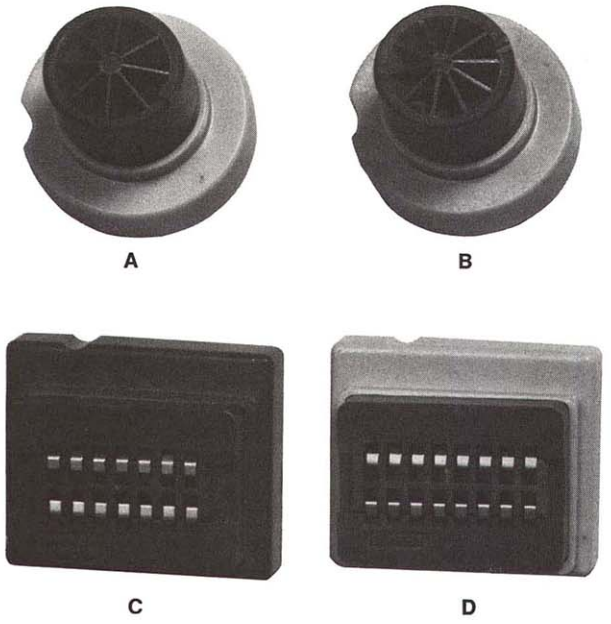
G. Axial Lead Diode Adapter — Order (013-0111-00) **$35**

H. Stud Diode Adapter — Order (013-0110-00) **$35**

I. Blank Adapter — For mounting special sockets.
Order (013-0104-00) **$18**

J. Power Transistor Adapter —
Order (013-0163-00) **$40**





3 PIN ADAPTERS

The following accessories may be used with any of the TEKTRONIX Curve Tracer products. They do not have Kelvin sensing contacts.

A. Long Lead Transistor Adapter — Order (013-0069-00) **$15**

B. TO5 or TO18 Transistor Adapter — Order (013-0128-00) . . **$16.50**

C. Blank Adapter — For mounting special sockets.
Order (013-0073-00) **$9**

D. TO3 or TO66 Transistor Adapter — Order (013-0070-01) **$18**

E. Diode Test Adapter — Holds axial-lead diodes.
Order (013-0072-00) **$13**

F. Diode Test Adapter — Magnetically holds steel axial-lead diodes.
Order (013-0079-00) **$75**

MULTILEAD SOCKETS

These sockets are used with the Integrated Circuits Adapter (013-0124-01) listed under Dual Width Adapters, and with the 178 Test Fixture.

A. 8 lead TO package — Order (136-0444-00) **$25**

B. 10 lead TO package — Order (136-0441-00) **$16**

C. 14 lead dual-in-line package — Order (136-0443-00) **$11**

D. 16 lead dual-in-line package — Order (136-0442-00) **$21**

(These four sockets are the most commonly required in curve tracer applications. Additional socket configurations, including zero insertion style, are available from Amphenol Sales Division, 2875 South 25th Avenue, Broadview, Illinois 60153, OR from Textool Products, Inc., 1410 W. Pioneer Dr., Irving, TX 76061.)

5CT1N
7CT1N

Curve Tracer

Plug-ins for the 5000- and 7000-Series Oscilloscopes

Tests Semiconductor Devices to 0.5 W

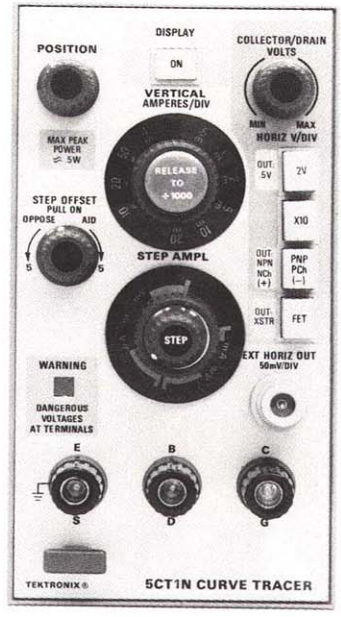
10 nA/div to 20 mA/div Vertical Deflection Factors

0.5 V/div to 20 V/div Horizontal Deflection Factors

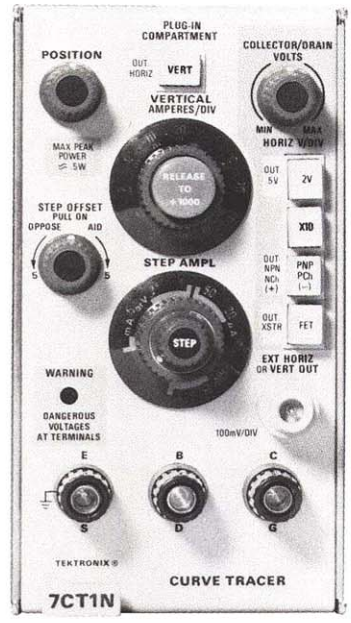
Easy to Operate

The 7CT1N Curve Tracer is a plug-in unit for use in TEKTRONIX 7000-Series Oscilloscope Systems and the 5CT1N Curve Tracer is a plug-in unit for use in TEKTRONIX 5000-Series Oscilloscope Systems. Both are for displaying characteristic curves of small-signal semiconductor devices to power levels up to 0.5 watts. The plug-ins operate in a vertical compartment of the respective mainframes. The 7CT1N also operates in the horizontal compartments of the 7000-Series Oscilloscope Systems.

5CT1N



7CT1N



CHARACTERISTICS

COLLECTOR/DRAIN SUPPLY

	X1		X10	
Horizontal Volts/Div	0.5	2	5	20
Voltage Range	0 - 7.5 V	0 - 30 V	0 - 75 V	0 - 300 V
Maximum Current	240 mA	60 mA	24 mA	6 mA

Max Open Circuit Voltage — Within ±20%. Max short circuit current, within 30%.

Series Resistance — Automatically selected with horizontal V/div switches. Peak power is 0.5 W or less, depending upon control settings.

High Voltage Warning — When the horizontal V/div switch is in the X10 position, a flashing warning light appears on the front panel indicating that dangerous voltages may exist at the test terminals.

STEP GENERATOR

Transistor Mode — Step amplitude range is 1 μA/step to 1 mA/step, 1-2-5 sequence. Max current (steps plus aiding offset) is X15 amplitude setting. Max voltage (steps plus aiding offset) is at least 13 V. Max opposing offset current is at least X5 amplitude setting.

FET Mode — Step amplitude range is 1 mV/step to 1 V/step, 1-2-5 sequence. Voltage amplitude (steps plus aiding offset) is X15 amplitude setting, 13 V max. Source impedance is 1 kΩ ± 1%.

Accuracy — Incremental; within 3% between steps. Absolute; within ± (3% + X0.3 amplitude setting).

Step Polarity — The step generator polarity is the same as the collector/drain supply in the transistor mode and opposing in the FET mode.

Number of Steps — Selectable in one-step increments between 0 and 10.

Offset — Selectable from 0 to 5 steps. Polarity aids or opposes the step polarity.

Vertical Deflection Factors — 10 nA/div to 20 μA/div with the ÷1000 control activated. 10 μA/div to 20 mA/div in the X1 mode.

Vertical Display Accuracy — Within 5% in the X1 mode. Within 5% ±0.2 nA per displayed horizontal V when in the ÷ 1000 mode.

Horizontal Deflection Factors — Selectable: 0.5 V, 2 V, 5 V, or 20 V.

5CT1N Horizontal Display Accuracy — Within 5% plus the deflection factor accuracy of the plug-in being driven. The plug-in would be a vertical or horizontal amplifier (such as the TEKTRONIX 5000-Series Plug-ins) with a 50 mV/div deflection factor and an input R of at least 50 kΩ and would be used in the horizontal compartment of the 5000-Series Oscilloscope Mainframe.

7CT1N Horizontal Display Accuracy — Within 5% plus the deflection factor accuracy of the plug-in being driven. The plug-in would be a vertical or horizontal amplifier (such as the TEKTRONIX 7000-Series Plug-ins) with a 100 mV/div deflection factor and an input R of at least 50 kΩ and would be used in the horizontal compartment of the 7000-Series Oscilloscope Mainframe.

OTHER CHARACTERISTICS

Ambient Temperature — Performance characteristics are valid from 0°C to +50°C.

	5CT1N		7CT1N	
Dimensions	**in**	**cm**	**in**	**cm**
Length	12.0	30.5	14.5	36.8
Width	2.6	6.6	2.8	7.1
Height	5.0	12.7	5.0	12.7
Weight	**lb**	**kg**	**lb**	**kg**
Net	1.8	0.8	2.5	1.1
Shipping	4	1.8	6	2.7

Included Accessories — Test Adapter (013-0128-00) with two sets of test terminals, one with TO-5 basing and the other with TO-18 basing.

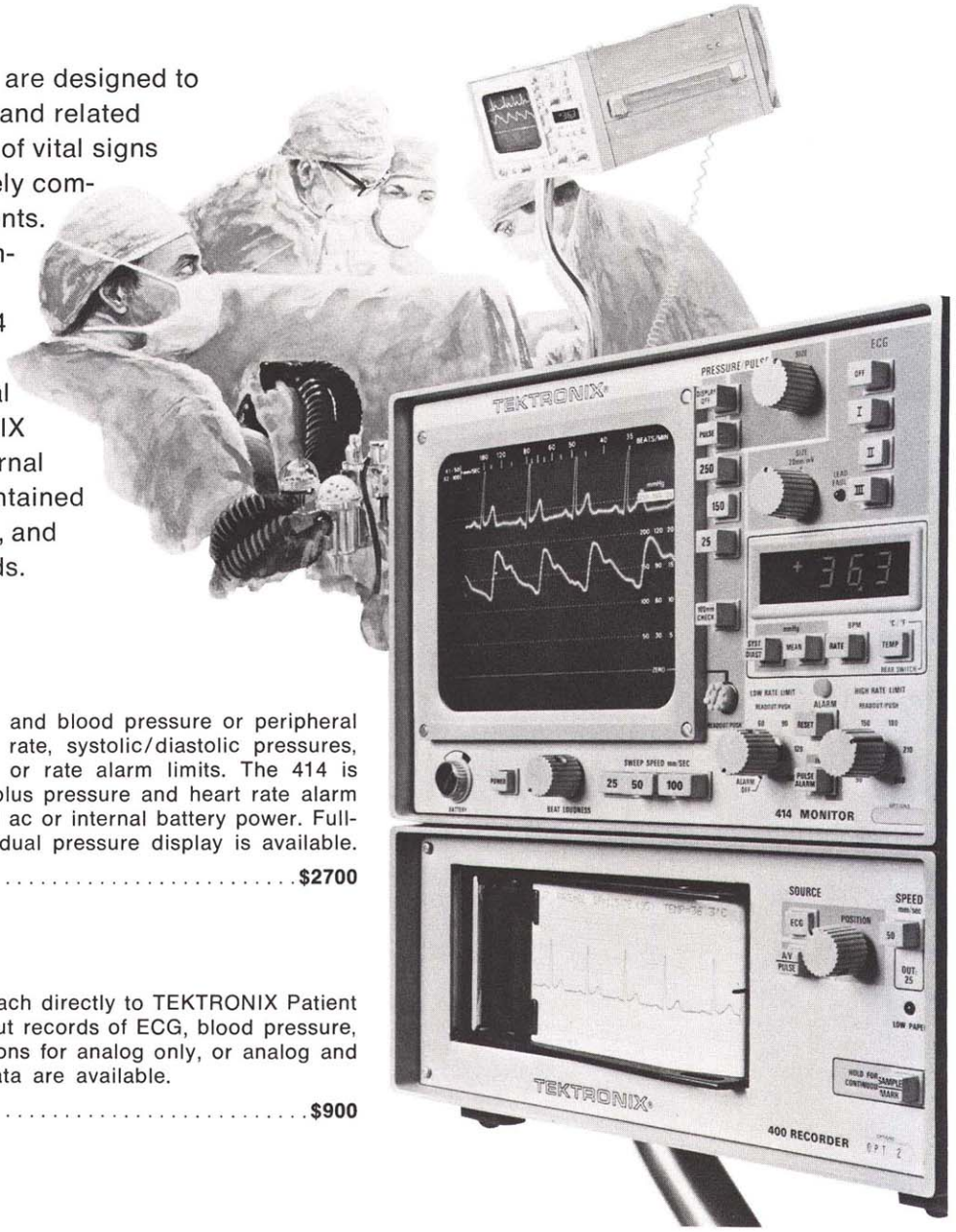
Order 5CT1N Curve Tracer $630

Order 7CT1N Curve Tracer $815

For optional accessories see 3 pin adapters on page 213.

Portable Patient Monitors

TEKTRONIX Medical Monitors are designed to provide the *medical specialist* and related professionals with a full range of vital signs monitoring features in extremely compact, easy-to-operate instruments. From simple ECG to pulse, temperature, and blood pressure variables, the 408, 412, and 414 Monitors offer *exceptional* capabilities in portable medical instrumentation. All TEKTRONIX Monitors permit cordless (internal battery) operation, are self-contained in a single instrument package, and weigh approximately 12 pounds.



414 Portable Monitor

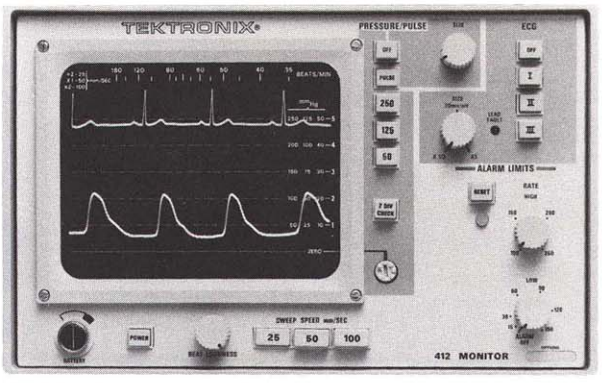
The 414 Monitor is dual trace (ECG and blood pressure or peripheral pulse) with digital display of heart rate, systolic/diastolic pressures, mean blood pressure, temperature, or rate alarm limits. The 414 is standard with three-lead selection, plus pressure and heart rate alarm limits, selectable sweep speeds, and ac or internal battery power. Full-lead selection is optional. Optional dual pressure display is available.

Standard 414 Monitor **$2700**

400 Series Recorders

These six-pound hard copy units attach directly to TEKTRONIX Patient Monitors and provide thermal printout records of ECG, blood pressure, or peripheral pulse waveforms. Options for analog only, or analog and alphanumeric printout of monitor data are available.

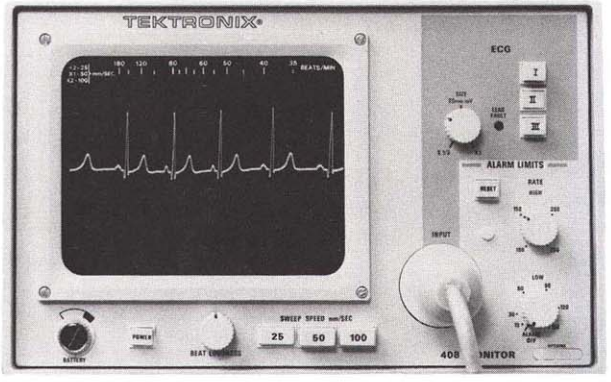
Standard 400 Recorder **$900**



412 Portable Monitor

Standard model offers dual-trace, three-lead selectable ECG and blood pressure or peripheral pulse display; also variable heart rate alarm limits, three sweep speeds, and ac or internal battery operation. The 412 may be ordered with full-lead selection.

Standard 412 Monitor **$2000**



408 ECG Monitor

The 408 Monitor is a low-cost, single-trace instrument designed for applications requiring ECG measurements. It features three-lead selection, variable heart rate alarm limits, three selectable sweep speeds,, and ac or internal battery operation. Full-lead selection is optional.

Standard 408 Monitor **$1500**

408/412/414 CHARACTERISTICS

ECG

ECG patient circuits are fully isolated for max patient safety.

Monitoring Bandwidth — 0.2 Hz to 50 Hz. Recovery after defibrillation—within 1 second.

Outputs — Two calibrated output levels, times 1000 gain and times 1 gain. Times one gain permits direct recording on a standard ECG machine.

Patient Circuit Leakage Current — Less than 5 μA rms at 120 V 60 Hz ac.

414 Lead Check — Lead I: 1.0 mV. Lead II: 1.5 mV. Lead III: 0.5 mV.

408 and 412 Lead Check — 0.5 mV for Lead I and III, 1.0 mV for Lead II.

Lead Fault — Front panel lamp lights with loss of connection to patient.

Pressure (412 and 414)

Requires transducer standardized to 50 μV/V/cmHg.

Ranges (414) — 250 (−50 to +300 mmHg), 150 (−30 to +180 mmHg), and 25 (−5 to +30 mmHg.)

Output — −0.5 V to +3.0 V full scale on each range and −0.5 mV to +3.0 mV full scale on each range.

Ranges (412) — 250: −50 to +300 mmHg; 125: −25 to +150 mmHg; 50: −10 to +60 mmHg.

414 Calibration Check — 100 mmHg on each range. Produces over-range indication on 25 mmHg range. Confirms system function.

412 Calibration Check — 2 div on display. Confirms system function.

Drift — Chopper stabilized for drift-free operation and minimum operating adjustment.

Pulse — (412 and 414) Uses light sensing peripheral blood pulse sensors. Output ±2.5 V and ±2.5 mV full scale.

Digital Display (414 only)

Syst/Diast — Display alternates between systolic and diastolic values in mmHg with brief blank intervals to aid recognition.

Mean — Mean blood pressure in mmHg.

Rate — Heart rate in beats/minute.

Temp — Temperature in °C or °F, as selected by rear panel switch. Resolution to 0.1 degree. Uses Yellow Springs 700-Series Probes.

Over-Range — Display flashes on each function when range is exceeded.

Other Characteristics

Rate Alarm Limits — Rate limits apply to ECG when that function is in use. When ECG is off on 412 and 414, rate applies to either Pressure or Pulse. HIGH RATE limits can be set between 90 and 240 beats-per-minute (414), 100 and 250 beats-per-minute (412 and 408). LOW RATE can be set between 30 and 150 b/m (414), 15 and 150 beats-per-minute (412 and 408). Alarm is indicated in three ways: a yellow lamp, a continuous audible tone of operator-controlled loudness, and an electrical output from a rear-panel connector. Alarm reset is by a front-panel pushbutton or by a remote switch via a rear connector.

Audio — Alarm is a continuous tone. Alarm and beat loudness are independently controlled.

Cathode-Ray Tube — Rectangular 8 x 10 cm viewing area. The P-7 phosphor has long decay time for convenient viewing. Anti-reflection graticule has a graduated heart-rate scale at the top and a vertical scale marked in centimeters, plus vertical graduations in mmHg on the 412 and 414.

Sweep Rates — 25, 50, or 100 mm/s. Crt graticule on 408 and 412 is marked in beats/min, for direct use with the 50 mm/s rate. On the 414, sweep is triggered on 50 and 100 mm/s speeds and free running on 25 mm/s.

Power — Ac: 115 V ac or 230 V ac, 48 to 440 Hz. Battery pack ("D" cell) provides at least 3⅓ hours of cordless operation for the 408, 2 hours for the 412 and 1½ hours for the 414. Battery recharge time is approx 16 hours. Option 3 ("F" cell battery pack) approx doubles battery operation time.

Dimensions — Height: 6.0 in (15.2 cm); width: 10.0 in (25.4 cm); depth: 11.7 in (29.7 cm).

Weights (Approx) — Without battery pack: 10.0 lb (4.5 kg); with battery pack: 11.5 lb (5.2 kg); domestic shipping: 16.0 lb (7.3 kg); export packed: 18.0 lb (8.2 kg). Add 0.5 pounds for the 414 monitor.

408, 412, 414 ACCESSORIES

Patient Cables

Torso Cable (3 electrodes) — (012-0445-00).....**$30**

Limb Cable (3 electrodes) — With #4-40 tapped fittings (012-0459-00) **$55**

Electrode Wires for Patient Cables

18 in wires with snap fittings for disposable electrodes, set of three (012-0502-00).....**$2.50**

18 in wires with #4-40 tapped fittings —
White (RA) (012-0449-00) **$7.50**
Black (LA) (012-0450-00) **$7.50**
Red (LL) (012-0451-00) **$7.50**

Electrode Adapters

All equipped with #4-40 thread to mate with limb cable or related electrode wires.

Snap Adapter — (103-0110-00) **$2.50**

Needle Adapter — (103-0108-00) **$2**

Plate Adapter — (103-0079-00) **$1**

ELECTRODES

Electrode — Re-usable, Ag/AgCl, with #4-40 thread (119-0197-00) **$10**

Attachment Rings — (006-1099-00) **$7.50**

Other attachment methods — MICROPORE tape or pads cut from RESTON #1360 or #1561.

Electrode Paste — (006-1098-00) **$2**

Disposable Electrodes — Snap-fit adult monitoring electrodes. Pre-gelled; foam adhesive pad. Box of 30 (in sealed envelopes of three each).
Order 119-0353-01 .....**$30**

PULSE SENSORS

Finger — (015-0236-01) **$80**

Radial — For finger, toe, etc (015-0237-01).....**$80**

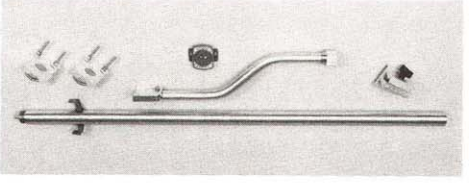
Lobe — For ear or nose (015-0238-01).....**$80**

TRANSDUCERS

Statham P23 Ia — (015-0233-00).....**$490**

Trantec 800 — (015-0234-00) **$470**

Bell & Howell — 4-327 I-0109 (015-0235-00) **$490**



MOUNTING FIXTURES

Mounting Kit — Mounts monitor at five ft level. Attached to vertical pipes or surfaces of anesthesia machines or similar devices. (016-0110-00).....**$135**

Support — The upper-most portion of the mounting stand is available separately. (407-1767-00).....**$4.25**

Mounting Adapter — Attaches to instrument.
(014-0054-00) **$10**

Pole Clamp, used to mount monitor models 408, 412, 414 on poles ½ in to 1¼ in in diameter.
(014-0053-00) **$36**

MISCELLANEOUS

Replacement "D" Cell Battery Set —
(119-0441-01) **$90**

Replacement "F" Cell Battery Set —
(119-0443-01) **$130**

Accessory Pouch — (016-0560-00).....**$15**

Servicing Extender Set — (020-0078-00)
408 and 412 only **$50**

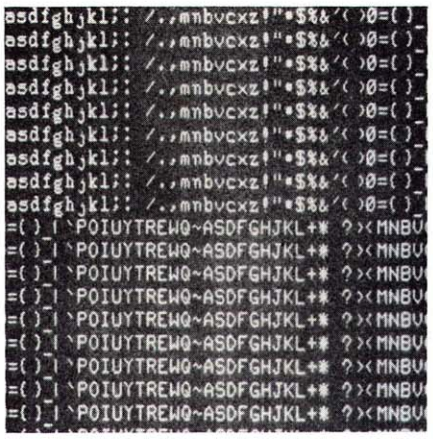
Servicing Extender Set for 414 —
(020-0188-00) **$45**

Repair Kit for #4-40 ends on limb cables and electrode wires (040-0696-01) **$21**

Display Components

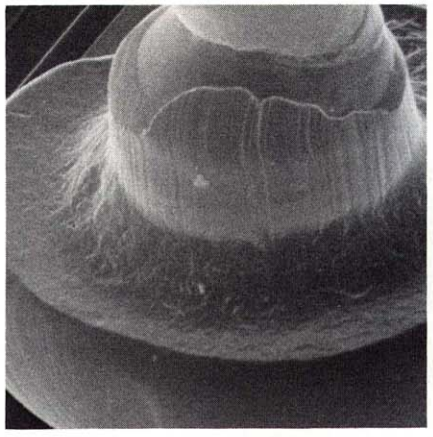
For 30 years, Tektronix has evolved an oscillography and display technology that is second to none. This depth, and an ever-increasing sensitivity to OEM and end-user requirements, have resulted in the broadest and most useful display component product line available.

Seven instruments make it easier for you to optimally choose the right combination of screen size, resolution, storage capability and price. And these display units are complemented by a full line of cameras, filters, rack-mounting options, and other accessories.



OEM assistance . . . Call your nearest Tektronix Field Office

It can be difficult to specify and select the correct monitor for your system. That's why Tektronix is prepared to help you now—with applications assistance and technical information on displaying and recording any type of data; also on installing, and operating display monitors and Cameras—contact your nearest Tektronix Representative.



Timely Sales and Ordering Information

Call your nearest Tektronix Field Engineer (listing on pages 260-261). He is well prepared to discuss display and camera components and their accessories. He'll also advise you of OEM arrangements and quantity discounts.

After-sales Service

Tektronix' philosophy of technical excellence extends to after-sales service. Fifty Tektronix Service Centers across the country and around the world will keep your display instruments operating up to spec. Technicians are well-versed on monitor documentation and use the latest test equipment and test fixtures designed specifically to facilitate repair or calibration of each TEKTRONIX Display Monitor type.

		603 BISTABLE STORAGE	607 VARIABLE PERSISTENCE STORAGE
CRT	**Spot Size**	0.25 mm at 0.5 μA	0.25 mm at 0.5 μA
	Display Size	10.2 cm vertically, 12.7 cm horizontally	7.2 cm vertically; 9 cm horizontally
	Phosphor (Standard)	P1	P31
	Cathode Ray Tube	6-1/2 in, flat faced	5 in, flat faced
	Graticule (Standard)	No graticule	No graticule
	Display Linearity	The voltage required to produce a 2.5 cm deflection from any point on the crt will not vary more than 5%.	The voltage required to produce a 1.8 cm deflection from any point on the crt will not vary more than 5%.
	Acceleration Potential	3.5 kV	12 kV
STORAGE	**Type of Storage**	Bistable	Variable Persistence
	Writing Speed	Standard: 20 div/ms Option 2: 200 div/ms	0.8 div/ μs, viewable for 1.0 minute
	Dot Writing Time	Standard: 4 μs Option 2: 0.5 μs	0.5 μs, viewable for 15 seconds 1 μs, viewable for 3 minutes
	Resolution Stored	Vertical: 80 line pairs Horizontal: 100 line pairs	18 dots/div
	Storage Rate	Standard: 200,000 dots/s Option: 1 million dots/s	1 million dots/s, viewable for 3 minutes
	Viewing Time	At least 1 hour — up to 10 hours with variable brightness control.	Greater than 5 min at reduced writing speed. Extended up to 10 times in the save mode.
	Erase Time	250 ms	500 ms
VERTICAL HORIZONTAL AMPLIFICATION	**Bandwidth**	Dc to ≥2 MHz	Dc to ≥3 MHz
	Settling Time	≤1 μs from any point on the crt within 0.36 mm of final position.	≤1 μs from any point on the crt within 0.3 mm of final position.
	Deflection Factor	Nominally 125 mV/div. Adjustable from <0.05 to 1.25 V/div.	Nominally 125 mV/div. Adjustable from <0.05 to 1.25 V/div.
	Input R and C	1 MΩ ±1% paralleled by less than 47 pF	1 MΩ ± 1% paralleled by less than 47 pF
	X-Y Phase Difference	<1° to 500 kHz	≤1° to 500 kHz
	Maximum Input Voltage (non destructive)	± 100 V (dc + peak ac)	± 100 V (dc + peak ac)
	Linear Common-Mode Signal Range	± 3 V (nonattenuated), ± 15 V in 5X attenuator position.	± 3 V (nonattenuated), ± 15 V in 5X attenuated position.
	Common-Mode Rejection Ratio	≥100:1 to at least 100 kHz ≥50:1 to 100 kHz with 5X attenuator.	≥100:1 to at least 500 kHz. ≥40:1 to 500 kHz with 5X attenuator.
	Recommended Source Impedance	≤10 kΩ	≤10 kΩ
Z AXIS AMPLIFIER	**Bandwidth**	Dc to ≥5 MHz	Dc to ≥5 MHz
	Rise Time	≤70 ns	≤70 ns
	Linear Common-Mode Signal Range	± 5 V	± 5 V
	Common-Mode Rejection Ratio	≤100:1 to 100 kHz	≤100:1 to 100 kHz
	Input R and C	1 MΩ <47 pF	1 MΩ <47 pF
	Input Sensitivity Range	Adjustable from 0-1 to 0-5 V	Adjustable from 0-1 to 0-5 V
	Recommended Source Impedance	≤10 kΩ	≤10 kΩ
OTHER CHARACTERISTICS	**Power Requirements**	Nominal line voltages are 100, 110, 120, 200, 220, or 240 internally selectable. 48 to 440 Hz 75 W max at nominal line voltage.	Nominal line voltages are 100, 110, 120, 200, 220, or 240 internally selectable. 48 to 440 Hz 53 W max at nominal line voltage.
	Temperature Range for Electrical Specifications	0°C to + 50°C	0°C to + 50°C
	Finish	Blue vinyl painted cabinet, aluminum construction.	Blue vinyl painted cabinet, aluminum construction.
	Dimensions	Dimensions: Cabinet in / cm; Rackmount in / cm Height 6.65 / 16.9 / 5.25 / 13.3 Width 8.4 / 21.3 / 8.4 / 21.3 Length 19.25 / 48.9 / 19.0 / 48.3 Weight (Approx): lb / kg / lb / kg Net 17.5 / 7.9 / 17.5 / 7.9 Shipping 23.0 / 10.4 / 23.0 / 10.4	Dimensions: Cabinet in / cm; Rackmount in / cm Height 6.65 / 16.9 / 5.25 / 13.3 Width 8.4 / 21.3 / 8.4 / 21.3 Length 19.25 / 48.9 / 19.0 / 48.3 Weight (Approx): lb / kg / lb / kg Net 17.5 / 7.9 / 17.5 / 7.9 Shipping 23.0 / 10.4 / 23.0 / 10.4
INCLUDED ACCESSORIES		External 25-pin program connector; connector cover; ruled clear external graticule; instruction manual.	Operator's manual; instruction manual; ruled 8 x 10 div clear external graticule; 25-pin connector; connector cover, smoke gray filter.
OPTIONS		01—Internal graticule 02—Fast writing speed crt 03—without handle and feet 04—Time base 06—UL listed 07—without handle , feet and all dust covers	01—Internal graticule 03—without handle and feet 04—Time base 06—UL listed 07—without handle , feet and all dust covers
RECOMMENDED CAMERAS		C-59P, C-5A, C-5A Opt 1	C-30AP, C-5A, C-5A Opt 1

606 HIGH RESOLUTION	**604** LOW COST	**602** 8 MIL SPOT SIZE
0.13 mm at 0.1 μA	0.36 mm at 0.5 μA	0.20 mm at 0.5 μA
8 cm vertically; 10 cm horizontally	10.2 cm vertically; 12.7 horizontally	8 cm vertically, 10 cm horizontally
P31	P31	P31
5 in, flat faced	6-1/2 in, flat faced	5 in, flat faced
No graticule	Internal, parallax free, nonilluminated, 8 x 10 divisions	Internal, parallax free, variable illumination. 8 x 10 divisions
The voltage required to produce a 2 cm deflection from any point on the crt will not vary more than 5%.	The voltage required to produce a 2.5 cm deflection from any point on the crt will not vary more than 5%.	The voltage required to produce a 2 cm deflection at any point on the crt will not vary more than 2% in the vertical direction and 6% in the horizontal direction.
5.6 kV	3.5 kV	4 kV
NON-STORAGE MONITOR	**NON-STORAGE MONITOR**	**NON-STORAGE MONITOR**
Dc to ≥3 MHz	Dc to ≥2 MHz	Dc to ≥1 MHz
≤ 0.5 μs from any point on the crt to within 0.25 mm of final position.	≤ 1 μs from any point on the crt to within 0.36 mm of final position.	≤ 1 μs from any point on the crt to within 0.20 mm of final position.
Nominally 125 mV/div. Adjustable from < 0.05 to 1.25 V/div.	Nominally 125 mV/div. Adjustable from < 0.05 to 1.25 V/div.	Nominally 100 mV/div. Adjustable from .09 to .135 V/div.
1 MΩ ± 1% paralleled by less than 47 pF	1 MΩ ± 1% paralleled by less than 47 pF	100 kΩ ± 10% paralleled by less than 30 pF
≤ 1° to 500 kHz	≤ 1° to 500 kHz	≤ 1° to 1 MHz
± 100 V (dc + peak ac)	± 100 V (dc + peak ac)	± 10 V (dc + peak ac)
± 3 V (nonattenuated), ± 15 V in 5X attenuated position.	± 3 V (nonattenuated), ± 15 V in 5X attenuated position.	Not Applicable
≥100:1 to at least 500 kHz ≥40:1 to 500 kHz with 5X attenuator	≥ 100:1 to at least 100 kHz ≥ 50:1 to 100 kHz with 5X attenuator	Not Applicable
≤10 kΩ	≤10 kΩ	≤1 kΩ
Dc to ≥10 MHz	Dc to ≥5 MHz	Dc to ≥1 MHz
≤ 35 ns	≤70 ns	<200 ns
± 5 V	± 5 V	Not Applicable
≤100:1 to 500 kHz	≥100:1 to 100 kHz	Not Applicable
1 MΩ <47 pF	1 MΩ <47 pF	100 kΩ <70 pF
Adjustable from 0-1 to 0-5 V	Adjustable from 0-1 to 0-5 V	0-1 V
≤10 kΩ	≤10 kΩ	≤1 kΩ
Nominal line voltages are 100, 110, 120, 200, 220, or 240 internally selectable. 48 to 440 Hz 75 W max at nominal line voltage.	Nominal line voltages are 100, 110, 120, 200, 220, or 240 internally selectable. 48 to 440 Hz 56 W max at nominal line voltage.	90 to 136 V ac, or 180 to 270 V ac, 48 to 440 Hz 50 W at 115 V ac, 60 Hz. Rear Panel Selector provides for 6 line-voltage ranges.
0°C to + 50°C	0°C to + 50°C	0°C to + 50°C
Blue vinyl painted cabinet, aluminum construction.	Blue vinyl painted cabinet, aluminum construction.	Blue vinyl painted cabinet, aluminum construction.
Dimensions — Cabinet: in / cm; Rackmount: in / cm Height 6.65 / 16.9 / 5.25 / 13.3 Width 8.4 / 21.3 / 8.4 / 21.3 Length 19.25 / 48.9 / 19.0 / 48.3 Weight (Approx) — lb / kg / lb / kg Net 17.5 / 7.9 / 17.5 / 7.9 Shipping 23.0 / 10.4 / 23.0 / 10.4	Dimensions — Cabinet: in / cm; Rackmount: in / cm Height 6.65 / 16.9 / 5.25 / 13.3 Width 8.4 / 21.3 / 8.4 / 21.3 Length 19.25 / 48.9 / 19.0 / 48.3 Weight (Approx) — lb / kg / lb / kg Net 17.5 / 7.9 / 17.5 / 7.9 Shipping 23.0 / 10.4 / 23.0 / 10.4	Dimensions — Cabinet: in / cm Height 6.5 / 16.5 Width 8.5 / 21.6 Length 17.38 / 44.2 Weight (Approx) — lb / kg Net 17.5 / 7.9 Shipping 22.0 / 10.0
External 8 x 10 cm graticule instruction manual; operator's manual.	External 25-pin program connector; connector cover; instruction manual.	Smoke gray filter; instruction manual.
01—Internal graticule 03—without handle and feet 04—Time base 05—Vector display graticule 06—UL listed 07—without handle , feet and all dust covers	01—without graticule 03—without handle and feet 04—Time base 05—Vector display graticule (P31 phosphor only) 06—UL listed 07—without handle , feet and all dust covers	01—without cabinet 02—without graticule 05—Vector display graticule (P31 phosphor only) 07—without handle , feet and all dust covers
C-30AP, C-5A, C-5A Opt 1	C-59P , C-5A, C-5A Opt 1	C30AP, C-5A, C-5A Opt 1

607 Variable Persistence Display Monitor

50-Minute Gray-Scale Storage

50-minute storage

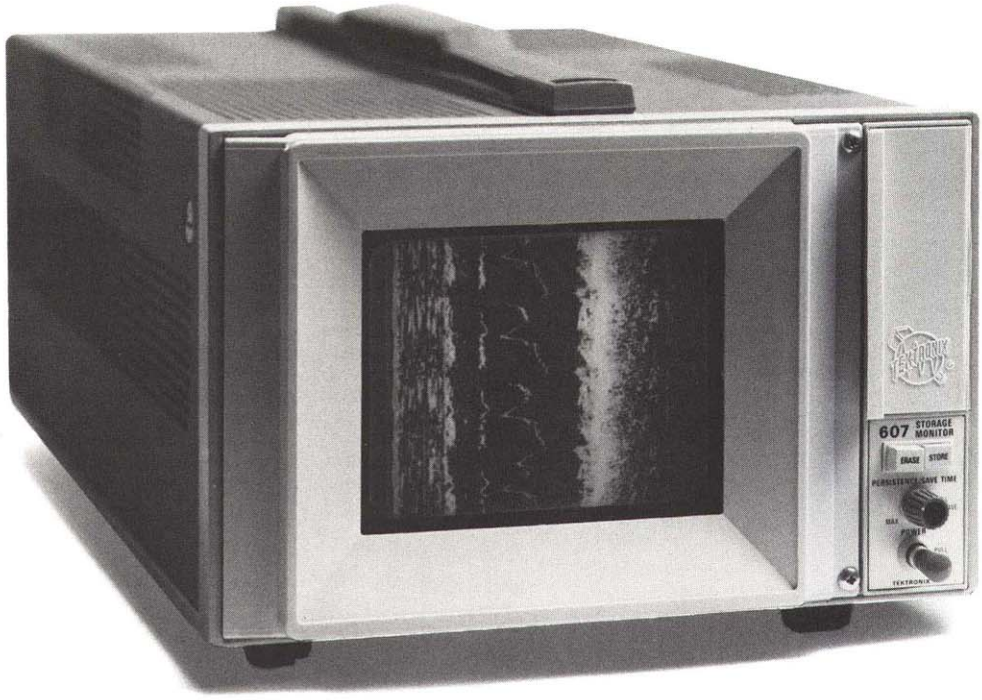
Less deterioration of stored image than any other variable persistence monitor

Adjustable persistence

Remotely programmable storage functions

The TEKTRONIX 607 Variable Persistence Storage Display Monitor produces detailed images that may be stored up to 50 minutes, with less deterioration than any other variable persistence monitor. Display persistence is adjustable to allow the image to fade at a rate consistent with the event being monitored. The TEKTRONIX 607 writes at 0.8 div/μs; X- and Y-axis bandwidth is 3 MHz and Z-axis bandwidth is 5 MHz. It features excellent gray scale capability and a 20 mil-(.51 mm) stored, and 12 mil-(.30mm) non-stored spot size, measured by the shrinking raster method. Differential inputs are standard; erase, non-store, and save-storage functions may be programmed remotely at TTL logic levels. The 607 may be ordered with a time base option that adds amplitude-versus-time measurement capability.

The 607 is an ideal display component where excellent gray scale, resolution and contrast are needed. For instance, in scanning Auger microprobe (SAM) applications where non-destructive analysis of semiconductor, metal or insulator surfaces is performed, the TEKTRONIX 607 is utilized as a preview monitor, while a companion TEKTRONIX 606 and camera are used for photography. Typically, the SAM operator will examine an image on the 607 for impurities or inappropriate elements on, for example, a semiconductor surface. If he suspects a problem, the high resolution TEKTRONIX 606 is used to photograph the area of concern for more exhaustive study. The TEKTRONIX 607 Display Component is especially applicable where display of several recurrences of a transient event, or capture and storage of single-shot events are required. This variable persistence monitor also accommodates display of repetitive phenomena where the persistence is adjusted to let the image fade immediately before the signal is repeated. This is required in applications such as engine analysis, spectrum analysis and radar/sonar displays.



SPECIFICATIONS

CRT DISPLAY AND STORAGE

Variable Persistence Storage Crt—5-inch, flat-faced rectangular tube with P31 phosphor. 12 kV accelerating potential.

Display Size—8 divisions vertically, 10 divisions horizontally at 0.9 cm/div.

Graticule—Standard graticule, external; internal 8 x 10-div graticule supplied as Option 01.

Maximum Writing Speed—At least .8 div/μs for 1 minute viewing time.

Stored Dot Writing Time—A stationary dot written in 500 ns or less can be viewed for at least 15 seconds. With a black background, a stationary dot written in 1 μs or less can be viewed for at least 3 minutes. (Measured within a 6 x 8 div quality area.)

Storage View Time—Greater than 3 minutes at reduced writing speed.

Save Time—Viewing time is extended to over 50 minutes.

Halftone Resolution—At least 18 dots/div.

Halftone Luminance—At least 200 fL.

Erase Time—Approximately 500 ms.

VERTICAL AND HORIZONTAL AMPLIFIERS

Bandwidth—Dc to 3 MHz at 3 dB down (80% full screen scan).

Polarity—Positive signal to both + inputs moves beam up and to the right.

Deflection Factor—Nominally 1 V full scale. Internally adjustable from 0.5 V to 2.5 V full scale. Internal 5:1 attenuator extends deflection factor range to 12.5 V full scale.

Input R and C—1M Ω paralleled by less than 47 pF.

X-Y Phase Difference—Not more than 1° to 500 kHz.

Beam Position—Front-panel position control allows setting zero-signal position to any point on screen. Position shift is 0.09 cm/hr or less after 20 minute warm-up.

Settling Time—Typically 1.0 μs to settle within 1 spot diameter.

Maximum Input Voltage—±100 V (dc plus peak ac).

Linear Common-Mode Signal Range—±3 V (without attenuators; ±15 V with 5X attenuators.

Common-Mode Rejection Ratio—At least 100:1 to at least 500 kHz, 40:1 to 500 kHz with 5X attenuators.

Recommended Source Impedance—10 kΩ or less.

Optional Horizontal Time Base—1 μs/div to 0.1 s/div in six calibrated steps (decade sequence), accurate within 3%. Uncalibrated continuously variable between steps and to approximately 1 s/div, TRIG SLOPE/LEVEL control for stable, triggered displays. For nontriggered display, an internal switch selects bright base line or no sweep.

Z-AXIS AMPLIFIER

Linear Z-axis amplifier permits intensity modulation of the writing beam. Display intensity increases with positive inputs.

Bandwidth—Dc to 5 MHz (−3 dB). Sensitivity adjustable from 1 V to 5 V for full intensity control.

Differential Input—Cmrr at least 100:1 to 100 kHz up to 5 V p-p.

Input R and C—1M Ω paralleled by less than 47 pF.

Maximum Input Voltage—±100 V (dc plus peak ac).

OTHER CHARACTERISTICS

Remote Program Connector—

Inputs—Provides direct connections at the + X-(horizontal), + Y-(vertical), and + Z-axis amplifiers.

The erase, non-store and save-storage functions can be controlled remotely with TTL compatible signals.

Outputs—Erase interval—TTL Compatible. Logic low is 0.4 V or less. Logic high is 2.5 V or more. Will drive 10 unit loads.

Power Requirements—Line voltage selector allows operation from 100, 110, 120, 200, 220, and 240 volts (±10% on each range), and 50 to 60 Hz. Power consumption is 40 watts maximum at nominal line voltage.

Ambient Temperature Limits—0°C to 50°C operating; −40°C to +70°C nonoperating.

Dimensions	Cabinet	
	cm	in
Height	16.9	6.65
Width	21.4	8.4
Length, overall	51.9	20.4
Weights (Approx)	**kg**	**lb**
Net	7.7	17.0
Shipping Weight	≈9.9	≈22.0

Included Accessories—External graticule (331-0391-00); external program connector (131-0570-00); connector cover (200-0281-00).

ORDERING INFORMATION

607 X-Y Display Monitor $1800

Option 01 Internal Graticule . . . . . No Charge

Option 03 Without Handle and Feet . . . . . Sub $10
(Not available with Option 07)

Option 04 Time Base . . . . . Add $150

Option 07 Without Handle, Feet and all Dust Covers (not available with Option 03) . . . . . Sub $20

See page 226 for information on Cameras, page 222 for crt light filters and page 224 for rackmounting.

5-mil or smaller spot size at 0.1μA beam current

Light output uniform across crt

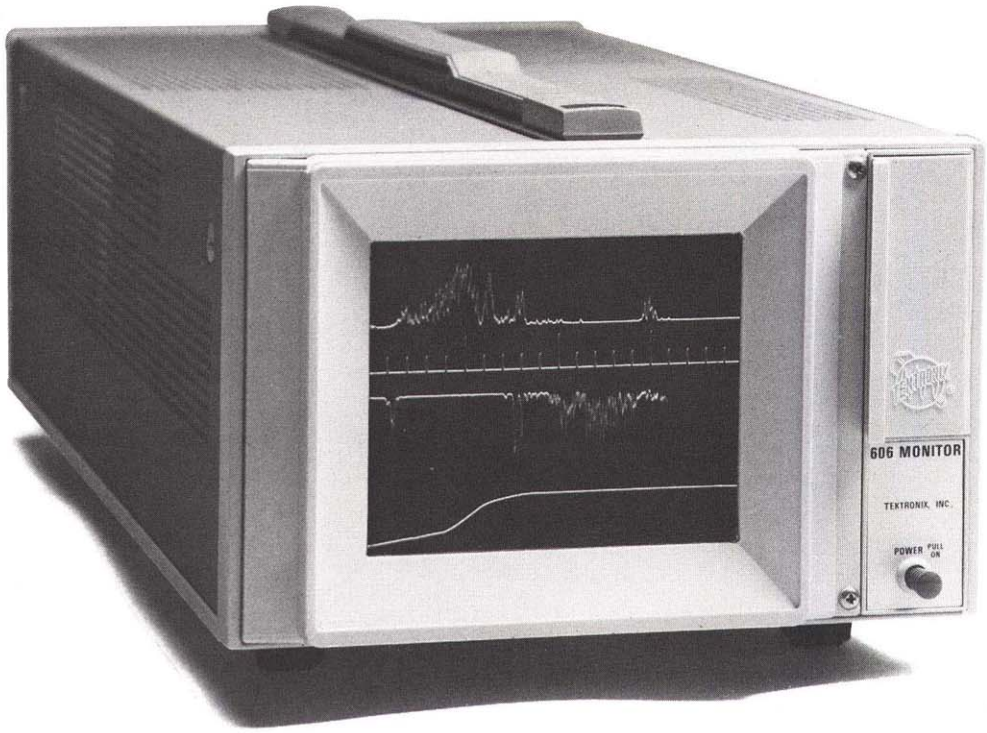
Ideal for photography

10 MHz linear Z-axis bandwidth

An excellent choice for crisp photographs and well-defined displays, the new TEKTRONIX 606 is a very high resolution X-Y Display Monitor. Spot size is 5 mils (.13mm), measured at 0.1μA beam current and by the shrinking raster method; light output is uniform over the entire crt. The linear Z-axis amplifier, with 10 MHz bandwidth, allows the many shades of gray necessary for an accurate image.

The high resolution of the 606 is most useful in applications such as scanning Auger and electron microscopes, ultrasound systems, and gamma camera systems. In medical gamma camera operation, the TEKTRONIX 606 displays the emission of injected radioactive fluid as it moves through and collects in areas of a patient's body. The high resolution of the 606 is well-suited to displaying the tiny dot-like bursts of light that a TEKTRONIX Camera with open shutter integrates onto film. The resulting sharp photo aids the doctor in analysis and diagnosis.

The TEKTRONIX 606 Display Component is also useful where several concurrent waveforms must be displayed, yet resolution maintained. For instance, in an ultrasound application (photo above) the brightness of the 606 results in four high resolution waveforms; the first and third convey tissue density information; the second provides a centimeter scale to measure against; and the bottom waveform imparts time gain curve (TGC) data from which the operator visually sets the ultrasound system gain characteristics.



SPECIFICATIONS

CRT DISPLAY

Cathode-Ray Tube—5-inch flat-faced rectangular crt with P31 phosphor. P7 and P11 phosphor optional.

Display Size—8 cm vertically, 10 cm horizontally.

Graticule—External 8 x 10 cm graticule included as accessory. Internal 8 x 10 cm graticule supplied as Option 01.

Display Linearity—The voltage required to produce a 2-cm deflection at any point on the crt will not vary more than 5%.

Center Screen Spot Diameter—(Measured with shrinking raster method.) 0.005 inch or less at 0.1μA beam current, 0.007 inch or less at 5μA beam current.

Acceleration Potential—5.6 kV.

VERTICAL AND HORIZONTAL AMPLIFIERS

Bandwidth—Dc to 3 MHz at 3-dB down (80% full screen scan).

Polarity—Positive signal to both + inputs moves the beam up and to the right.

Deflection Factor—Vertical and horizontal: Nominally set for IV full scale. Internally adjustable from .5 to 2.5 V full scale. 5:1 fixed internal attenuator extends range to at least 12.5 full scale.

Input R and C—1 MΩ +1%, paralleled by less than 47 pF.

X-Y Phase Difference—Not more than 1° to at least 500 kHz.

Beam Position—Front panel position controls permit setting spot to any point on screen without input signal. Position shift is 0.1 cm or less per hour after 20-min warm-up with cabinet covers in place. Less than 0.2 cm in 24 hours.

Maximum Input Voltage—±100 V dc plus peak ac.

Linear Common-Mode Signal Range—±3 V (without attenuators): ±15 V with 5X attenuators.

Common-Mode Rejection Ratio—At least 100:1 to at least 500 kHz, 40:1 to 500 kHz with 5X attenuator.

Recommended Source Impedance—10 kΩ or less.

Optional Horizontal Time Base—1 μs/div to 0.1 s/div in six calibrated steps (decade sequence), accurate within 3%. Uncalibrated, continuously variable between steps and to approximately 1 s/div. TRIG SLOPE/LEVEL control for stable, triggered displays. For non-triggered operation, an internal switch selects bright base line or no sweep.

Z-AXIS AMPLIFIER

Linear Z-axis amplifier permits intensity modulation of the writing beam. Positive input to + input increases the display intensity.

Bandwidth—DC to 10 MHz (−3 dB). Sensitivity range adjustable from 0 to 1 V to 0 to 5 V for full intensity control.

Differential Input—Cmrr at least 100:1 to 500 kHz up to 5 V p-p.

Input R and C—1 MΩ ±1% paralleled by less than 47 pF.

Maximum Input Voltage—±100 V dc plus peak ac.

OTHER CHARACTERISTICS

Power Requirements—Line voltage selector allows operation from 100, 110, 120, 200, 220, and 240 V (±10% on each range), 50 to 60 Hz and 400 Hz, 75 watts maximum at nominal line voltage.

Dimensions	Cabinet	
	cm	in
Height	16.9	6.65
Width	21.4	8.4
Length, overall	51.9	20.4
Weights (Approx)	**kg**	**lb**
Net	7.7	17.0
Shipping Weight	≃9.9	≃22.0

Included Standard Accessories—External graticule (337-1674-10).

ORDERING INFORMATION

606 Display Monitor $1425

Option 01 Internal Graticule ..... No Charge
Option 03 Without Handle and Feet ..... Sub $10 (Not available with Option 07)
Option 04 Time Base ..... Add $150
Option 06 UL Listed ..... Add $50
Option 07 Without Handle, Feet and All Dust Covers (not available with Option 03) Sub $20
Option 76 P7 Phosphor ..... No Charge
Option 78 P11 Phosphor ..... No Charge

See page 226 for information on cameras, page 222 for crt light filters, and page 224 for rackmounting.

604 | Display Monitor

Low cost

Large 10.2 x 12.7 cm (6½-inch diagonal crt)

X-Y phase difference within 1° to 500 kHz

Time base option

Priced under $1000, the TEKTRONIX 604 Display Monitor is an excellent choice for cost-sensitive applications. Its 10.2 x 12.7 cm view area, and 5 MHz Z-axis bandwidth result in an easy-to-view display and a versatile instrument.

In medical diagnostic ultrasound applications, the 604 displays an A-scan waveform that shows the depth of tissue density changes. The screen is calibrated, so that the waveform on the TEKTRONIX 604 can be matched to the scan to determine the precise distances and movements of the organs.

The 604 may also be switched to display a cross-sectional B-scan waveform. Ultrasound is typical of numerous applications where a low cost display component with a large screen is required—the 604 is an apt choice for such system installations.

CRT DISPLAY

Cathode Ray Tube—6½-in flat-faced rectangular crt with P31 phosphor.

Display Size—Internal parallax-free nonilluminated graticule marked in 8 vertical and 10 horizontal div (1.27 cm/div). Option 1 is without graticule.

Display Linearity—The voltage required to produce a 2.5 cm deflection at any point on the crt will not vary more than 5%.

VERTICAL AND HORIZONTAL AMPLIFIERS

Bandwidth—Dc to 2 MHz at 3 dB down from 80% of full scan.

Deflection Factor—Nominally 1 V full scale. Internally adjustable from 0.5 V to 2.5 V full scale. Internal 5X attenuator extends deflection factor range to 12.5 V full scale.

Input R and C— 1 MΩ ±1% paralleled by less than 47 pF.

X-Y Phase Difference—Not more than 1° to at least 500 kHz.

Beam Position—Front panel position controls permit setting 0 signal position to any point on screen. Position shift is 1 mm/hr or less after 20 min warm up.

Max Input Voltage—±100 V (dc plus peak ac).

Linear Common-Mode Signal Range— ±3 V, ±15 V in 5X fixed attenuator position.

Common-Mode Rejection Ratio—At least 100:1 to at least 100 kHz, 50:1 to 100 kHz with 5X attenuator.

Recommended Source Impedance— 10 kΩ or less.

Optional Horizontal Time Base— 1 μs/div to 0.1 s/div in 6 calibrated steps (decade sequence), accurate within 3%. Uncalibrated, continuously variable between steps and to approx 1 s/div. TRIG SLOPE/LEVEL control for stable triggered displays. For nontriggered operation, an internal switch selects bright baseline or no sweep.

Z-AXIS AMPLIFIER

Linear Z-axis amplifier permits intensity modulation of the writing beam. Positive input to + input increases the display intensity.

Bandwidth—Dc to 5 MHz over usable range. Sensitivity range is adjustable from 0 to +1 V to 0 to +5 V for full intensity control; 0 V input cuts off intensity.

Differential Input—Cmrr at least 100:1 and common-mode range at least ±5 V.

Input R and C—1 MΩ ±1% paralleled by less than 47 pF.

Max Input Voltage—±100 V (dc plus peak ac).

OTHER CHARACTERISTICS

Power Requirements—Line voltage selector allows operation from 100, 110, 120, 200, 220, and 240 V (±10% on each range), 50 to 60 Hz and 400 Hz, 56 W max at nominal line voltage.

Dimensions	Cabinet		Rackmount	
	cm	in	cm	in
Height	16.9	6.65	13.5	5.25
Width	21.4	8.4	21.4	8.4
Length	48.9	19.25	48.25	19.0
Weights (Approx)	**kg**	**lb**	**kg**	**lb**
Net	7.9	17.5	7.9	17.5
Shipping Weight	10.4	23.0	10.4	23.0

Included Accessories—External program connector (131-0570-00); connector cover (200-0821-00).

ORDERING INFORMATION

604 Monitor **$925**

Option 01 Without Graticule ..... No Charge

Option 03 Without Handle and Feet ..... Sub $10 (not available with Opt 07)

Option 04 Time Base ..... Add $150

Option 05 Vector Display Graticule (P31 Phosphor Only) ..... Add $30

Option 06 U.L. Listed ..... Add $50

Option 07 Without Handle, Feet, and All Dust Covers (not available with Opt 03) ..... Sub $20

Option 76 P7 Phosphor ..... No Charge

Option 78 P11 Phosphor ..... No Charge

See page 226 for information on cameras, page 224 for rackmounting and tables below for crt light filters.

Light Filters/Graticules

Monitor	Filters/Graticules	Part No.	Price
602	Smoke-Gray Filter*	378-0586-00	$2.20
	Amber Filter for Opt. 76	378-0595-00	$6.00
	Blue Filter	378-0845-00	$1.90
	Graticule*	331-0406-00	$4.25
	Clear Shield*	337-1017-00	$6.25
603 and 604	Clear Filter for 604*	337-1440-00	$1.50
	Green Filter for 603*	337-1440-01	$1.50
	Amber Filter for Opt. 76	337-1440-02	$1.50
	Blue Filter	337-1440-03	$1.50
	Gray Filter	337-1440-04	$1.50
	Graticule*	331-0303-00	$3.30

Monitor	Filters/Graticules	Part No.	Price
605 and 607	Blue Filter	337-1674-00	$2.15
	Amber Filter	337-1674-05	$2.50
	Smoke-Gray Filter*	337-1674-06	$2.15
	Graticule*	331-0391-00	$3.90
606	Smoke-Gray Filter	337-1674-06	$2.15
	Blue Filter	337-1674-11	$2.40
	Amber Filter	337-1674-12	$3.15
	Graticule*	337-1674-10	$2.50
	Clear Shield*	337-1674-13	$2.50

*Shipped on or with the standard instrument.

10-Hour Storage

1 million dot/second stored writing speed

Large 10.2 cm x 12.7 cm viewing area

Stored or nonstored display

The 603 utilizes a Tektronix-developed bistable storage crt that makes refreshing of the display and associated costly memory devices unnecessary. Image brightness may be adjusted to extend storage time to ten hours. Erase and store commands are remotely programmable and are accessable together with +X, +Y, and +Z inputs through a 25-pin connector on the rear panel.

The TEKTRONIX 603 Bistable Storage Monitor assists in analysis and documentation of changing mechanical, electrical or biological phenomena. The 603 is indispensable for direct comparison of successive images. In a dental application, for example, a kinesiograph monitors bite position or jaw movement producing a series of stored displays on the 603. These waveforms help the dental specialist in diagnosis, or confirming success of a treatment.

The TEKTRONIX 603 also functions as a preview monitor. Information can be stored and studied before taking a photograph; or when many repetitions of an event are performed, each may be stored and scrutinized before deciding to photograph, eliminating the need to record every occurrence.

CRT DISPLAY AND STORAGE

Cathode Ray Tube—6½-in flat-faced, bistable storage tube. Phosphor is similar to P1. 3.5 kV accelerating potential. Two storage tubes are available (standard crt for brighter stored display or Option 02 for a faster writing speed at lower stored brightness). When used in the nonstore mode, both tubes exhibit characteristics of a conventional crt.

Writing Speed—Standard crt, at least 20 div/ms; Option 02, at least 200 div/ms.

Dot Writing Time—Time required to write (store) one dot: standard crt, 4 μs or less; Option 02 crt, 0.5 μs or less.

Information Storage Rate—Standard crt, at least 200,000 dots/s; Option 02 crt, at least 1 million dots/s.

Display Size— 10.2 cm vertically, 12.7 cm horizontally. An internal nonilluminated graticule (8 x 10 div, 1.27 cm/div) is available as Option 01.

Resolution—Stored, equivalent to 80 vertical x 100 horizontal stored line pairs. Nonstored, equivalent to 128 vertical x 160 horizontal line pairs.

Display Linearity—The voltage required to produce a 1-in deflection from point on the crt will not vary more than 5%.

Viewing Time—At least 1 hr at normal intensity without loss of resolution. Viewing time can be extended to 10 hr with the variable brightness control.

Erase Time—Approx. 250 ms.

VERTICAL AND HORIZONTAL AMPLIFIERS

Bandwidth—Dc to 2 MHz at 3 dB down from 80% of full scan.

Deflection Factor—Nominally 1 V full scale. Internally adjustable from 0.5 V to 2.5 V full scale. Internal 5X attenuator extends deflection factor range to 12.5 V full scale.

Input R and C—1 MΩ ±1% paralleled by less than 47 pF.

X-Y Phase Difference—1° or less to at least 500 kHz.

Beam Position—Front-panel position controls permit setting 0 signal position to any point on screen. Position shift is 1 mm/hr or less after 20-min warm-up.

Settling Time—0.2 μs or less for distances of 1 div or less. 1 μs or less from any point on the crt to within 1 spot diameter of final position.

Max Input Voltage—± 100 V dc plus peak ac.

Linear Common-Mode Signal Range—±3 V, ±15 V in 5X fixed attenuator position.

Common-Mode Rejection Ratio—At least 100:1 to at least 100 kHz, 50:1 to 100 kHz with 5X attenuator.

Recommended Source Impedance— 10 kΩ or less.

Optional Horizontal Time Base—1 μs/div to 0.1 s/div in 6 calibrated steps (decade sequence), accurate within 3%. Uncalibrated continuously variable between steps and to approx 1s/div. TRIG SLOPE/LEVEL control for stable, triggered displays. For nontriggered operation, an internal switch selects bright baseline or no sweep.

Z-AXIS AMPLIFIER

Linear Z-axis amplifier permits intensity modulation of the writing beam in nonstored mode. Positive input to + input increases the display intensity. To insure storage of each written dot, the Z-axis on-time should be at least 4μs with the standard crt and at least 0.5 μs with the Option 2 crt. The Z-axis pulse should be timed so that the system settling time is completed before unblanking occurs.

Bandwidth—Dc to 5 MHz over usable range. Sensitivity range is adjustable from 0 to +1 V to 0 to +5 V for full intensity control; 0 V input cuts off intensity.

Differential Input—Cmrr at least 100:1 and common-mode range at least ±5 V.

Input R and C—1MΩ ±1% paralleled by less than 47 pF.

Max Input Voltage—±100 V (dc plus peak ac).

OTHER CHARACTERISTICS

Power Requirements—Line voltage selector allows operation from 100, 110, 120, 200, 220, and 240 V (±10% on each range), 50 to 60 Hz and 400 Hz. 75 W max at nominal line voltage.

Dimensions	Cabinet		Rackmount	
	cm	in	cm	in
Height	16.9	6.65	13.5	5.25
Width	21.4	8.4	21.4	8.4
Length	48.9	19.25	48.25	19.0
Weight (approx)	**kg**	**lb**	**kg**	**lb**
Net	7.9	17.5	7.9	17.5
Shipping Weight	10.4	23.0	10.4	23.0

Included Accessories—External program connector (131-0570-00); connector cover (200-0821-00); external graticule (331-0303-00).

ORDERING INFORMATION

603 Storage Monitor **$1400**

Option 01 Internal Graticule ..... No Charge

Option 02 Fast Writing Speed Crt ..... Add $35

Option 03 Without Handle and Feet ..... Sub $10 (not available with Opt 01)

Option 04 Time Base ..... Add $150

Option 06 U.L. Listed ..... Add $50

Option 07 Without Handle, Feet, and All Dust Covers (not available with Opt 03) ..... Sub $20

See pages 226 for information on cameras, page 222 for crt light filters, and page 224 for rackmounting.

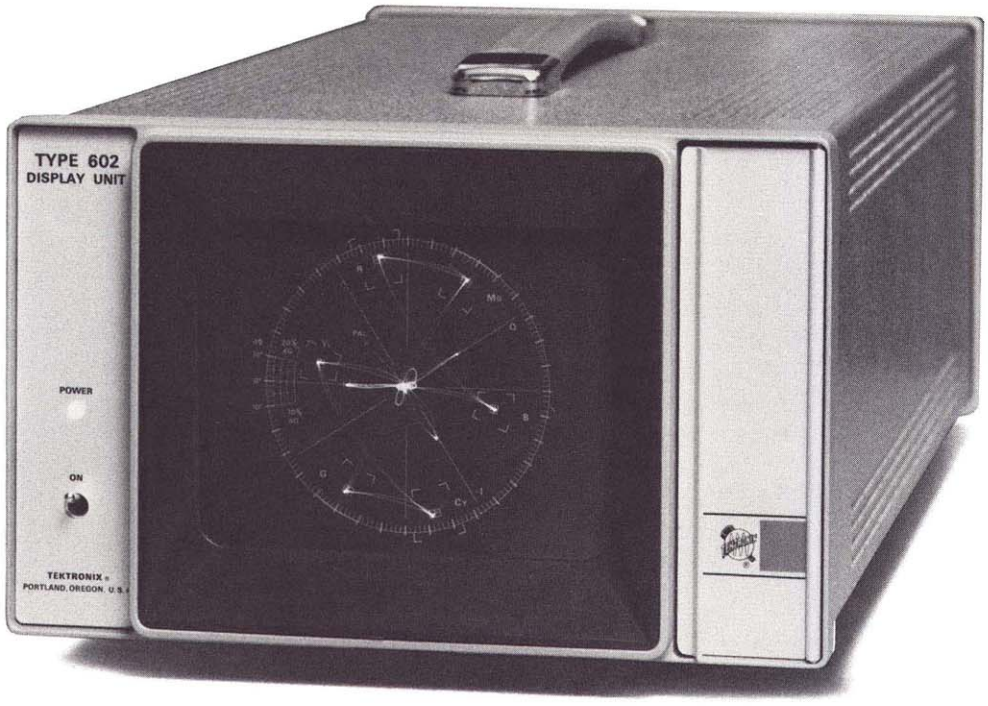
602 Display Monitor

8-Mil spot size

High resolution—an excellent value

X-Y phase difference within 1° to 1 MHz

1 MHz X and Y Bandwidth



The TEKTRONIX 602 is a prime value. Its 8-mil (.20mm) spot size will satisfy many applications requiring high resolution (spot size measured at .5μA beam current and by shrinking raster method). A linear Z-axis amplifier permits precise intensity modulation of the writing beam. The 602 display area measures 8 x 10 cm, but the entire monitor is just 16.5 x 21.6 x 44.2 cm.

Its performance features, size, and low cost make the 602 an excellent choice for graphic, alphanumeric, and vector display applications. For instance, the 602 is sold with an optional vector display graticule; when used with a TEKTRONIX 650 Color Monitor in video tape recorder systems, it provides an exceptionally accurate vector display.

The phase and amplitude of a tv signal's color components, as referenced to a standard color burst signal, are aligned to where vector peaks line up with designated points on the vector graticule. The result is precise color. The 602 Monitor's stability contributes to an accurate color separation display.

CRT DISPLAY

Cathode Ray Tube—5-in flat-faced rectangular crt with P31 phosphor.

Display Size—8 cm vertically and 10 cm horizontally.

Graticule—Standard graticule: internal, parallax-free, variable illumination supplied with standard 602, as shown above. Optional graticule: internal 8 x 10 cm outline (no graticule lines) supplied with Option 02.

Trace Width—Max trace width within the 8 x 10 cm display area is 14 mils at 0.5μA beam current (typically less than 10 mils).

Display Linearity—The voltage required to produce a 2 cm deflection at any point on the crt will not vary more than 2% in the vertical direction and 6% in the horizontal direction.

VERTICAL AND HORIZONTAL AMPLIFIERS

The X (horizontal) and Y (vertical) differential amplifier input circuits are isolated from ground and offer noise-rejection capabilities to minimize noise signals common to the inner and outer conductor of the connecting cables.

Bandwidth—DC to 1 MHz at 3 dB down.

Deflection Factor—Vertical: 90 mV/cm to 135 mV/cm, internally variable. Horizontal: 90 mV/cm to 110mV/cm, internally variable.

Phase Difference—Not more than 1° between X and Y amplifiers up to 1 MHz.

Beam Position—Front panel vertical and horizontal position ranges permit setting zero signal position to any point on screen. Position shift is not more than 1 mm/hr after 20 min warm up.

Polarity—Positive input to the vertical and horizontal inputs moves the beam up and to the right.

Input R and C—100 kΩ ±10% paralleled by 30 pF or less.

Max Input Voltage—± 10 V (dc and peak ac).

Recommended Source Impedance—1 kΩ or less.

Z-AXIS AMPLIFIER

A linear Z-axis amplifier permits intensity modulation of the writing beam. Analog input: dc to 1 MHz over 0.0 V to +1 V range. Signal input is a BNC connector on the rear panel.

Input R and C—100 kΩ ±10% paralleled by 70 pF or less.

Max Input Voltage—±10 V (dc plus peak ac).

Recommended Source Impedance—1 kΩ or less.

OTHER CHARACTERISTICS

Power Requirements—90 to 136 V ac, or 180 to 272 V ac, 48 to 440 Hz. 50 W at 115 V ac, 60 Hz. Rear-panel selector provides rapid accommodation for 6 line-voltage ranges.

Temperature—Electrical specifications are valid over the range of 0°C to +50°C ambient.

Finish—Blue vinyl painted cabinet, aluminum construction.

Dimensions	Cabinet	
	cm	in
Height	15.3	6
Width	21.6	8½
Length	44.1	17⅜
Weights (approx)	**kg**	**lb**
Net Weight	7.9	17½
Shipping Weight	≈9.9	≈22

Included Accessories—Smoke-gray filter.

ORDERING INFORMATION

602 Display Unit $1150

Option 01 Without cabinet ..... Subtract $25

Option 02 Without graticule ..... No Charge

Option 05 Vector Display Graticule (P-31 Phosphor Only) ..... Add $25

Option 76 P7 Phosphor ..... No Charge

Option 78 P11 Phosphor ..... No Charge

See page 226 for information on cameras, page 222 for crt light filters, and below for rackmount/conversion information.

Rackmounts / Conversions

Rackmounting For 602

5¼-inch Rack Adapter—Two 602s may be mounted side by side.
Order 016-0115-02 ..... $155

Blank Panel—For covering half of 016-0115-02 Rack Adapter when only one 602 is used.
Order 016-0116-00 ..... $22

Rackmounting For 603, 604, 605, 606 and 607

Cabinet-to-Rackmount Conversion, equipped with slide-out assembly, to rackmount any TEKTRONIX Display Monitor (except 602) with Option 03 in a standard 19-inch rack. This includes securing hardware and a blank front panel.
Order 040-0601-00 ..... $112

Cabinet-to-Rackmount Conversion, equipped with slide-out assembly, to rackmount any two TEKTRONIX Display Monitors (except 602) with Option 03, side-by-side in a standard rack width.
Order 040-0600-00 ..... $80

Rackmount-to-Cabinet Conversion, required to convert a rackmount 603, 604, 605, 606 or 607 to a cabinet style.
Order 040-0602-00 ..... $65

Cabinet-to-Rackmount Conversion, equipped with slide-out assembly, required to rackmount a TM503 modular test system and a 603, 604, 605, 606 or 607 in a standard 19-inch rack.
Order 040-0624-00 ..... $65

Cameras, Probes, Oscilloscope Carts, and Other Accessories

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CHOOSING A TEKTRONIX CAMERA

Overview of TEKTRONIX Camera Families

A camera can be a key part of your measurement system. It allows you to capture single events and document your results, and it helps you communicate your results with clarity and credibility. The following pages give information to help you select a camera well suited to your needs.

MOUNTING

The table on page 228 indicates the camera adapters required for most TEKTRONIX Instruments and a few by other manufacturers. In some cases, adapters are available from Hewlett-Packard or DuMont to mount TEKTRONIX Cameras to their instruments.

LENSES

TEKTRONIX Camera lenses differ mainly in light gathering ability, magnification, and field of view.

Speed—The f-number of a lens inversely signifies its aperture area and light gathering ability. For example, the aperture area of an f/1.4 lens is four times that of an f/2.8 lens of the same magnification and gathers four times the light. The relative light gathering ability of all lenses used in TEKTRONIX Cameras is referenced to the f/1.9, 0.85 magnification lens which is arbitrarily rated at 1.0. For recording a stored or stable recurrent crt display, a lens as slow as the f/16 type used in the C-5A Camera is adequate. However, to record a fast, dim, single-sweep trace, you may need a lens as fast as the f/1.2 types used in the C-31 and C-51 Cameras.

Field of View—The description for each camera includes a statement of its field of view; this signifies how large a crt display the camera can fully record. It is determined by the combined effects of the magnification and angular field of view of the lens, any field-limiting apertures in the camera adapter, camera body, film holder, and the image area of the film.

Magnification — Modern optical technology has made possible wide-aperture, wide-angle, flat-field lenses with short focal length for more compact cameras. To realize their inherent low distortion, high resolution, and uniform focus, these fixed focal length lenses must be used at their design center magnification.

Operating such lenses at a different magnification tends to compromise their important performance characteristics. For this reason, most TEKTRONIX Cameras are designed for use at one lens magnification. One exception is the C-30A Camera which has a magnification range of 0.7 to 1.5 (at some increase in distortion at the magnification extremes) to accommodate several portable oscilloscopes that have displays ranging in size from 3.8 x 6.3 cm to 8 x 10 cm.

The rated magnification of a lens signifies its image-to-object ratio.

Maximum Magnification to Record Entire Screen

	Screen Size			
	5 x 6.3 cm	7.2 x 9 cm	8 x 10 cm	9.76 x 12.2 cm
Polaroid pack and roll film	1.0	1.0	0.85	0.67
4 x 5 sheet film	1.0	1.0	1.0	0.85 or less
6 x 7 cm format roll film (70 mm, 120, 220, etc.)	1.0	0.67	0.67	not recommended

0.5 magnification is used for high speed recording, since reducing the size of image increases its brightness.

For maximum resolution, the lens should produce the largest complete image possible within the image area of the film. The film most widely used for oscilloscope trace recording is Polaroid Type 107 pack film which has an image area of 73 x 95 mm. In most cases, the magnification is selected to provide the largest possible complete image of a particular display. An exception is in high writing speed applications where a 0.5 magnification lens is usually used to achieve higher writing speed by concentrating the trace light in a smaller area of the film.

SHUTTERS

There are two types of shutters: **mechanical** and **electric.**

Mechanical shutters are simple to operate and are economical. They are actuated by pressure on a release mechanism.

Electrical shutters permit remote, automatic, or manual release and offer higher reliability. The SPEEDCOMPUTER control box for the C-12, C-27, and C-30-Series electric shutters requires 115 or 230 V ac. They may be actuated by an insulated switch closure.

The C-50, 51, 52, and 53 electric shutters require + 15 V, normally supplied by a 7000-Series Oscilloscope. An external battery pack is available for situations where one of these cameras is used on a non-7000 Series instrument. These shutters can be actuated by a switch closure to ground.

VIEWING

Except for the C-30-Series, all TEKTRONIX Cameras have a viewing port which provides a binocular view of the crt. All TEKTRONIX Cameras, except the C-5A, are hinge mounted and can be swung aside to allow a wide-angle view of the crt. The lightweight C-5A can easily be slipped off the crt bezel to view the crt. The C-27 and C-50-Series Cameras have an off-axis viewing hood that accommodates eyeglasses for a comfortable binocular view of the crt display while excluding ambient light.

By means of mirrors, the C-12 viewing tunnel provides a straight-on view of the crt to minimize parallax errors when photographing an external graticule. The optional Projected Graticule accessory for the C-12 provides parallax-free changeable graticules of any design.

FILMS

The three types of backs used on TEKTRONIX Cameras accommodate most of the films that are used for crt trace recording. These include sheet films, roll films, and pack films.

Polaroid films are the most convenient to use. They offer the advantages of development in seconds to a finished dry print with wide spectral response, good resolution, and high sensitivity. ASA ratings do not necessarily give a true indication of how a film will respond in crt recording due to the narrow spectral output range of most phosphors and different spectral sensitivity of various film types.

Many different types of Polaroid film are available in rolls, packs, and 4 x 5 inch single-sheet packets. The types most used in oscilloscope and monitor photography are types 107, 47, 57, and 410.

Technical assistance with Polaroid film and back questions or problems is available directly from The Polaroid Corporation. Call (800) 225-1618 toll free.

The more commonly used films for each type of camera back are listed below.

POLAROID FILMS

Film Type	ASA Equivalent Speed	Develop. Time (Seconds at 75° F)	Format	Resolution Line Pairs/mm	Characteristics	CRT Recording Uses: Repetitive	Stored	TV Type (Gray Scale)	Scintillation Type Medical	Graphics, Alpha Numer.	Single Sweep
PACK FILMS 3¼ x 4¼ in. — Actual image size 73 x 95 mm											
665	75	30	Positive Print Negative Transparency	20-25 160-180	Med. Contrast, wide gray scale	XX	XX	XX			
107	3,000	15-20	Positive Print	20	Medium Contrast	XX	XX				XX
084	3,000	15	Positive Print	20	Medium Contrast			XX	XX		
667	3,000	30	Positive Print	16	Medium Contrast, no coating required			XX	XX		
108	75	60	Positive Print	15-17	Color—Balanced for 5500° K	XX		XX			
668	75	60	Positive Print	15-17	Color—Balanced for Electronic Flash	XX		XX			
ROLL FILMS 3¼ x 4¼ in. — Actual image size 73 x 95 mm (46L and 146L are 62 x 83 mm)											
42	200	15-20	Positive Print	25-28	Med. Contrast, wide gray scale	XX	XX	XX			
47	3,000	15-20	Positive Print	20-22	Medium Contrast	XX	XX				XX
410	10,000	15	Positive Print	20	High Contrast						XX
46L	800	120	Positive Trans	35-40	Medium Contrast	XX	XX	XX			
146L	200*	30	Positive Trans	40-50	High Contrast, Blue Sensitive	XX				XX	
SHEET FILMS 4 x 5 in. — Actual image size 89 x 114 mm											
51	320*	15-20	Positive Print	28-32	High Contrast, Blue Sensitive					XX	
52	400	20	Positive Print	35-40	Medium Contrast, wide gray scale	XX	XX	XX			
55 P/N	50	20	Positive Print Negative Transparency	22-25 160	Medium Contrast, wide gray scale	XX	XX	XX			
57	3,000	15-20	Positive Print	20	Medium Contrast	XX	XX			XX	XX
58	75	60	Positive Print	15-17	Color Balanced for 5500° K	XX		XX			

*Daylight rating.

Blue type indicates most popular films for oscilloscope trace recording.

PHOTOGRAPHIC WRITING SPEED

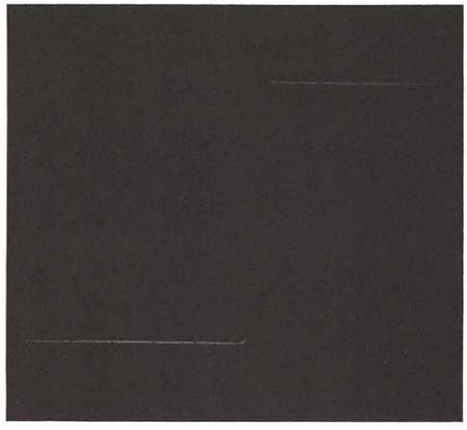
Photographic writing speed signifies the ability of a particular oscilloscope/camera system to provide a useful photographic record of a fast single-sweep trace. It is stated as an oscilloscope performance characteristic and is expressed in cm/μs or cm/ns. It is designed to answer the question, "What is the speed of the fastest single-sweep trace the system can record?" All statements of writing speed must specify the measurement conditions, including the crt phosphor and film used, and the definition of a readable trace image.

The method used for measuring and stating the photographic writing speed of TEKTRONIX Oscilloscope/camera systems is described in the 7000-Series Application Note 42 m 1.0 (Ax 3031): "Photographic Writing Speed," which is available from your Tektronix Field Office or Representative.

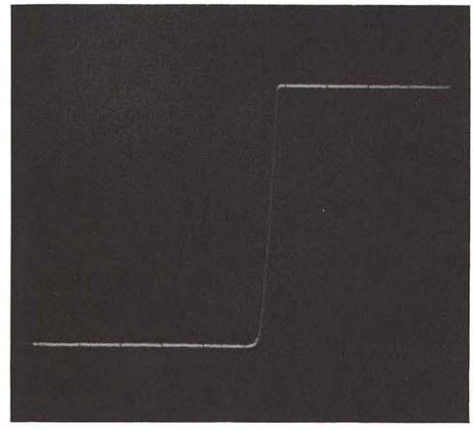
Film fogging is a technique for increasing the maximum sensitivity of photographic film by giving it a short exposure to dim, diffuse light. The TEKTRONIX Writing Speed Enhancer is designed to fill this need.

The Enhancer installs in minutes, and can be triggered in three ways: by a pushbutton on the control box, remotely with a switch closure to ground (such as provided by the camera-shutter x sync switch), or by the oscilloscope-sweep + gate.

Thus, the film can be fogged before, after, or while the sweep occurs. The techniques are respectively called prefogging, post-fogging, and simultaneous fogging. Of these modes, simultaneous fogging provides the greatest gain in writing speed. Automatic, simultaneous fogging is easily achieved by triggering the Enhancer with the oscilloscope-sweep + gate.



This Polaroid Type 107, 3000-Speed pack film was exposed to the single-trace display of a pulse waveform with a fast rising leading edge too dim to produce a developable image.



Film from the same pack was exposed to the same single-trace waveform and simultaneously to light from a Writing Speed Enhancer. The Enhancer light supplied the additional photons needed at the weak film development centers formed by the dim leading edge, to produce a visible image of the entire waveform.

Polaroid Film: Type	Polaroid Film: ASA Equivalent Speed	Relative Film Writing Speed: Unfogged: Print viewed with front illumination	Unfogged: Print viewed with back illumination	Fogged: Print viewed with front illumination*
107	3000	1 (Reference)	Print base is opaque	3
47	3000	1	1.2	3
410	10,000	2	2.2-2.4	4

*Viewing a fogged print with back illumination does not increase the apparent writing speed.

Oscilloscope Camera/Adapter

TYPE OSCILLOSCOPE	RECOMMENDED CAMERA	USE*	C-5A ADAPTER HOOD PART NUMBER	C-50 SERIES AND C-27 ADAPTER PART NUMBER	C-30 SERIES ADAPTER PART NUMBER	C-12 ADAPTER PART NUMBER
314 326 335	C-30A	GP	—	—	016-0327-00	—
422	C-30A	GP	—	—	016-0306-00	—
432[1], 434[2], 464, 466	C-30A Opt 01 C-5A Opt 02	GP LC	016-0359-00	—	016-0301-00	—
453, 453A, 454, 454A	C-30A C-31	GP HS	—	—	016-0306-00	—
455, 465, 475, 475A	C-30A Opt 01 C-31 Opt 01 C-5A Opt 02	GP HS LC	016-0359-00	—	016-0301-00 (C-30A Opt 01) 016-0269-02 (C-31 Opt 01)	—
485	C-30A C-31	GP HS	—	—	016-0306-00	—
491	C-30A	GP	—	—	016-0306-00	—
502, 502A	C-59	GP	—	016-0225-03	016-0243-00	016-0226-01
503, 504	C-27	GP	—	016-0225-03	016-0243-00	016-0226-01
519	C-27 Opt 4 C-51[4]	HS HS	—	016-0240-00 (Integral w/519)	—	016-0239-00
520A, 521A, 522A	C-59	GP	—	016-0295-00	—	—
528	C-59 C-5A Opt 01	GP LC	016-0357-00	016-0249-03	016-0248-00	—
529	C-59	GP	—	016-0224-00	016-0244-00	016-0217-00
530, 540, 550 Series	C-27	GP	—	016-0225-03	016-0243-00	016-0226-01
561A, 561B, 564A, 564B	C-27	GP	—	016-0224-00	016-0244-00	016-0217-00
565	C-59	GP	—	016-0225-03	016-0243-00	016-0226-01
568	C-27	GP	—	016-0224-00	016-0244-00	016-0217-00
575	C-27	GP	—	016-0225-03	016-0243-00	016-0226-01
576	C-27 C-59	GP GP	—	See Adapter Frame/Corrector Lens Systems at right		
577[2]	C-5A C-59	LC GP	016-0357-00	016-0249-03	016-0248-00	016-0263-00
601, 602	C-30A C-5A Opt 01	GP LC	016-0357-00	016-0249-03	016-0248-00	016-0263-00
603[6 7]	C-5A Opt 01 C-59	LC GP	016-0357-00	016-0249-03	016-0248-00	016-0263-00
604 [6 8]	C-5A	LC	016-0357-00	016-0249-03	016-0248-00	016-0263-00
605, 606, 607	C-30A C-5A Opt 01	GP LC	016-0357-00	016-0249-03	016-0248-00	016-0263-00
647, 647A	C-27	GP	—	016-0223-00	—	—
1420 Series	C-5A	LC	016-0357-00	016-0249-03	016-0248-00	016-0263-00
1480 Series	C-59	GP	—	016-0342-00	—	—
1502, 1503	C-30A	GP	—	—	016-0327-00[1]	—
5030, 5031	C-27 C-59	GP GP	—	See Adapter Frame/Corrector Lens Systems at right		
5100 Series	C-5A	LC	016-0357-00	016-0249-03[1 6]	016-0248-00[1 6]	016-0263-00[1 6]
5403/D40 5440, 5444	C-59 C-5A Opt 01	GP LC	016-0357-00	016-0249-03[6]	016-0248-00[6]	016-0263-00[6]
5403/D41, 5441	C-58 C-59 C-5A Opt 01	GP 67 LC	016-0357-00	016-0249-03	016-0248-00	016-0263-00
7313[2], 7503, 7504, 7514, 7613 7623A, 7633 7704A, 7904, R7903, 7834, 7844	C-53, C-27 C-59 C-51 C-5A Opt 01 C-58	GP 67 HS LC 45	016-0357-00	016-0249-03	016-0248-00	016-0263-00

TYPE OSCILLOSCOPE	RECOMMENDED CAMERA	USE*	C-5A ADAPTER HOOD PART NUMBER	C-50 SERIES AND C-27 ADAPTER PART NUMBER	C-30 SERIES ADAPTER PART NUMBER	C-12 ADAPTER PART NUMBER
7403N, 7603 7603-N11S	C-59 C-5A Opt 01	GP LC	016-0357-00	016-0249-03[6]	016-0248-00[6]	016-0299-00[6]
SC502	C-30A	GP	—	—	016-0327-00[1]	—
T900 Series Except T922R	C-5A Opt 03	LC	016-0358-00	—	—	—
T922R	C-5A Opt 01	LC	016-0357-00	016-0249-03	016-0248-00	016-0263-00
TELEQUIPMENT Except D83	None	—	—	—	—	—
TELEQUIPMENT D83	C-59 C-5A Opt 01	GP LC	016-0357-00	016-0249-03[6]	016-0248-00[6]	016-0263-00[6]
HP 5" Round CRT	C-27	GP	—	016-0228-00	—	—
HP 5" Rect. CRT	C-27	GP	—	HP 10362-A[5]	HP 10363-A[5]	HP 10361-A[5]
HP 1332A, 1335A	C-27 C-5A	GP LC	016-0357-00	016-0249-03	016-0248-00	016-0263-00
Some HP Some HP	C-30A	GP	—	—	HP 10106-A[5]	—
HP 182	—	—	—	—	—	—
600, 5100, 5400, 7000-Series	—	—	014-0045-00	Will mount HP Models 195A, 197A Cameras.		

[1]Graticule is nonilluminated and will not photograph.

[2]Graticule is nonilluminated and will not photograph except when crt is in the stored mode.

[3]Increases camera's field-of-view so that the full 8 x 10-cm crt display area can be recorded.

[4]C-50, C-51, C-52, and C-53 Cameras require Battery Pack 010-0270-00 for power when not used with 7000-Series Oscilloscopes.

[5]Available from Hewlett-Packard. See HP catalog for additional compatability information and prices.

[6]Only the C-5A and C-59 Cameras can entirely record the 6½-inch crt display without cropping.

[7]The C-59 is suitable for the standard-model Type 603 but it cannot photograph the nonilluminated graticule of the Option 01 Model.

[8]The C-59 also mounts directly onto the Type 604 but it cannot photograph the nonilluminated graticule of the standard model.

*GP = General Purpose
LC = Low Cost
HS = High Speed
45 = 4 x 5" Sheet film
67 = 6 x 7 cm Roll film (70 mm, 120, 220, etc.)

CAMERA ADAPTER PART NUMBERS & PRICES

014-0045-00	$65	016-0263-00	$40
016-0217-00	$40	016-0269-02**	$65
016-0223-00	$40	016-0295-00	$40
016-0224-00	$40	016-0299-00	$40
016-0225-03	$40	016-0301-00***	$60
016-0226-01	$40	016-0306-00†	$60
016-0228-00	$40	016-0327-00	$42
016-0243-00	$45	016-0342-00	$42
016-0244-00	$45	016-0357-00††	$12
016-0248-00	$45	016-0358-00†††	$12
016-0249-03*	$48	016-0359-00††††	$12

*(Included with C-50 Series Cameras)

**(Adapter with lens included with C-31 Opt 01 Cameras)

***(Adapter with lens included with C-30A Opt 01 Cameras)

†(Included with C-30A, C-31 Cameras)

††(Included with C-5A and C-5A Opt 01 Cameras)

†††(Included with C-5A Opt 03 Cameras)

††††(Included with C-5A Opt 02 Cameras)

see page 234 for extra viewing doors and flash units

ADAPTER FRAME/CORRECTOR LENS FOR C-12 or C-27 CAMERA

Expands the field of view of the C-12 and C-27 to fully cover the 6½ in crt and adjacent scale readout characters of the 576 Curve Tracer and 5030-Series scopes. The Corrector Lens reduces the effective magnification of a standard camera's 0.85-mag lens to 0.45 so it can record the entire display on Polaroid 3¼ x 4¼ in film.

Although each camera's photographic field is expanded to include the entire display, the view through the viewing tunnel is not. The C-12 provides a view of the crt screen only. The C-27's view is restricted to the lower two thirds of the crt and scale readout. Both cameras can of course be swung aside to allow a full view of the entire display. The adapter frame requires use of a standard camera adapter (016-0226-01 for C-12, or 016-0225-03 for C-27), not included.

Order 016-0264-01 .....$60

ADAPTER FRAME/CORRECTOR LENS C-50 and C-59 CAMERAS

Expands the field of view of the C-50 and C-59 to fully cover the 6½-inch crt and adjacent scale-readout characters of the 576 Curve Tracer and 5030-Series scopes. The Corrector Lens reduces the effective magnification of the C-50 to 0.55 and the C-59 to 0.5 so they can record the entire display on Polaroid 3¼ x 4¼-inch film.

Although each camera's photographic field is expanded to include the entire display, the view through the viewing tunnel is not. However, all but the upper one-fourth of the display can be viewed via the viewing tunnel and both cameras can be swung aside to allow a full view of the entire display.

For C-50 Camera, Order 016-0271-00 .....$80

For C-59 Camera, Order 016-0288-00 .....$75

ACCESSORIES FOR GRAFLOK TYPE BACKS (For C-12, C-27, and C-50-Series)

Here are a few of the film holders available for use with the Graflok Backs to allow use of roll film, and Polaroid 4 x 5 in Film. Order these accessories from the manufacturer or from your local camera store.

RH/10 120 Roll-Film Holder—10 exposures 2¼ x 2¾ in Graflex Catalog #1295 for 4 x 5 in Graflok Backs. **(122-0736-01)**

RH/20 220 Roll-Film Holder—20 exposures, 2¼ x 2¾ in Graflex Catalog #1297 for a 4 x 5 in Graflok Backs. **(122-0971-00)**

RH/50 70 mm Holder—50 exposures, 2¼ x 2¾ in Graflex Catalog #1240 for 4 x 5 in Graflok Backs only. **(122-0967-00)**

Polaroid Land #545 4 x 5 Film Holder—For Polaroid 4 x 5 in Single Exposure Film Packets. **(016-0201-01)**

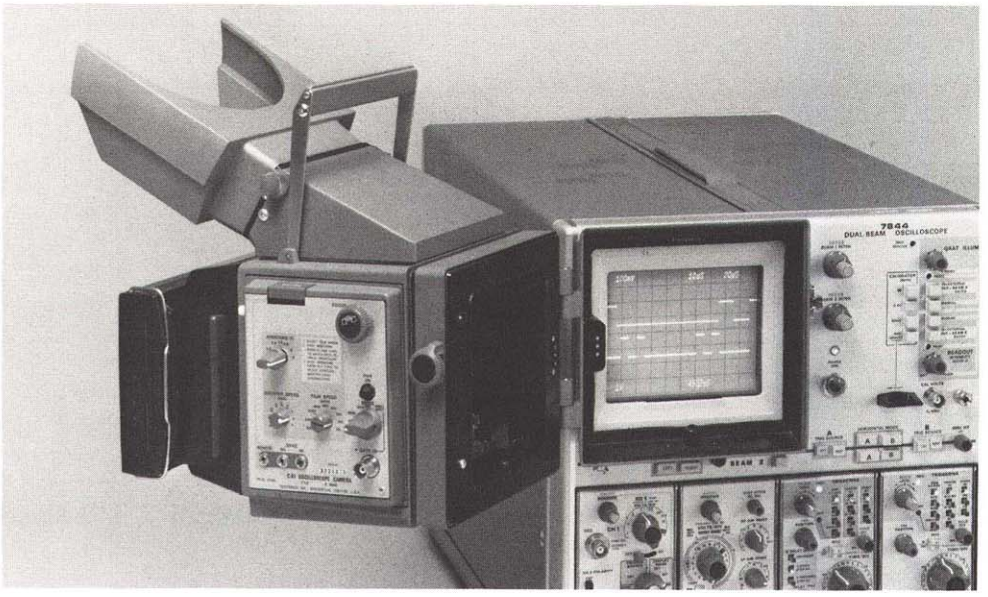
Roll film holders are also manufactured by several other companies.

C-50-SERIES COMMON FEATURES

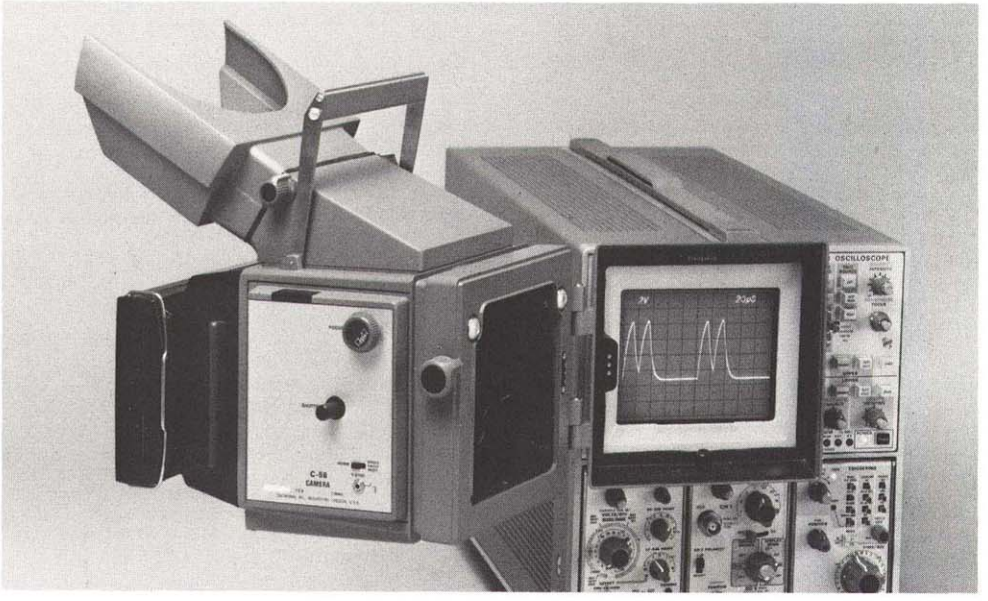
INTERCHANGEABLE FILM BACKS
LIFT-OFF MOUNTING
SWING-AWAY HINGING

The six C-50-Series Cameras are designed for use with all TEKTRONIX 7000-Series Oscilloscopes. They can also be adapted to most TEKTRONIX 5000-Series Oscilloscopes and 600-Series Display Monitors. Please refer to the oscilloscope/camera/adapter guide, pages 228 and 229.

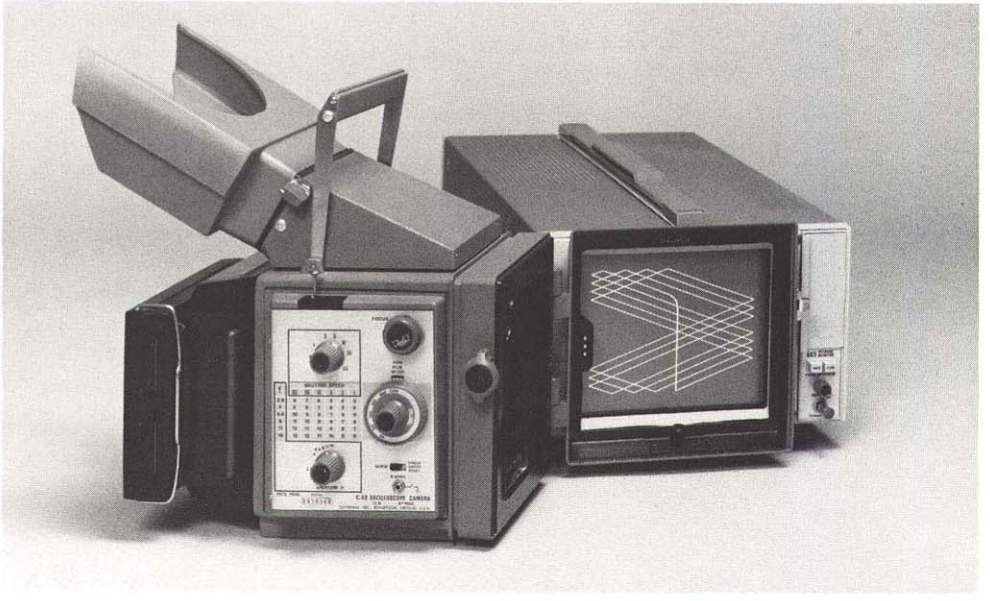
All the C-50-Series Cameras can be ordered for either Polaroid pack or roll film, or a Graflok-type 4 x 5 inch back. All three backs can easily be removed and interchanged without fogging the film.



C-50, C-51, C-52 and C-53
Electronic-Controlled Shutter
Photometer Exposure Aid
Range-Finder Focusing
Automatic Single-Sweep Control



C-58
Low-Cost
Unity-Magnification Lens
Wide Field Of View With No Vignetting



C-59
Low-Cost
Photometer Exposure Aid
Range-Finder Focusing
Internal Battery Power
For Larger CRT's

SUMMARY COMPARISON OF MAJOR CHARACTERISTICS

CAMERA	C-50	C-51	C-52	C-53	C-58	C-59
FEATURES	General purpose for crt's up to 6½ inches; Medium writing speed.	Fastest writing speed (at expense of image size)	Full-size image; Medium writing speed	General purpose for 7000-Series with 8 x 10-cm crt's** Medium writing speed	Full-size image of largest field, low price. Slow writing speed	General purpose low price. For crt's up to 6½ inches; Slow writing speed
LENS SPEED	f/1.9	f/1.2	f/1.4	f/1.9	f/2.8	f/2.8
MAGNIFICATION	0.7	0.5	1.0	0.85	1.0	0.67
RELATIVE LIGHT GATHERING ABILITY	1.2	3.0	1.4	1.0	0.4	0.65
FIELD OF VIEW	10.2 x 12.7 cm with Polaroid pack and roll film	8 x 10 cm with Polaroid pack and roll film	8 x 10 cm with Polaroid 4 x 5-inch film	8 x 10 cm with Polaroid pack and roll film	8.9 x 11.4 cm with Polaroid 4 x 5-inch film	10.2 x 12.7 cm with Polaroid pack and roll film
SHUTTER	Electrically actuated, 4 to 1/60 second, plus Bulb and Time. Provides x sync.				Mechanically actuated 1 to 1/100 sec, bulb and time. Provides x sync.	Mechanically actuated 1 to 1/50 sec, bulb and time. Provides x sync.

Blue type indicates most popular models

DIMENSIONS AND WEIGHTS WITH FILM BACK ORDINARILY USED

	C-50-P		C-51-R		C-52-G		C-53-P		C-58-G		C-59-P	
	In	cm	In	cm	In	cm	In	cm	In	cm	In	cm
Height	11.5	29.2	11.5	29.2	11.5	29.2	11.5	29.2	11.5	29.2	11.5	29.2
Width	7.5	19.1	9.8	24.8	7.5	19.1	7.5	19.1	7.7	19.3	7.7	19.3
Length	10.8	27.3	10.8	27.3	10.8	27.3	10.8	27.3	10.8	27.3	10.8	27.3
Weight (Approx)	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
Net	7.5	3.4	9.5	4.3	8.0	3.6	7.5	3.4	6.0	2.7	7.0	3.2
Shipping	12.0	5.4	15.0	6.8	12.0	5.4	12.0	5.4	10.0	4.5	11.0	5.0

**The C-53 lens records the largest practical image of an 8 x 10-cm crt display on Polaroid pack and roll film.

ORDERING INFORMATION

"P" Models accept Polaroid pack film.

"R" Models accept Polaroid roll film.

"G" Models have Graflok type backs that accept 4 x 5 inch sheet film holders or roll film holders.

C-50

C-50P CAMERA **$1140**
C-50R CAMERA **$1140**
C-50G CAMERA **$1140**

C-51

C-51P CAMERA **$1370**
C-51R CAMERA **$1370**
C-51G CAMERA **$1370**

C-52

C-52P CAMERA **$1390**
C-52R CAMERA **$1390**
C-52G CAMERA **$1390**

C-53

C-53P CAMERA **$1100**
C-53R CAMERA **$1100**
C-53G CAMERA **$1100**

C-58

C-58P CAMERA **$840**
C-58R CAMERA **$840**
C-58G CAMERA **$840**

C-59

C-59P CAMERA **$660**
C-59R CAMERA **$660**
C-59G CAMERA **$660**

Included Accessories—Focus Plate for Polaroid pack film (387-0893-02), or focus plate for Polaroid roll back (387-0893-01), or focusing screen integral with Graflok type back; mounting adapter for all 7000, 5000, and small 600-Series (016-0249-03).

OPTIONAL ACCESSORIES

Mounting Adapters—see table on pages 228 and 229.

Battery Pack—Provides an auxiliary + 15 V power source for the C-50, C-51, C-52, and C-53 with oscilloscopes that don't provide camera power. A three-position mode switch on the battery pack also allows the camera to be powered from a 7000-Series Oscilloscope or an external + 15 V source. Net weight of pack, including batteries, is 1.2 lb.
Order 016-0270-00 ..... **$120**

Writing Speed Enhancer—Provides automatic controlled film fogging to increase writing speed by about 3 times for 3000 ASA film and about 2 times for 10,000 ASA film. Installs in minutes.

Writing Speed Enhancer for C-51 Camera.
Order 016-0279-00 ..... **$200**

Writing Speed Enhancer for C-53 Camera.
Order 016-0300-00 ..... **$200**

Writing Speed Enhancer for C-59 Camera.
Order 016-0290-00 ..... **$200**

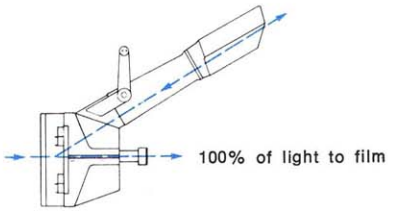
Polaroid Pack Film Back—Accepts Polaroid pack film. Included with "P" models.
Order 122-0926-01 ..... **$110**

Polaroid Roll Film Back—Accepts Polaroid roll film. Included with "R" models.
Order 122-0929-00 ..... **$150**

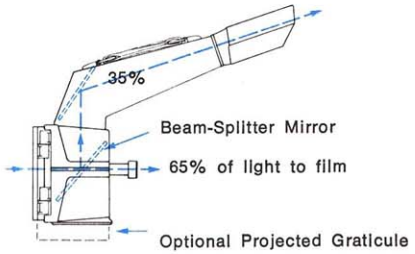
Graflok Type Film Back, 4 x 5 in—Accepts Polaroid 4 x 5 in film holder, standard cut-film holders, film-pack adapters, roll-film holders (except heavy motorized models). Included with "G" models.
Order 122-0931-01 ..... **$135**

Carrying Case—Holds a complete C-50-Series Camera with extra film-backs and accessories.
Order 016-0177-00 ..... **$130**

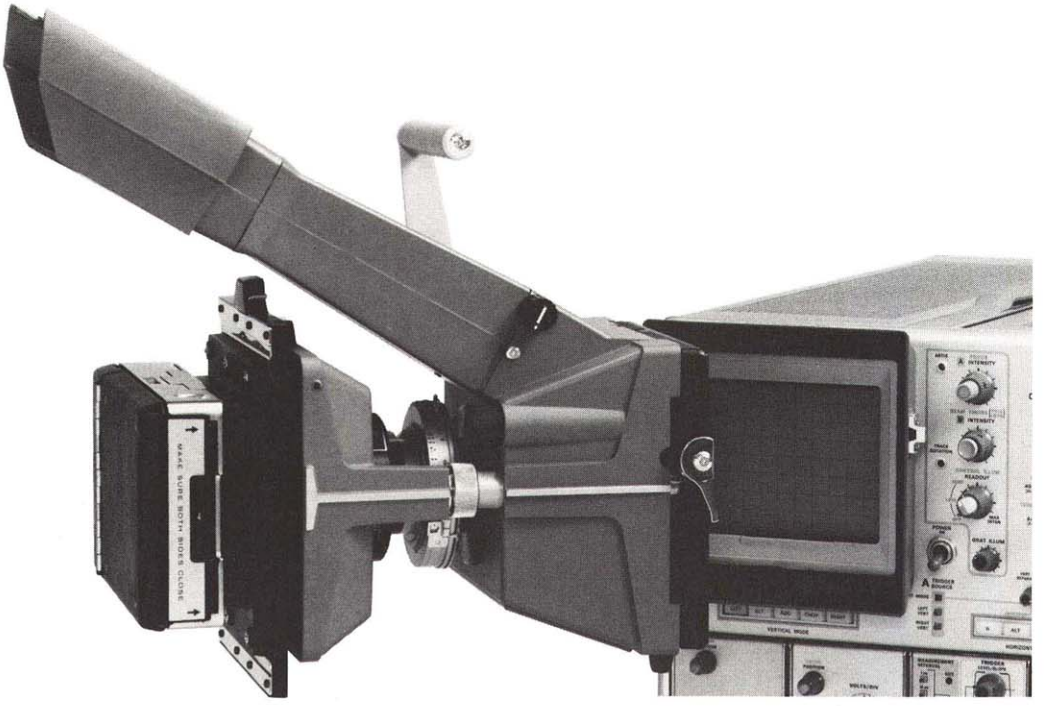
Modular Versatility
Interchangeable Lenses
Mechanical or Electric Shutter
Interchangeable Film Backs



C-27 MAIN FRAME



C-12 MAIN FRAME



	C-27 MAIN FRAME	C-12 MAIN FRAME
Viewing	Direct	Indirect, straight on by means of mirrors
Lens Speed	f/1.9*	f/1.9*
Magnification	0.85*	0.85*
Relative Light Gathering Ability	1.0*	1.0* (However, mirrors reduce this to approx. 0.65)
Field of View	8 x 10 cm* with Polaroid pack and roll film	8 x 10 cm* with Polaroid pack and roll film
Shutter	Mechanical shutter standard, electric shutter available. Provides speeds of 1 to 1/100 s plus bulb and time. Provides x sync.	

*Others available—see options.
Blue type indicates preferred model.

ORDERING INFORMATION

Mounting Adapter Required, See Pages 228 and 229

"P" Models accept Polaroid pack film.
"R" Models accept Polaroid roll film.
"G" Models have Graflok type backs that accept 4 x 5 in sheet film holders or roll film holders.

C-27

C-27P **$760**
C-27R **$760**
C-27G **$760**

C-12

C-12P **$840**
C-12R **$840**
C-12G **$840**

Electric Shutter Versions—includes SPEEDCOMPUTER control box with shutter speeds from 1 to 1/60 s plus bulb and time. Remote triggering with insulated switch closure. Requires 115 V ac, 50-60 Hz. Add "E" to camera designation.

C-12GE **$1210**
C-12PE **$1210**
C-12RE **$1210**
C-27GE **$1130**
C-27PE **$1130**
C-27RE **$1130**

Included accessories: Cable release (122-0586-02); split-image focus plate for Polaroid pack film back (387-0893-02) or split-image focus plate for Polaroid roll back (387-0893-01) or focusing screen integral with Graflok type back.

C-12 AND C-27 OPTIONS

Option 01

FOR RECORDING 8 x 10 CM DISPLAYS ON CONVENTIONAL ROLL FILM

A f/1.9, 0.7 mag lens with relative light-gathering ability of 1.2, records 8 x 10 cm display on a 6 x 7 cm format roll film such as 120, 220, or 70 mm.

Specify Opt 01 ..... **Add $20**

Option 03

UNITY MAGNIFICATION

A f/1.4 unity mag lens with relative light-gathering ability of 1.4 records full-sized image of 8 x 10 cm display on a 4 x 5-inch film.

Specify Opt 03 ..... **Add $200**

Option 04

HIGH WRITING SPEED

A f/1.3, 0.5 mag lens with relative light gathering ability of 2.6 records 8 x 10 cm display on Polaroid roll or pack film or on conventional roll or sheet film. Image size is reduced to obtain maximum writing speed.

Specify Opt 04 ..... **Add $200**

Option 09

Electric shutter less SPEEDCOMPUTER

Specify Opt 09 ..... **No additional cost**

OPTIONAL ACCESSORIES

Mounting adapters—see pages 228 and 229.

Writing Speed Enhancer—Provides automatic controlled film fogging to increase writing speed about 3 times for 3000 ASA film and about 2 times for 10,000 ASA film. Installs in minutes.
Order 016-0280-00 .....**$200**

X Sync Cable—Mates to mechanical shutters or SPEEDCOMPUTER. Other end of cable has miniature phone plug.
Order 012-0364-01 .....**$15**

Carrying Case—Protects your C-12 or C-27 Camera during transport.
Order 016-0208-01 .....**$145**

Projected Graticule (C-12 only)—Projects film work graticule. Includes 8 x 10 cm film work, 6 x 10 cm film work, write-in area film work, mask, graticule film holder, power cord (161-0091-00), for 115 V.
Order 016-0204-00 .....**$245**
for 230 V, Order 016-0234-00 .....**$245**

Polaroid Pack Film Back—Accepts Polaroid pack film. Included with "P" models.
Order 122-0671-00 .....**$135**

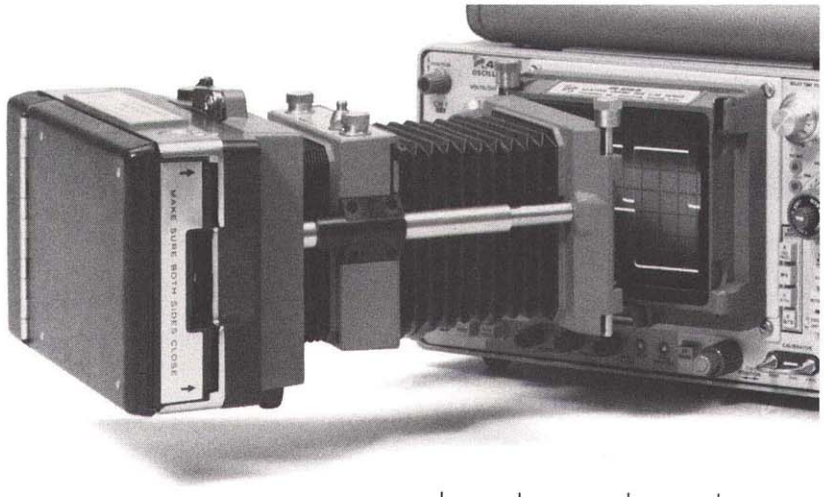
Polaroid Roll Film Back—Accepts Polaroid roll film. Included with "R" models.
Order 122-0603-00 .....**$135**

4 x 5 inch Graflok Type Back with Focusing Screen—Accepts standard cut-film holders, film-pack adapters, roll-film holders, Polaroid 4 x 5 in film holder. Included with "G" models.
Order 122-0604-00 .....**$135**

Extra interchangeable lenses with mechanical or electrical shutters are available to convert the C-12 or C-27 to the various options, see camera instruction manual or contact your nearest Tektronix Field Office or Representative.

Dimensions	C-12		C-27	
	in	cm	in	cm
Height	15.4	39.1	17.2	43.6
Width	7.5	19.1	7.5	19.1
Length	17.3	43.9	13.4	34.1
Weight	**lb**	**kg**	**lb**	**kg**
Net	12.3	5.5	10.5	4.7
Shipping	16.0	7.2	14.0	6.3

Variable Magnification and High Writing Speed Camera | C-30A C-31



Optional Electric Shutter
Adaptable to Many Instrument Types
Interchangeable Film Backs

The C-30A and C-31 Cameras are primarily designed for use with the 400-Series portable oscilloscopes, but are also adaptable to 8 x 10 cm crt or smaller 7000, 5000, and 600-Series instruments, and to some others. See chart on pages 228 and 229. The C-30A has variable magnification, permitting it to make use of the entire photo frame even with different crt sizes. The C-31 is designed for maximum writing speed (at the expense of image size).

Camera	Lens Speed	Magnification	Relative Light Gathering Ability	Field of View
C-30A	f/1.9	0.7 to 1.5	1.0	8 x 10 cm
C-31	f/1.2	0.5	2.9	8 x 9 cm

Shutter—Mechanically actuated, with speeds from 1 to 1/60 s plus bulb and time. Provides x sync switch closure for arming oscilloscope single sweep or initiating the event of interest.

Recommended for—485, 491. See pages 228 and 229 for compatibility with other instruments. Also see Option 01.

Included Accessories: Split-image focusing plate for Polaroid pack back (387-0893-02); or for Polaroid roll back (387-0893-01; mounting adapter for 485 and 491 size bezel (016-0306-00).

Dimensions	C-30AP		C-31R	
	in	cm	in	cm
Height	5.1	13.0	5.5	14.0
Width	7.5	19.1	9.1	23.1
Length	10.4	25.4	10.6	26.9
Weight (approx)	**lb**	**kg**	**lb**	**kg**
Net	4.8	2.2	6.8	3.1
Shipping	9.0	4.1	11.0	5.4

ORDERING INFORMATION

"P" Models accept Polaroid pack films.
"R" Models accept Polaroid roll films.

C-30A

C-30AP CAMERA **$690**
C-30AR CAMERA **$690**

C-31

C-31P CAMERA **$870**
C-31R CAMERA **$870**

OPTIONS

C-30A Opt 01 Expanded Field of View—f/1.9, 0.8 magnification lens covers 8 x 10 cm crt screen without vignetting. Relative light-gathering ability is 0.9. Includes 016-0301-00 adapter for 465 size crt bezel. Recommended for—455, 464, 465, 466, 475.
Specify Option 01 .....**Add $15**

C-31 Opt 01, Expanded Field of View—f/1.2, 0.5 magnification lens with relative light gathering ability of 2.9 covers crt screens up to 8 x 10 cm. Includes 016-0269-02 adapter for 465 size crt bezel.

Recommended for—455, 464, 465, 466, 475, 475A.

Specify Opt 01 ..... **Add $15**

Electric Shutter—Allows remote or automatic actuation of the shutter with an insulated switch closure. Includes SPEEDCOMPUTER control box. Provides speeds of 1 to 1/60 s plus bulb and time. Requires 115 V ac, 50-60 Hz. Add E to camera designation.

C-30APE **$1060**
C-30ARE **$1060**
C-31PE **$1240**
C-31RE **$1240**

CONVERTING OPT 01 MODEL TO STANDARD MODEL

The Option 01 versions of the C-30A and C-31 Cameras can be converted to standard models by simply slipping off the Corrector Lens, removing the Adapter Frame, and adding an 016-0306-00 Adapter. Please refer to pages 228 and 229 for prices and compatibility.

CONVERTING STANDARD MODEL TO OPT 01 MODEL

A standard-model C-30A or C-31 can be converted to an Option 01 model by means of the appropriate Adapter Frame/Corrector Lens: 016-0301-00 for C-30A; 016-0269-02 for the C-31. Please refer to pages 228 and 229 for prices and compatibility.

OPTIONAL ACCESSORIES

Mounting Adapters—See Pages 233 and 234.

Writing Speed Enhancer—Increases effective film speed about 3 times for 3000 speed film or about 2 times for 10,000 speed film. Installs in minutes.

Order 016-0284-00 ..... **$200**

Polaroid Pack Film Back—Accepts Polaroid pack film. Included with "P" models.

Order 122-0752-00 ..... **$135**

Polaroid Roll Film Back—Accepts Polaroid roll film. Included with "R" models.

Order 122-0754-00 ..... **$135**

Graflok Type 4 x 5 in Back—Accepts Polaroid Land 4 x 5 in film holders, standard cut film holders, film pack adapters, roll film holders (except heavy motorized roll film holders).

Order 016-0487-00 ..... **$150**

Carrying Case—Molded high-impact plastic case with polyurethane foam liners to protect your camera in transit. 18½ x 14½ x 8 in.

Order 016-0587-00 ..... **$50**

X Sync Cable—

Order 012-0364-01 ..... **$15**

C-30A Portra Lens—A slip-on auxiliary lens which extends the focus distance of the camera so it can be used for off-scope photography of scenes such as test set-ups. At a distance of 21 in. the camera covers 19 x 21 in. usable with either the C-30A or C-30A Opt 01.

Order 016-0246-02 ..... **$22**

C-5A | Low Cost Camera

Easy to Use
Low Cost
Graticule Illumination
Modular Versatility

The C-5A is a low-cost general-purpose camera with Polaroid Pack-film back and a graticule illuminator. Its lightweight modular design provides three interchangeable adapter hoods that fit most TEKTRONIX Oscilloscopes and small monitors.

All three adapter hoods have an opening in the top for a lift-up viewing door or a Xenon Flash Unit module for illuminating the crt graticule. The flash unit has a flipdown viewing door.

Lens 0.67 or 0.85 magnification selectable by user. The fixed f/16 aperture provides a wide depth of field and eliminates need for adjustable focus.

The f/16 lens has a relatively low light-gathering ability of 0.02 and is not recommended for photographing single-sweep waveforms.

Shutter Mechanically actuated with speeds of 1/5, 1/10, and 1/25 s plus bulb and time.

Graticule Illumination Variable intensity Xenon Flash, triggered by shutter opening, evenly illuminates the crt screen to backlight non-illuminated graticules.

Recommended Film Type 107, 3,000-Speed pack film.

Field of view 0.67 mag—9.8 x 12.2 cm, 0.85 mag—8 x 10 cm.

Dimensions	in	cm
Height	5.5	14
Width	6.6	16.8
Length	10.1	25.7
Weights (approx)	**lb**	**kg**
Weight	3	1.4
Net Shipping	4.1	1.9

ACCESSORIES

ADAPTER HOODS (also requires door or flash listed below)

Included with the C-5A and C-5A Option 01 Cameras.
016-0357-00 ..... **$12**

Included with the C-5A Option 02 Camera.
016-0359-00 ..... **$12**

Included with the C-5A Option 03 Camera.
016-0358-00 ..... **$12**

VIEWING DOOR Fits all three adapter hoods. Mounting screws included. Included with C-5A Opt 01 and Opt 02.

016-0630-00 ..... **$5**

FLASH UNIT Fits all three adapter hoods. Mounting screws included. Included with C-5A and C-5A Opt 03.

016-0363-01 ..... **$52.50**

Order	For Use With	Adapter Hood (Included) Part Number	Flash Unit Included	Price
C-5A	577, 600-Series with unilluminated graticule, 1420-Series, 5100-Series	016-0357-00	Yes	$250
C-5A Opt 01	528, 600-Series w/o graticule, or with illuminated graticule, 5400-Series, 7000-Series, T922R, TELEQUIPMENT D83	016-0357-00	No	$215
C-5A Opt 02	432, 434, 455, 464, 465, 466, 475, 475A	016-0359-00	No	$215
C-5A Opt 03	T900 Series except T922R	016-0358-00	Yes	$250

For amplitude measurements, the capacitance and resistance of the probe form a voltage divider with the circuit under test. For low frequency (about 5 MHz and below), the resistive component is of primary importance in most probes and should be at least two orders of magnitude greater than the circuit source impedance. For higher frequencies (greater than about 30 MHz), the importance of the capacitance increases drastically and will become the prime consideration.

For general-purpose use, passive voltage probes offer a wide probe selection for a variety of applications for 1 MΩ inputs.

VOLTAGE PROBES for 1 MΩ Inputs

Type	Atten	Length*	Package Number	Loading		Useful[5] BW MHz	Dc Max	Scope C in pF	Readout	Page
P6006[1]	10X	3.5 6 9 12	010-0127-00 Opt 01 010-0160-00 Std 010-0146-00 Opt 02 010-0148-00 Opt 03	10 MΩ	7.5 pF[2] 8.5 11 13	35 25 25 12	600 V	15 to 55	NO	243
P6007	100X	3.5 6 9 12	010-0150-00 Opt 01 010-0165-00 Std 010-0152-00 Opt 02 010-0154-00 Opt 03	10 MΩ	2 pF[2] 2.2 2.4 2.6	25 20 15 13	1.5 kV	15 to 55	NO	243
P6008	10X	6	010-0129-01 Std	10 MΩ Environmentalized —50°C to +150°C	7.5 pF	100	600 V	12 to 47	NO	243
P6009	100X	9 9	010-0170-00 Opt 04 010-0264-01 Std	10 MΩ	2.5 pF[2] 2.5	120 100	1.5 kV	12 to 47	NO YES	243
P6010	10X	3.5	Furnished with S-5 (Page 84). For other uses see P6105 or P6106							
P6013A	1000X	10 25	010-0177-01 Std 010-0175-01 Opt 03	100 MΩ	3 pF 3.5	80 13	12 kV	15 to 55	NO	244
P6015	1000X	10	010-0172-00 Std	100 MΩ	3 pF	75	20 kV	12 to 47	NO	244
P6028	1X	3.5 6 9 12	010-0074-00 Opt 01 010-0075-00 Std 010-0076-00 Opt 02 010-0077-00 Opt 03	1 MΩ	50 pF 67 90 112	17 10 7 4	600 V	ANY	YES	244
P6048	10X	6	010-0215-00	1 kΩ	1 pF	100	20 V	15 to 20	NO	—
P6049B	10X	OBSOLETE—REPLACED BY P6149								
P6053B	10X	OBSOLETE—REPLACED BY P6106								
P6054A	10X	OBSOLETE—REPLACED BY P6106								
P6055[3]	10X	3.5	010-6055-01 Std	1 MΩ	10 pF	60	500 V	20 to 47	YES	244
P6060[3]	10X	3.5 6	010-6060-01 Opt 01 010-6060-03 Std	10 MΩ	7.5 pF[2] 8.5	35 25	600 V	15 to 55	YES[4]	245
P6062B	10X or 1X 10X or 1X 10X or 1X	3.5 6 9	010-6062-11 Opt 01 010-6062-13 Std 010-6062-15 Opt 02	10 MΩ 1 MΩ 10 MΩ 1 MΩ 10 MΩ 1 MΩ	13.5 pF 100 14 105 17 135	100 8 100 6.7 95 4.5	500 V	15 to 47	YES	245
P6063B	10X or 1X 10X or 1X	3.5 6	010-6063-11 Opt 01 010-6063-13 Std	10 MΩ 1 MΩ 10 MΩ 1 MΩ	11 pF 80 14 105	200 12 200 6	500 V	15 to 24	YES	245
P6075A	10X	OBSOLETE—REPLACED BY P6106								
P6101	1X	1 m 2 m 3 m	010-6101-01 Opt 01 010-6101-03 Std 010-6101-05 Opt 02	1 MΩ	32 pF 54 78	34 15.5 8	500 V	ANY	—	246
P6105	10X	1 m 2 m 3 m	010-6105-01 Opt 01 010-6105-03 Std 010-6105-05 Opt 02	10 MΩ	10.5 pF 13.0 15.5	100 100 95	500 V	15 to 47	YES	246
P6106	10X	1 m 2 m 3 m	010-6106-01 Opt 01 010-6106-03 Std 010-6106-05 Opt 02	10 MΩ	10.5 pF 13.0 15.5	300[6] 250 150	500 V	15 to 24	YES	246
P6108	10X	1 m 2 m 3 m	010-6108-01 Opt 01 010-6108-03 Std 010-6108-05 Opt 02	10 MΩ	10.5 pF 13.0 15.5	100 100 95	500 V	15 to 47	NO	246
P6149	10X	2 m	010-6149-03 Std	10 MΩ	15.5 pF	50	500 V	20 to 62	NO	246

**Length in feet except where specified.*

1. *To convert to uhf connectors, use adaptor 103-0015-00.*
2. *Rating varies with scopes having other than 20 pF inputs.*
3. *Designed for use with scopes having differential inputs.*
4. *Not compatible with crt readout.*
5. *25 Ω source.*
6. *Typically 300 MHz at probe tip with bandwidth at least 325 MHz.*

Probes and Accessories

Tektronix, Inc., offers a wide variety of probes to help accomplish a wide variety of measurements. In the process of selecting a probe for your applications, a few general concepts should be kept in mind.

Where higher frequencies (above 250 MHz) are encountered, active FET probes which have high input resistance and low input capacitance through their dynamic range should be used. For 50 Ω systems, see adjacent selection chart of 50 Ω divider probes.

FET PROBES

Type	Atten	Length*	Package Number	Loading	Rise time in ns	INPUT LIMITS: Max dc + pk ac	INPUT LIMITS: Linear Dynamic Range	INPUT LIMITS: Dc Offset Range	Read-out	Page
P6046 Diff/Amp	1X	6.0	010-0232-00 Std	1 MΩ 10 pF	3.5	±25 V	±5 V		NO	239
	10X			10 MΩ 3 pF		±250 V	±5 V			
P6201 FET	1X	6.0	010-6201-01 Std	100 kΩ 3 pF	0.4	±100 V	±0.6 V	±5.6 V	YES	238
	10X			1 MΩ 1.5 pF		±56 V	±200 V	±6 V		
	100X			1 MΩ 1.5 pF		±200 V	±60 V	±200 V		
P6202 FET	10X	2m	010-6202-01 Std	10 MΩ 2 pF	0.7	±200 V	±6 V	±55 V	YES	238
	100X		W/010-0384-00Atn	10 MΩ 2 pF	0.7	±200 V	±60 V	±200 V	NO	

For rise time measurements, the interaction of the probe capacitance with the source impedance is of importance (RC time constant). For best results, the capacitance should be kept minimal. Typical probe specifications represent their response to a 25 Ω source environment.

50-Ω DIVIDER PROBES—For use with 50Ω input amplifiers

Type	Atten	Length*	Package Number	Loading	Rise time in ns	INPUT LIMITS: Max dc + pk ac	INPUT LIMITS: Linear Dynamic Range	Read-out	Page
P6056	10X	6.0	010-6056-03 Std	500 Ω 1 pF	0.1	±16 V	±16 V	YES	239
		9.0	010-6056-05 Opt 2						
P6057	100X	6.0	010-6057-03 Std	5 kΩ 1 pF	0.25	±50 V	±50 V	YES	239
		9.0	010-6057-05 Opt 2						

**Length in feet except where specified.*

For measuring currents from dc to 1000 A, see the adjacent selection chart for current probes.

Current probes can be used where low loading of the circuit is necessary. Loading is typically in the milliohm to low ohm range. Current probes can be used for differential measurements, where the probe measures the results of two opposing currents in two conductors in the jaw of the probe.

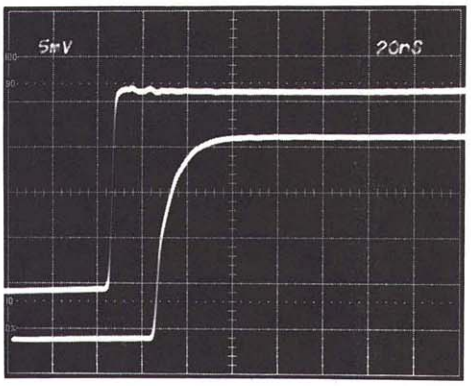
A current waveform may be very different from a voltage waveform in a current-dependent circuit. Measuring only the voltage will not show this difference. To obtain the total picture, a measurement of the current waveform is necessary.

CURRENT PROBES

Type	Bandwidth Hz to MHz	Current/Div Scope at: 10 mV/div	Current/Div Scope at: Any Sensitivity mA/mV	SATURATION: Dc Amps	SATURATION: Pulse Amp-S Product	MAXIMUM CURRENT: dc + pk ac Amp	MAXIMUM CURRENT: ac p-p Amp	MAXIMUM CURRENT: Derate Below	MAXIMUM CURRENT: Derate Above	Peak Pulse Amp	Page
P6302/ AM503	dc 50	1 mA to 5A		20	100x10⁻⁶	20	40		1 MHz	50	
P6302/ AM 503 with CT-5	0.5 20	20 mA to 5 kA		20	0.1		40 k	20 Hz	1.2 kHz	50 k	240
P6021 Passive Term	120 60	50 mV/div	2 or 10	0.5	0.5x10⁻³		15	300 Hz	5 MHz	250	
134	12 38	1 mA to 1A		0.5	0.5x10⁻³		15	230 Hz	5 MHz	15	241
CT-5/ Passive Term	120 20		40 or 10 k	20	0.5		2000	300 Hz	1.2 kHz	50 k	
CT-5/134	12 20	20 mA to 1 kA		20	0.5		2000	230 Hz	1.2 kHz	15 k	
P6022 Passive Term	8.5 k 200		1 or 10	0.2	9x10⁻⁶		6	3 kHz	10 MHz	100	241
134	100 65	1 to 1		0.2	9x10⁻⁶		6	1.3 kHz	10 MHz	15	
CT-1	30 k 1000		5mV/mA	0.2	1x10⁻⁶		1.4			100	242
CT-2	1.2 k 100		1m/mA	0.2	50x10⁻⁶		7			100	242

OTHER PROBES

Probe	Package Number	Function	Use	Page
P6058	010-0260-00	Temperature and Voltage Probe	DM 501 7D13	144 79
P6430	010-6430-00	Temperature Probe	DM 44	106
P6104	010-6104-00	Voltage Probe	465M	113
40 kV	010-0277-00	High Voltage Probe	DM 501 DM 502	148 149
P6450	010-6450-01	Data Acquisition Probe	LA 501 W	25
P6451	010-6451-01	Data Acquisition	7D01 LA 501W	20 25
P6401	010-6401-01	Logic Probe	TTL Logic	28
P6420	010-6420-03	RF Probe	DM 501 DM 502 DM 44	148 149 106



Low Capacitance Loading
High Frequency Response
Full 1X Sensitivity

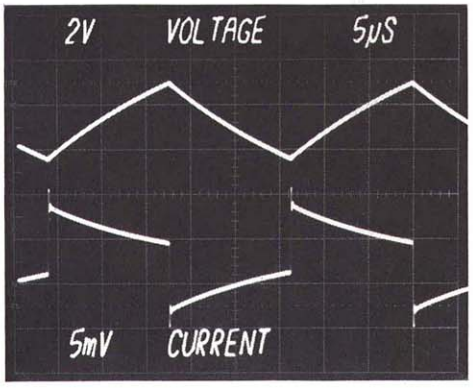
The lower waveform shows the rise time of a circuit using a passive probe with 10 pF input capacitance. The upper waveform shows the same circuit and an active FET probe with less than 2 pF input capacitance.

USAGE

Where	What & Why
1. High source impedance points; >50 Ω	1. P6201 or P6202 depending on frequency and sensitivity desired: the low input C and high input R combination, available only in an active probe, provides fastest rise time (C influenced) and accurate amplitude.
2. Low power circuits	2. P6201 or P6202 depending on frequency and sensitivity desired: the high input impedance of an active probe at all frequencies will provide a minimum signal power drain.
3. Small signal circuits	3. P6201: 1X or full sensitivity without bandwidth loss allows maximum amplitude of small signals.
4. >200 MHz frequency responses desired	4. P6201, P6202, P6056, P6057: the specific choice will depend upon the frequency and other circuit characteristics.
5. Tuned circuits	5. P6201, P6202: these probes offer minimum disturbance due to low C.
6. No instrument probe power availability	6. P6202: the only active probe available today designed to work from a 110/220 outlet.
7. Generally any circuit where a voltage measurement is needed and minimal circuit disturbance desired	7. The general benefit of an active probe is its combination of low C and high R.
8. High cmrr needed—differential measurement	8. P6046: to obtain maximum cmrr, the active circuitry needs to be at the measurement point.

Descriptions of active and 50-Ω probes begin on page 238. A performance summary is on facing page.

USING A CURRENT PROBE



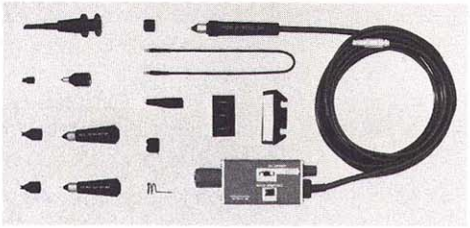
Lowest Loading
Clip-on; No Need to Break Circuit under Test
Observe Current Waveform
Differential Measurements
Measure Bare Conductors

This picture shows the difference between a voltage and a current waveform. This application is looking at the charging voltage and current of a capacitor.

When	Why
1. Looking at reactive sources (capacitive, inductive).	1. Voltage measurements tell only a portion of the system's characteristics.
2. Evaluating current dependent devices (transistors, SCR's, commutators, etc)	2. A voltage measurement alone can't characterize the operation of the device.
3. Probing high source impedance points (drains, collectors, plates, and other passive or active high impedance points).	3. Lower loading providing more accurate rise time and amplitude measurements.
4. Evaluating source points sensitive to loading.	4. Voltage techniques may alter the operating characteristics of circuits sensitive to loading. Current probes exhibit significantly less source loading, providing more accurate signal representations (minimize alteration of actual circuit operation).
5. Any time information on current characteristics is needed.	5. A current measurement directly defines current characteristics without calculations and assumptions about the circuit.

For current probes, see pages 240, 241 and 242, or the performance summary on facing page.

P6201 Dc to 900 MHz, 1X



Dc to 900 MHz Bandwidth

Unity Gain

Two Plug-on Attenuator Heads that Maintain Scope Readout Factor

Low Input Capacitance

Dc Offset

Ac-dc Coupling Switch

The P6201 is an active (FET) probe providing unity gain and dc to 900 MHz bandwidth. The P6201 is the best general-purpose probe within its voltage range from the standpoint of electrical performance. The very low input capacitance of the probe permits acquisition of high frequency signals with minimum loading of circuits under test while the high input resistance minimizes low frequency and dc loading. Plug-on attenuator heads provide higher input resistance and reduced input capacitance.

The P6201 will maintain excellent rise time and pulse fidelity in higher source impedance circuits, due to low input capacitance when compared to other general-purpose probes.

The P6201 provides a dc offset feature to bias out a voltage level and allow observation of signals riding atop a carrier. This allows the signal to be brought within the linear input window of the probe. Ac or dc coupling selection is also available. When ac coupled, the dc voltage component, which could otherwise saturate an active probe, is blocked, allowing viewing of the superimposed signal. The P6201 is designed primarily for use with TEKTRONIX 7900, 7800, and 7700 Series, 475 and 485 Oscilloscopes, due to its direct compatibility with the probe power available on these instruments. The P6201 is valuable for use in the 50 Ω and 1 MΩ input real time oscilloscope systems and also with sampling systems, spectrum analyzers, and counters where high performance and minimum signal source loading is desired.

The probe includes a locking-type BNC connector which provides scale-factor readout information to instruments having readout capability, while maintaining compatibility with those instruments without readout. The 10X and 100X attenuator heads couple readout information to the instrument via the output connector.

The 1101 Accessory Power Supply is available to power the P6201 for use with instrumentation not supplying probe power.

Bandwidth (−3 dB) dc to 900 MHz. **Rise Time** is 0.4 ns or less. **Probe Gain** is 1X within 3%. **Attenuator Accuracy** ≤ 4% with probe (10X or 100X). **Input Impedance** (probe only) is 100 kΩ (within 1%) shunted by approx 3.0 pF. Attenuator heads are 1 MΩ (within 1%) shunted 1.5 pF or less. **Dynamic (Signal) Range** is at least ± 600 mV; extends to ± 6 V with 10X attenuator, ± 60 V with 100X attenuator. **Dc Offset Range** is at least −5.6 to +5.6 V (with respect to tip of probe without attenuator head). Effective offset is extended by 10X and 100X attenuation heads to ± 56 V and ± 200 V respectively. **Noise** (Tangential) is 300 μV or less at output. **Max Input Voltage** is ± 100 V, probe only and ± 200 V with attenuation heads, derating with frequency. **Lf Response** (−3 dB) (ac coupled) is 10 Hz or lower; 10X attenuator extends lf response to ≤ 1 Hz; with 100X attenuator, lf response is ≤ 10 Hz.

Included Accesories:

013-0135-00	1 **TIP,** retractable hook
010-0376-00	1 **ATTENUATOR** head 10X
010-0377-00	1 **ATTENUATOR** head 100X
206-0200-00	3 **PROBE TIPS**
131-1302-00	1 **CONTACT,** ground
175-0848-02	1 **LEAD,** ground, 3 in
103-0164-00	1 **PROBE TIP** to test point jack
344-0046-00	1 **CLIP,** alligator
166-0557-00	1 **SLEEVE,** insulating
342-0180-00	1 **INSULATOR,** ground contact
016-0156-02	1 **CARRYING CASE**

ORDERING INFORMATION

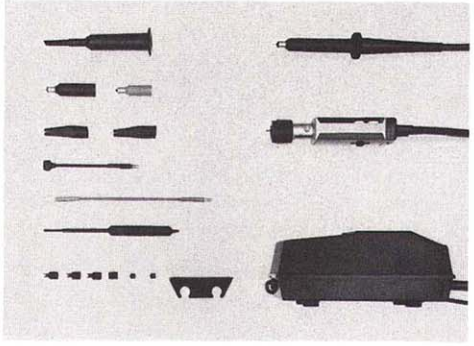
P6201 FET Probe, Order 010-6201-01 . . $680

1101 Power Supply

Accessory Power Supply, for powering up to four P6201 Probes.

1101 Probe Power Supply, Order 1101 . . $375

P6202



Dc to 500 MHz Bandwidth

Self-Contained Power Supply

Dc Offset

High Input Impedance through Freq Range

Small Probe Size

Rugged

Low Cost

The P6202 is an active (FET) probe providing dc to 500 MHz bandwidth. Because of its self-contained power supply, it can be used on any instrument without concern for probe power. The very low input capacitance of the probe permits acquisition of high frequency signals with a minimum loading of circuits under test while the high input resistance minimizes low frequency and dc loading.

The probe has a dc offset feature to offset any dc component within the range of the control to bring the signal into the dynamic range of the probe.

The probe was designed to be used with any oscilloscope (real time, sampling, spectrum analyzer, etc) where high frequency signals are acquired and/or low circuit loading is necessary. A switch in the output of the probe amplifier allows the probe to be used on 50 Ω or 1 MΩ inputs.

The probe body is small for getting into tight areas, and is very rugged to withstand the rigors of production testing and yet sophisticated enough for R & D work.

Optional accessories are a plug-on 10X attenuator head for 100X attenuation and a plug-on ac coupling head to block out unwanted dc components.

The probe includes a BNC connector which provides scale readout on the 10X mode to instruments having readout capability, while maintaining compatibility with the instruments without readout.

Included Accessories:

013-0097-01	1 **TIP,** retractable hook
352-0351-00	1 **PROBE HOLDER**
344-0046-00	2 **CLIPS,** alligator
175-0849-00	1 **LEAD,** 8 cm ground
016-0378-00	1 **CARRYING CASE** (not shown)
003-0675-01	1 **TOOL,** adjustment
175-1017-00	1 **LEAD,** 13 cm ground
———	2 **TIPS,** probe*
166-0404-01	1 **SLEEVE,** insulating

*Available in package of 10 only, order 206-0230-01

ORDERING INFORMATION

P6202 FET Probe 2 Meter Cable, Order 010-6202-01 . . . . . $350

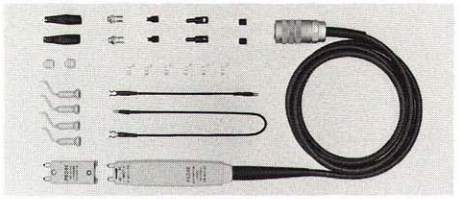
Optional Accessories:

P6202 10X Attenuator, Order 010-0384-00 . . . . . $40

P6202 AC Coupling Cap, Order 010-0360-00 . . . . . $17

SPECIFICATIONS

Characteristic	Probe	Opt 10X Attenuator Head	Opt Ac Coupling Cap
Bandwidth (−3 dB)	dc to ≥ 500 MHz	dc to ≥ 500 MHz	16 Hz to ≥ 500 MHz
Rise Time	≤0.7 ns	≤0.7 ns	≤0.7 ns
Attenuation	10X within 4%	100X within 2%	———
Input Impedance	10 MΩ within 2% shunted by approx 2 pF	10 MΩ within 2% shunted by approx 2 pF	approx 4 pF
Dynamic Range	0 to ±6 V	0 to ±60 V	———
Dc Offset Range	−55 V to +55 V	−200 V to +200 V	———
Noise (Tangential)	150 μV or less	150 μV or less	———
Max Safe Input Voltage	200 V dc + peak ac	200 V dc + peak ac	200 V dc + peak ac



Dc to 100 MHz with 1000:1 Cmrr at 50 MHz

The P6046 Differential Probe and P6046 Amplifier Unit provide new measurement capabilities when used with all TEKTRONIX Oscilloscopes. With this probe system, the differential-signal processing takes place in the probe itself, resulting in high common-mode signal rejection at higher frequencies. Differential probe-tip signal processing minimizes the measurement errors caused by differences in probes, cable lengths, and input attenuators. In addition, the wide-band capability of the P6046 Probe and Amplifier provides dc to 100 MHz single-ended and differential measurements. The cmrr of the P6046 and amplifier is 1000:1 at 50 MHz.

A switch on the probe selects ac or dc input coupling. Accessories include a plug-on 10X attenuator for extending the differential input voltage range, and a ground tip for applications requiring single-ended input. Unique swivel tips provide variable spacing to accommodate varying distance between test points.

The P6046 Amplifier mounts conveniently on the side of the oscilloscope and features a calibrated 1 mV/div to 200 mV/div (2 V/div with 10X attenuator) deflection factor (oscilloscope deflection factor set at 10 mV/div). The output impedance of the amplifier is 50 Ω. A 50-Ω termination is supplied with the amplifier for use with 1-MΩ systems.

The P6046 Differential Probe may be used with the 1A5 Differential Amplifier with TEKTRONIX 540 and 550 Series Oscilloscopes. The P6046 Probe extends the differential measurement capabilities of the 1A5 to 45 MHz. The 1A5 supplies both probe power and amplification.

CHARACTERISTICS
Probe and Amplifier

Deflection Factor is 1 mV/div to 200 mV/div in 8 calibrated steps, 1-2-5 sequence, accurate within 3% (with an oscilloscope deflection factor of 10 mV/div). **Bandwidth** is dc to 100 MHz at 3 dB down. **Rise Time** is 3.5 ns or less. **Common-Mode Rejection Ratios** with deflection factors of 1 mV/div to 20 mV/div to at least 10,000:1 at 50 kHz, 5000:1 at 1 MHz, 1000:1 from 10 MHz to 20 MHz, and 1000:1 at 50 MHz. **Common-Mode Linear Dynamic Range** is ±5 V, ±50 V with 10X attenuator. **Input RC** is 1 MΩ paralleled by 10 pF or less. **Input Coupling** is ac or dc, selected by a switch on the probe. Low frequency response ac-coupled is 3 dB down at 20 Hz, 2 Hz with 10X attenuator. **Displayed Noise** is 280 μV or less (tangentially measured). **Max Input Voltage** is ±25 V (dc + peak ac), ±250 V with 10X attenuator. **Output Impedance** is 50 Ω through a BNC-type connector. A 50-Ω termination is supplied with the amplifier for use with 1-MΩ systems. **Probe Cable** is 6 ft long terminated with a special nine-pin connector. **Amplifier Power Requirements** are 10 W max, 48 to 400 Hz. Factory wired for 105 V to 125 V (117 V nominal) operation. Transformer taps permit operation at 210 V to 250 V (234 V nominal).

Included Accessories:

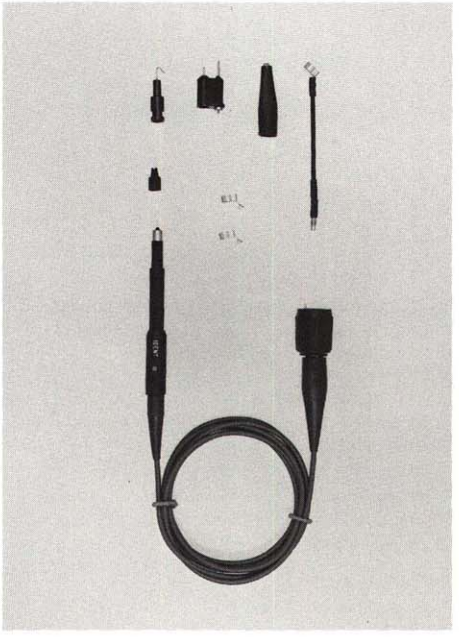
014-0029-00	1 **HANGER,** power supply assembly
012-0076-00	1 **CABLE,** 50Ω
011-0049-01	1 **TERMINATION,** 50Ω
016-0111-01	1 **CARRYING CASE,** (not shown)

ORDERING INFORMATION

P6046 FET Differential Probe, Amplifier, and Power Supply, Order 010-0232-00 ..... $1100

Opt 05 w/o Amplifier, and Power Supply, Order 010-0213-00 ..... $570

P6056 Dc to 3.5 GHz 10X



The P6056 is a miniature low-capacitance probe for use with 50 Ω wide-band oscilloscopes. Bandwidth is dc to 3.5 GHz. This probe can also be used with 50 Ω sampling systems, with an appropriate BNC adapter. The P6056 is equipped with a special BNC connector that provides trace identification and crt READOUT information when used with plug-in units and mainframes that have these features. A convenient button on the probe activates the trace identification function.

Attenuation is 10X. **Input Resistance** is 500 Ω at dc and approx 300 Ω at 1 GHz. **Input Capacitance** is 1.0 pF. **Rise Time** is less than 100 ps, probe only. **Typical Rise Time** with 7904 Oscilloscope and 7A19 Amplifier is 0.8 ns. **Bandwidth** is 3.5 GHz probe only, dc to 500 MHz with 7A19 and 7904. **Max Input Voltage RF (CW)** 22 V, dc 16 V. **Max Power Dissipation** is 0.5 W. **Transit Time Variation** from probe to probe is less than 70 ps.

Included Accessories:

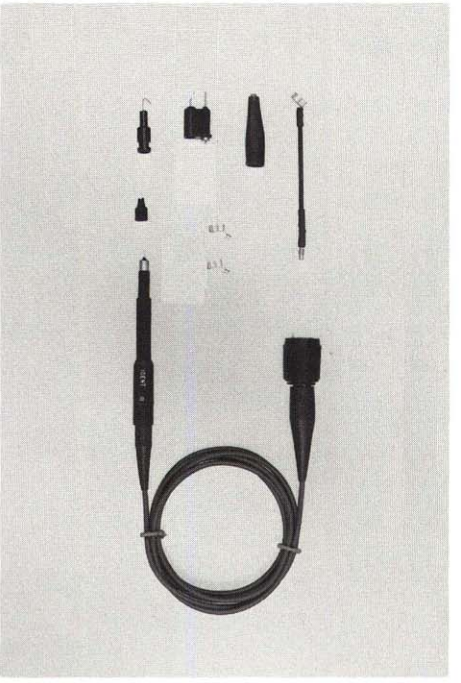
344-0046-00	1 **CLIP,** alligator
206-0114-00	1 **TIP,** hook
013-0085-00	1 **ADAPTER,** bayonet ground
214-0283-00	1 **CONTACT,** electrical
175-0249-00	1 **CABLE,** ground

ORDERING INFORMATION

P6056 10X 50 Ω Probe, 6 ft Order 010-6056-03 ..... $99

Opt 02, 9 ft Order 010-6056-05 ..... $99

P6057 Dc to 1.4 GHz 100X



The P6057 is a miniature low-capacitance probe for use with 50 Ω, wide-band oscilloscopes. Bandwidth is dc to 1.7 GHz. This probe can also be used with 50-Ω sampling systems, with an appropriate BNC female adapter (017-0063-00).

The P6057 is equipped with a special BNC connector that provides trace identification and crt READOUT information when used with plug-in units and mainframes that have these features. A convenient button on the probe activates the trace identification function.

Attenuation is 100X. **Input Resistance** is 5000 Ω at dc and approx 1500 Ω at 1 GHz. **Input Capacitance** is 1.0 pF. **Rise Time** is less than 250 ps, probe only. **Typical Rise Time** with 7904 Oscilloscope and 7A19 Amplifier is 0.8 ns. **Bandwidth** is 1.4 GHz probe only, dc to 480 MHz with 7A19 and 7904. **Max Input Voltage** 50 V dc or rms to 500 MHz decreasing to 21 V at 1 GHz. **Transit Time Variation** from probe to probe is less than 70 ps.

Included Accessories:

344-0046-00	1 **CLIP,** alligator
206-0114-00	1 **TIP,** hook
013-0085-00	1 **TIP,** bayonet ground
214-0283-00	1 **CONTACT,** electrical
175-0249-00	1 **CABLE,** ground

ORDERING INFORMATION

P6057 100X 50 Ω Probe, 6 ft, Order 010-6057-03 ..... $99

Opt 02, 9 ft, Order 010-6057-05 ..... $99

P6302 Current Probe and AM 503 Current Probe Amplifier

1 mA to 20 A, 50 A Peak Current Measurements

Ac or Dc Coupling

Dc to 50 MHz Bandwidth

Clip-on Probe

20 mA to 50,000 A Peak with CT-5

Motor Currents

SCR Currents

Power Supply Currents

Medical Research

Relay Currents

Common-mode rejection of dc and ac currents

Small loading—0.1 Ω insertion Z at 5 MHz, 0.5 Ω at 50 MHz

The P6302/AM 503 Current Probe System consists of: P6302 Current Probe, AM 503 Current Probe amplifier, any TM 500 Power Module and an oscilloscope. (For additional information on TM500 Power Modules see pages 170-172.)

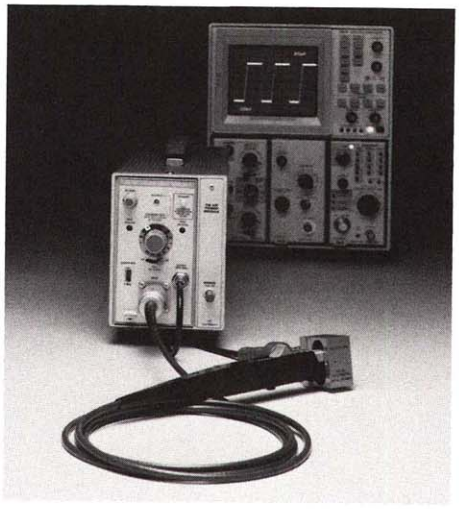
The P6302/AM 503 will find a wide variety of uses, from SCR to power supply measurements to medical applications. The P6302/AM 503 is especially useful when low loading is critical, such as with high impedance points or current dependent devices.

The P6302 operates with no electrical contact (inductive coupling). The probe is easy to use; just open the sliding jaw and place it around the conductor, no need to break the circuit. The P6302 is particularly useful for evaluating a circuit where a wide variety of parameters exist: fast transients, low frequency response, and dc level can all be measured simultaneously.

The probe can also be used to measure the sums or differences of currents in separate wires. When the probe is clipped around two wires carrying current in the same direction, the sum is displayed. By reversing one of the wires, the difference is displayed. For increasing sensitivity, several loops can be placed through the probe, increasing the sensitivity by the number of loops.

The AM503 is calibrated in 12 steps and the knob skirt is illuminated to indicate current per division. Bandwidth may be limited to 5 MHz to eliminate unwanted transients. Coupling can be set to ac or dc; ac coupling offers a convenient means of measuring low amplitude signals on a high-level dc current. A front-panel light warns of input currents above 20 A dc. More probes are planned to further extend the measurement capabilities of the AM 503.

Any oscillosope with at least 75 MHz bandwidth and 10 mV sensitivity will display the 50 MHz capability of the P6302/AM 503. The AM 503 output may be terminated with a supplied 50 Ω termination or plugged directly into a 50 Ω oscilloscope amplifier.



Current measurement capability can be extended to 20 mA to 5000 A/div (50,000 A Peak) with the addition of the CT-5 current probe. (For additional information on CT-5 current probe see page 242.)

SPECIFICATIONS

Bandwidth—DC to ≥ 50 MHz (−3 dB), ≥ 5 Hz to > 50 MHz (−3 dB) ac coupled; bandwidth may be limited to ≃ 5 MHz with AM 503 front panel switch.

Rise Time—7 ns or less.

Maximum Current—20 A (dc + peak ac).

Maximum Peak Pulse Current—50 A.

Amp Second Product—100 A μs.

Sensitivity—1 mA/div to 5 A/div within 3% (in calibrated steps) into 50 Ω load, indicating device sensitivity 10 mV/div.

Insertion Impedance—0.1 Ω at 5 MHz, 0.5 Ω at 50 MHz.

Maximum Voltage (bare connector)—500 V.

Maximum Conductor Size—0.15 in.

INCLUDED ACCESSORIES

AM 503—1 50 Ω BNC cable, 1 BNC 50 Ω termination.
P6302—1 5 in. ground lead, 1 3 in. ground lead.

ORDERING INFORMATION

P6302 Current Probe
Order 010-6302-01 ..... **$305**

AM 503 Current Probe Amplifier **$640**

CT-5 Current Probe
Order 015-0189-01 ..... **$680**

CT-5 Option 05 Current Probe
Order 015-0189-00 ..... **$520**

TM 501 Power Module **$130**
With Option 02 Interface ..... **add $ 55**

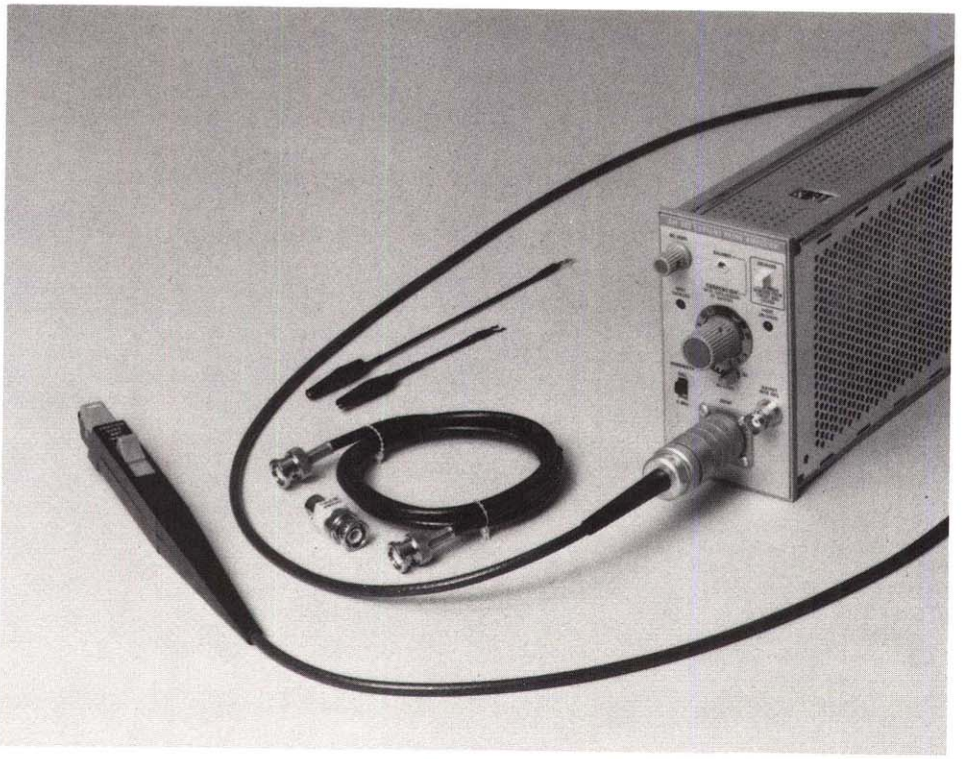
TM 503 Power Module **$160**
With Option 02 Interface ..... **add $ 75**

TM 504 Power Module **$180**
With Option 02 Interface ..... **add $100**

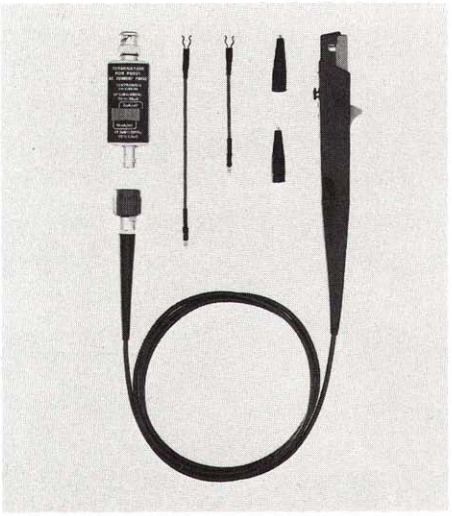
TM 506 Power Module **$240**
With Option 02 Interface ..... **add $150**

RTM 506 Power Module
(rackmount version) **$325**
With Option 02 Interface ..... **add $150**

TM 515 Traveler Mainframe **$325**
With Option 05 Interface ..... **add $ 75**
With Option 06 48-440 Hz fan ..... **add $150**



Ac Current Probes—12 Hz to 200 MHz



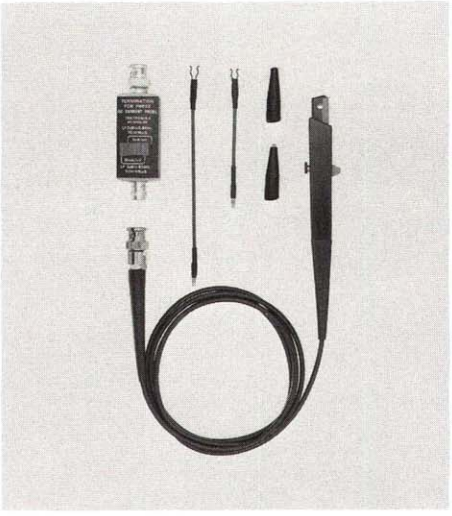
P6021 w/Term

For General-Purpose Applications
120 Hz to 60 MHz
Clip-on Probe

The individual units, P6021, 134, and P6022 provide versatility in a user-assembled ac current measurement system. These various components can be assembled into a variety of performance packages.

1. P6021 w/134
2. P6021 w/term
3. P6022 w/134
4. P6022 w/term

The P6021 and P6022 are ac current probes designed for use with real time oscilloscopes. Either probe, with passive termination or with the amplifier, can be used with oscilloscopes having input resistance of 1 MΩ or greater. (Neither the termination nor the amplifier is required to use the P6021 probe with the TEKTRONIX 5A21N Amplifier.) Both probes provide the facility for accurate current measurements over a wide range of frequencies without breaking the circuit under test. Just open the spring-loaded slide, place the conductor (up to 0.15 inch with P6021 and 0.1 inch with P6022) in the probe slot, and release the slide. No electrical connection is required.



P6022 w/Term

Small Size Suitable for Compact Circuitry
935 Hz to 200 MHz
Clip-on Probe

The shielded probe head is not grounded when the slide is in the open position, eliminating accidental grounding of the circuit under the test.

For general-purpose applications, the P6021 offers wide-band performance with excellent low-frequency characteristics. The extra-small size of the P6022 makes it ideally suited for measuring current in compact semiconductor circuits.

Both probes' low-frequency capabilities and sensitivity can be expanded using the 134 Current Probe Amplifier.

PERFORMANCE CHARACTERISTICS

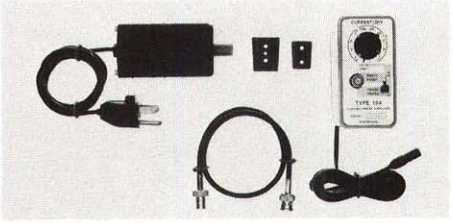
		Probe with Passive Termination	Probe with 134 Amplifier
Sensitivity	**P6021**	2 mA/mV or 10 mA/mV; selected by termination switch. Accuracy ± 3%.	134 Amplifier switchable in steps from 1 mA/div to 1 A/div (with 50 mV/div oscilloscope setting). Accuracy ± 3%.
	P6022	1 mA/mV or 10 mA/mV; selected by termination switch. Accuracy ±3%.	
Bandwidth†	**P6021**	2 mA/mV ≤ 450 Hz to 60 MHz 10 mA/mV ≤ 120 Hz to 60 MHz	12 Hz to 38 MHz
Probe Only*	**P6022**	1 mA/mV—≤ 8.5 kHz to 130 MHz 10 mA/mV—≤ 935 Hz to 200 MHz	100 Hz to 65 MHz
Max Current (CW)	**P6021**	15 A p-p sine wave between 1.2 kHz and 5 MHz at 2 mA/mV; between 300 Hz and 5 MHz at 10 mA/mV.	15 A p-p sine wave between 230 Hz and 5 MHz
	P6022	6 A p-p sine wave between 10 kHz and 10 MHz at 1 mA/mV; between 3 kHz and 10 MHz at 10 mA/mV.	6 A p-p sine wave between 1.3 kHz and 10 MHz
Max Current (Pulse)	**P6021**	250 A peak, not to exceed 500 A-μs or 5 A rms	15 A peak, not to exceed 500 A-μs or 5 A rms
	P6022	100 A peak, not to exceed 9 A-μs or 2 A rms	15 A peak, not to exceed 9 A-μs or 2 A rms
Noise			≤ 150 μA
Max Voltage (bare conductor)		600 V (dc + peak ac)	600 V (dc + peak ac)
Net Weight		≃ 1 lb	≃ 5 lb

†All bandwidths stated are −3dB

**To estimate the scope/probe system bandwidth from the probe only bandwidth, use the relationship*

$$(t_r \text{ system})^2 = (t_r \text{ probe})^2 + (t_r \text{ scope})^2$$

$$t_r = 0.35\ BW$$



134 Current Probe Amplifier

Use to Expand the Low Frequency Capability and Sensitivity of Either Probe

The 134 is used to extend the measurement capabilities of the P6021 or P6022 Current Probe. A CURRENT/DIV switch provides calibrated current steps from 1 mA/div to 1 A/div (with the oscilloscope or plug-in unit adjusted for a deflection factor of 50 mV/div). A passive termination is not required when using a 134 and a P6021 or P6022.

The 134 can also be used as an auxiliary voltage amplifier by placing the CURRENT/DIV switch in the VOLTS position.

ORDERING INFORMATION
P6021

P6021 Current Probe and Term, 5 ft, Order 015-0140-02 ..... $185

Opt 02, 9 ft and Term, Order 015-0140-03 ..... $185
Opt 06, 5 ft w/o Term, Order 010-0237-02 ..... $130
Opt 02 and 06, 9 ft w/o Term, Order 010-0244-02 ..... $130

P6022

P6022 Current Probe and Term, 5 ft, Order 015-0135-00 ..... $205

Opt 02, 9 ft and Term, Order 015-0135-01 ..... $205
Opt 06, 5 ft w/o Term, Order 010-0238-00 ..... $150
Opt 02 and 06, 9 ft w/o Term, Order 010-0238-02 ..... $150

134

134 Current Probe Amplifier, Order 015-0057-02 ..... $350

Included Accessories:
014-0029-00 1 **HANGER** assembly
012-0104-00 1 **CABLE** assembly
015-0058-01 1 **POWER SUPPLY,** 110 V

Opt 04, 230 V ac, Order 015-0057-03 ..... $350
Included Accessories: Same as above, but with 230 V power supply (015-0058-01).

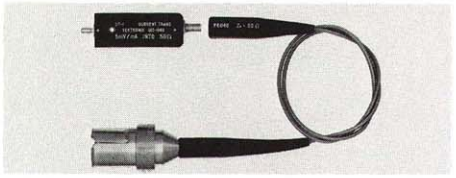
OPTIONAL ACCESSORIES for P6021, P6022, and 134

Calibrator Adapter, BNC, Order 013-0092-00 ..... $20
Carrying Case for P6021 and P6022, and a 134 Amplifier, Order 016-0087-01 ..... $13

Passive Termination
For P6021, Order 011-0105-00 ..... $75
For P6022, Order 011-0106-00 ..... $80

CT-1

1 GHz Ac Current Probe for 50 Ω Systems



Used with 50 Ω Systems, or Wide Band Non-sampling Oscilloscopes Using a 50 Ω Term

CT-1 Permanently Inserted in 50 Ω Circuit Has Minimum Effect in the 50 Ω Environment

Probe Cable

The 010-0133-00 probe cable is an interconnecting cable for the CT-1, used between the transformer and oscilloscope input. If several CT-1 Transformers are in a circuit, the probe cable can be used to monitor any one of them.

The probe cable can be used with other test-point connectors, such as Amphenol Series 27 Sub-Minax or Sealectro Sub-Miniature RF.

Impedance is 50 Ω. **Attenuation** is 1X. **Output Connector** is a GR type. **Cable Length** is 18 in. Additional 50 Ω cable can be used in series with the probe. RG213/U or RG58A/U is recommended for best preservation of the CT-1 Transformer high-frequency response.

CT-1 Current Transformer

Sensitivity is 5 mV/mA into a 50 Ω load. Accuracy is ± 3%. **Decay Time Constant** is 5 μs, approximated by 1% per 50 ns; limit, 1 μs. **Rise Time** is less than 350 ps. **Frequency Response** is 35 kHz to 1 GHz (3 dB down). **Insertion Impedance** with a 50 Ω termination is 1 Ω shunted by approx 5 μH; 2 Ω shunted by approx 5 μH without a 50 Ω termination. **Capacitance Loading** to a bare wire passing through the CT-1 Transformer is typically 1.5 pF for #14 gauge, 0.6 pF for #20 gauge. **Max Voltage of Circuit under Test** is 1000 V dc. **Direct Current** reduces the L/R time constant by a factor of 2 at 0.6 A. **Pulse Current Rating** is 100 A peak, with a max amp-second product of 1 A μs. **Rms Current Rating** is 500 mA max. **Temperature Rating** is −25°C to +65°C. **Physical Dimensions** are ⅜ x 9/16 x 1-13/16 in plus #6-32 x ¼ in mounting stud.

ORDERING INFORMATION

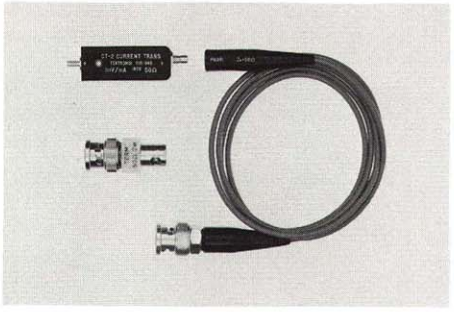
CT-1 Current Transformer and Probe, Order 015-0041-00 ..... $81

Opt 05 CT-1 Current Transformer (without Probe), Order 015-0040-00 ..... $47

Probe Cable, Order 010-0133-00 ..... $40

CT-2

100 MHz Ac Current Probe



Use with Oscilloscopes up to 100 MHz BW

Insulated Case for Limited Space Applications

Several CT-2 Transformers Can Be Used in the Circuit and Monitored by One Cable

Probe Cable

The 010-0164-00 probe cable connects the CT-2 Transformer and the oscilloscope input. A 50 Ω termination is used with the probe cable for terminating the probe cable at the high impedance input of the oscilloscope.

Impedance is 50 Ω. **Attenuation** is 1X. **Output Connector** is BNC type. **Cable Length** is 42 in. Additional 50 Ω cable can be used in series with the probe. RG213/U or RG58A/U cable is recommended to preserve the high-frequency response.

CT-2 AC CURRENT PROBE

Sensitivity is 1 mV/mA into a 50 Ω load. Accuracy is ±3%. **Decay Time Constant** is 125 μs, approx by 1% per 1.25 μs; limit 25 μs. **Rise Time** is approx 0.5 ns.

Frequency Response is 30% down at 1.2 kHz, 7% down at 200 MHz. **Insertion Impedance** with a 50 Ω termination is 0.04 Ω shunted approx 5 μH; 0.08 Ω shunted by approx 5 μH without a 50 Ω termination.

Capacitive Loading to a bare wire passing through the CT-2 Transformer is typically 2.1 pF for #16 gauge, 0.7 pF for #22 gauge. **Max Voltage of Circuit under Test** is 1000 V dc. **Direct Current** reduces the L/R time constant by a factor of 2 at 0.5 A. **Pulse Current Rating** is 100 A peak, with a max amp-second product of 50 μs. **Rms Current Rating** is 2.5 A max. **Temperature Rating** is −25° C to +65° C.

ORDERING INFORMATION

Included Accessories:

010-0164-00 1 **CABLE,** probe

011-0049-01 1 **TERMINATION,** 50 Ω

CT-2 Plus Cable and Term, Order 015-0047-00 ..... $86

Opt 05 w/o Cable or Term, Order 015-0046-00 .... $47

Probe Cable, Order (010-0164-00) $29

CT-5

Pulsed Currents to 50,000 A

20 mA per Division Sensitivity

1.5 Inch Diameter Conductors

Measurements on Bare Conductors to 3000 V

Nullifies Dc Effects to 300 A

The CT-5 is a clip-on high-current transformer which extends the measurement capability of TEKTRONIX Clip-on Current Probes. Maximum low-frequency performance is obtained using the P6302/AM503 Dc Current Probe. Pulse current to 50,000 A may be measured using the P6301 and passive termination, provided the 0.5 A-s rating is not exceeded. The P6021 and 134 Current Probe Amplifier may also be used for measurements at normal power line frequency and above. (The P6022 and CT-5 are not compatible with each other.) The CT-5 has receptacles for current probes in either 20:1 or 1000:1 step-down ratios. The 1.5 inch square opening makes it possible to clip onto large conductors without breaking the circuit under test. The core and shield assembly is insulated from the windings and the handle. This allows measurements on bare conductors to 3000 V, and to 10 kV rms when using high voltage bushing.

Use of dc bucking coil assembly allows up to 300 A of dc to be tolerated without appreciably degrading the measurements. This is very useful for measuring ac signals riding on top of dc.

CT-5 CHARACTERISTICS

The following are characteristics of the CT-5 using either the P6302/AM503 or P6021/134 combinations.

Rise Time is 17.5 ns or less. **Insertion Impedance** is 20 μΩ or less at 60 Hz, increasing to 20 mΩ at 1 MHz. **Current Range** is 20 mA/div to 100 A/div with P6302/AM503, and 20 mA/div to 20 A/div with P6021/134 (20:1 step down ratio); 1 A/div to 5 kA/div with P6302/AM503, 1 A/div to 1 kA/div with P6021/134, (1000:1 step down ratio). **Accuracy** is ±4%. Max Current is 1000 A peak cw.* **Amp-Sec product** is 8 A-s. **Max Voltage** of circuit test is 3000 V (bare conductor). **Max Dc Bucking Current** is 300 mA to buck out 300 A dc (using dc bucking coil). **Dimensions and weight**—the length is 10.5 in, width is 2.25 in, height is 9.5 in, net weight is approx 4 lb.

**Max current 1000 A peak from 20 Hz to 1.2 kHz derating to 100 A peak at 1 MHz.*

Included Accessories:

016-0191-03 1 **CARRYING CASE**

015-0194-00 1 **BUSHING,** high voltage, 12 in

ORDERING INFORMATION

CT-5 Current Probe (Includes Dc Bucking Coil) Order 015-0189-01 ..... $680

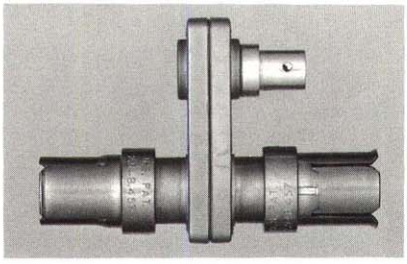
Opt 05 w/o Dc Bucking Coil, Order 015-0189-00 ..... $520

OPTIONAL ACCESSORIES

Dc Bucking Coil, Order 015-0190-00 ..... $170

High-Voltage Bushing, 4 ft long, inside diameter is 1 in, Order 015-0194-01 ..... $25

CT-3 SIGNAL PICKOFF



Designed for use with high-frequency oscilloscopes, the CT-3 Pickoff provides a convenient means of picking off a signal in a 50 Ω system. Used with any of the TEKTRONIX sampling instruments, the CT-3 provides the link for use as a trigger source.

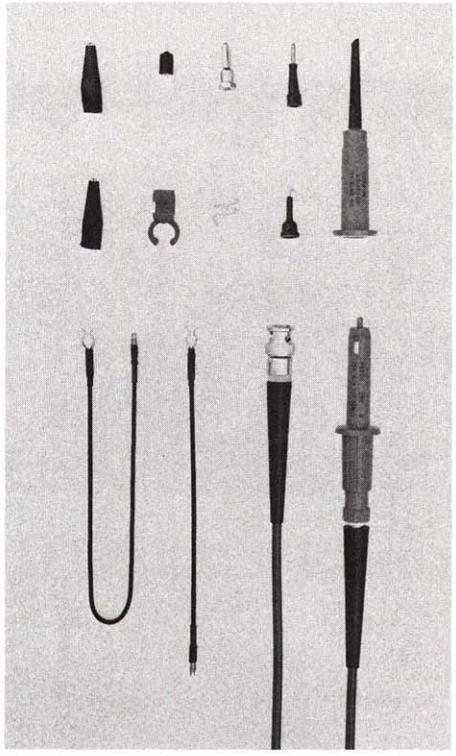
Sensitivity is 10% of the voltage under test, into a 50 Ω load. **Decay Time Constant** is 4.5 μs at 0 dc current. **Rise Time** is less than 0.4 ns. **Frequency Response** is 50 kHz to 875 MHz at 0 dc current. **Insertion Impedance** with a 50 Ω termination is 1 Ω shunted by 4.5 μH, 2 Ω shunted by 4.5 μH without a 50 Ω termination. **Vswr** is less than 1.2 at 1.5 GHz. **Voltage Rating** at 0 V dc is 25 V rms, 1-kv pulse peak. The Vs product is 100 Vμs. If exceeded, the L/R decay will decay rapidly toward zero.

CT-3 Signal Pickoff, Order 017-0061-00 ..... $81

CT-5 Current Measurement Combinations

Product	Current Div Scope Set 10 mV/div	Current Div Scope Set 50 mV/div	Bandwidth	Amp Micro-s Product	Max Current Rms	Max Current Peak Pulse
CT-5/P6302/AM 503	20 mA to 5 kA		0.5 Hz to 20 MHz	0.1	700 A	50 kA
CT-5/P6021/134		20 mA to 1 kA	12 Hz to 20 MHz	0.5	700 A	15 kA
CT-5/P6021/Term		100 mA to 0.5 A	120 Hz to 20 MHz	0.5	700 A	50 kA

P6006 Dc to 35 MHz 10X



The P6006 is a general-purpose probe. It can be compensated to match all TEKTRONIX Plug-ins and Oscilloscopes with nominal input capacitances of 15 pF to 55 pF and input resistance of 1 MΩ. This probe is more rugged and has a higher voltage rating than the miniature probes.

Attenuation is 10X; **Input Resistance** is 10 MΩ; **Input Capacitance** for standard length probe is approx 7.5 pF when used with an instrument having a 20 pF input capacitance; 8.5 pF for the 6 ft version, 11 pF for the 9 ft version, 13 pF for the 12 ft version; **Probe Rise Time** is approx 5 ns; **Voltage Rating** is 600 V dc, ac peak, or dc and ac peak combined.*

ORDERING INFORMATION

P6006 10X Probe, Order 010-0160-00 . . . $42

Opt 01, 3.5 ft. BNC, Order 010-0127-00 . . . . . $42

Opt 02, 9 ft. BNC, Order 010-0146-00 . . . . . $42

Opt 03, 12 ft BNC, Order 010-0148-00 . . . . . $42

**P-p voltage derating is necessary for cw frequencies higher than 5.7 MHz when working into a 20 pF input, or higher than 3.6 MHz when working into a 47 pF input.*

P6007 Dc to 25 MHz 100X

The P6007 is a low input capacitance, high-voltage (1.5 kV) probe. It can be compensated to match all TEKTRONIX Plug-ins and Oscilloscopes with nominal input capacitances of 15 pF to 55 pF and input resistance of 1 MΩ. The P6007 is similar to the photo of the P6006.

Attenuation is 100X; **Input Resistance** is 10 MΩ; **Input Capacitance** for 3.5 ft probe is approx 2.0 pF when used with an instrument having a 20 pF input capacitance; 2.2 pF for the 6 ft version, 2.4 pF for the 9 ft version, 2.6 pF for the 12 ft version; **Probe Rise Time** is approx 14 ns for the 3.5 ft version; **Voltage Rating** is 1.5 kV dc or ac rms, 4.2 kV ac p-p.*

ORDERING INFORMATION

P6007 100X Probe, 6 ft, Order 010-0165-00 . . . . . $72

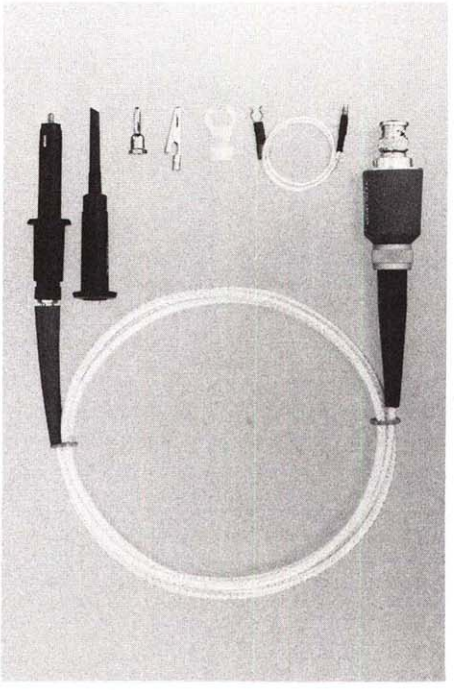
Opt 01, 3.5 ft, Order 010-0150-00 . . . . . $72

Opt 02, 9 ft, Order 010-0152-00 . . . . . $72

Opt 03, 12 ft, Order 010-0154-00 . . . . . $72

**P-p voltage derating is necessary for cw frequencies higher than 200 kHz. At 10 MHz, the max allowable p-p voltage is 2 kV. Above 10 MHz, additional derating is required depending on the input capacitance of the plug-in or instrument used.*

P6008 Environmental 10X



The P6008 Environmental Probe is designed to operate over −50°C to +150°C for the probe body and cable; the compensation box operates from −15° to +55°C. It is designed for use with TEKTRONIX dc to 100 MHz Oscilloscopes. The probe can be compensated to match TEKTRONIX Plug-ins and Oscilloscopes with nominal input capacitance of 12 pF to 47 pF and input resistance of 1 MΩ.

Attenuation is 10X; **Input Resistance** is 10 MΩ; **Input Capacitance** is approx 7.5 pF when used with an instrument having a 20 pF input capacitance; **Probe Rise Time** is less than 3.5 ns; **Bandpass** is 100 MHz; **Voltage Rating** is 600 V dc, ac peak, or dc and ac peak combined.*

Included Accessories:

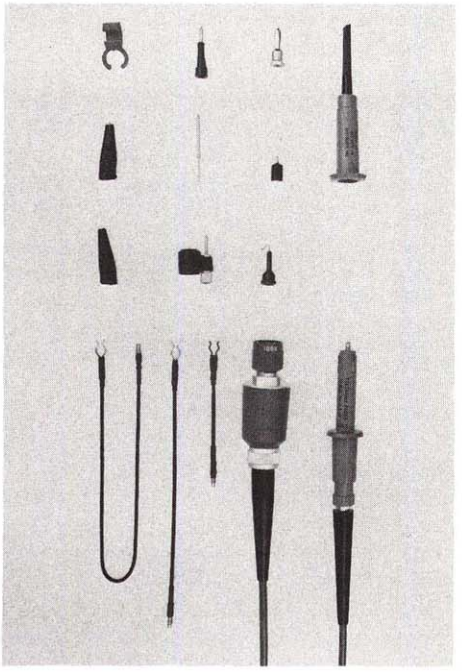
134-0013-00	1 **PLUG,** banana
344-0045-00	1 **CLIP,** miniature alligator
175-0925-00	1 **LEAD,** ground, 12.5 in
352-0090-00	1 **PROBE HOLDER**
013-0071-01	1 **TIP,** retractable hook

ORDERING INFORMATION

P6008 10X Probe, 6 ft, Envir, Order 010-0129-01 . . . . . $125

**P-p voltage derating is necessary for cw frequencies higher than 20 MHz. At 40 MHz, the max allowable p-p voltage is 300 V.*

P6009 Dc to 120 MHz 100X



The P6009 low input capacitance, high-voltage (1.5 kV) probe is designed for use with TEKTRONIX dc to 150 MHz Oscilloscopes. The probe can be compensated to match TEKTRONIX Plug-ins and Oscilloscopes with nominal input capacitances of 12 pF to 47 pF and input resistance of 1 MΩ.

A version of the P6009 is equipped with a special BNC connector that provides CRT READOUT† information when used with plug-in units and mainframes that have these features. The readout connector is not compatible with most standard non-readout BNC connectors.

Attenuation is 100X. **Input Resistance** is 10 MΩ. **Input Capacitance** is approx 2.5 pF when used with an instrument having a 20 pF input capacitance; **Probe Rise Time** is approx 2 ns; **Voltage Rating** is 1.5 kV dc or ac rms, 4 kV ac p-p.* **Cable** is 9 ft long, terminated with a BNC connector; **Net Weight** is approx 16 oz.

Included Accessories:

175-0125-01	1 **CABLE,** ground lead, 12 in
175-0124-01	1 **CABLE,** ground lead, 5 in
175-0263-01	1 **CABLE,** ground lead, 3 in
013-0071-00	1 **PINCHER TIP**
352-0090-00	1 **HOLDER,** probe
013-0052-00	1 **ASSEMBLY,** bayonet ground assembly includes: 214-0325-00 1 **PIN,** center
344-0046-00	2 **CLIPS,** miniature alligator
206-0060-00	1 **TIP,** probe, male, w/6-32 threads
206-0105-00	1 **TIP,** probe, w/6-32 threads
134-0013-00	1 **PLUG,** banana, female, w/6-32 threads
206-0015-00	1 **TIP,** w/straight shank

ORDERING INFORMATION

P6009 100X Probe, 9 ft, w/Readout, Order 010-0264-01 . . . . . $110

Opt 04 w/o Readout, Order 010-0170-00 . . . . . $105

**P-p voltage derating is necessary for cw frequencies higher than 200 kHz. At 40 MHz, the max allowable p-p voltage is 425 V.*

†Readout coding inoperative with 7A15A and 7A22.

P6013A 12 kV 1000X

The P6013A provides 1000X attenuation for oscilloscope measurements of high amplitude waveforms or dc potentials up to 12 kV. The probe can be compensated for oscilloscope input capacitance up to 60 pF and input resistance of 1 MΩ. The P6013A is similar to the P6015 shown in photo.

Attenuation is 1000X. **Input Resistance** is 100 MΩ. **Input Capacitance** of probe with 10 ft cable is 3 pF; 3.5 pF with 25 ft cable. **Probe Rise Time** is 7 ns or less with 10 ft cable, 13.5 ns or less with 25 ft cable. **Voltage Rating** is 12 kV, peak pulse, or peak ac.* **Net Weight** is approx 5½ lb.

Included Accessories:

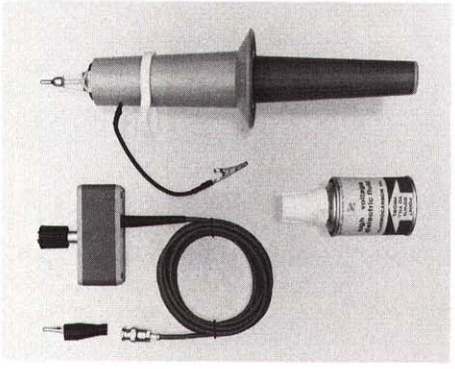
015-0083-00	1 **COMPENSATING BOX,** BNC
344-0005-00	1 **CLIP,** alligator
352-0056-00	1 **PROBE HOLDER**
016-0129-01	1 **CARRYING CASE**

ORDERING INFORMATION

P6013A 1000X probe, 10 ft,
Order 010-0177-01 . . . . . $345
Opt 03, 25 ft, Order 010-0175-01 . . . . . $345

**P-p voltage derating is necessary for cw frequencies higher than 100 kHz. At 1 MHz, the max allowable p-p voltage is 5.5 kV.*

P6015 40 kV 1000X



The P6015 provides 1000X attenuation for oscilloscope measurements up to 40 kV peak. Voltage or duty cycle derating is necessary for rf voltages at frequencies over 100 kHz, or in temperatures above 25°C.

The probe can be compensated for instruments with nominal input capacitance of 12 pF to 47 pF.

Attenuation is 1000X. **Input Resistance** is 100 MΩ. **Input Capacitance** is approx 3 pF. **Probe Rise Time** is approx 4 ns. **Temperature Range** is 10°C to 55°C. **Voltage Rating** is 40 kV peak ac or pulse, 20 kV dc or rms continuous at 25°C.*

Included Accessories:

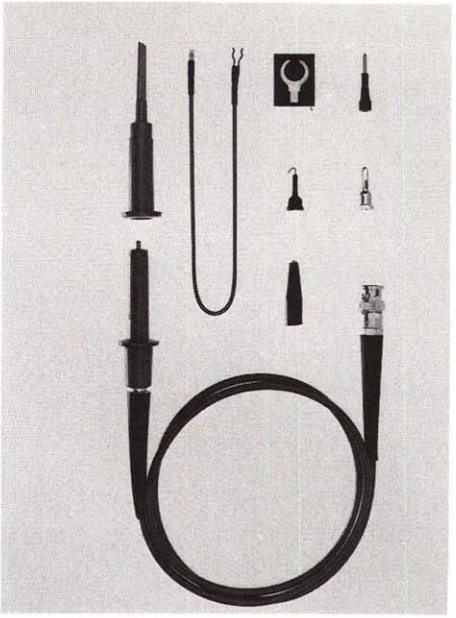
015-0049-00	1 **COMPENSATING BOX,** BNC
344-0005-00	1 **CLIP,** alligator
352-0056-00	1 **PROBE HOLDER**
252-0120-00	1 **CAN** of high-voltage dielectric fluid
016-0128-02	1 **CARRYING CASE**

ORDERING INFORMATION

P6015 1000X Probe, 10 ft,
Order 010-0172-00 . . . . . $380

**P-p voltage derating is necessary for cw frequencies higher than 100 kHz. At 10 MHz, the max allowable p-p voltage is 13 kV.*

P6028 Dc to 17 MHz 1X



The P6028 is a general-purpose 1X voltage probe designed for use with TEKTRONIX Oscilloscopes that have BNC input connectors.

Attenuation is 1X. **Input Resistance** is 1 MΩ, instrument input R included. **Input Capacitance** for 3.5 ft version is approx 30 pF, 47 pF for the 6 ft version, 70 pF for the 9 ft version, and 92 pF for the 12 ft version instrument excluded. For total input capacitance of the system, add input C of instrument. **Probe Rise Time** is approx 10 ns. **Voltage Rating** is 600 V dc or ac p-p.*

Included Accessories:

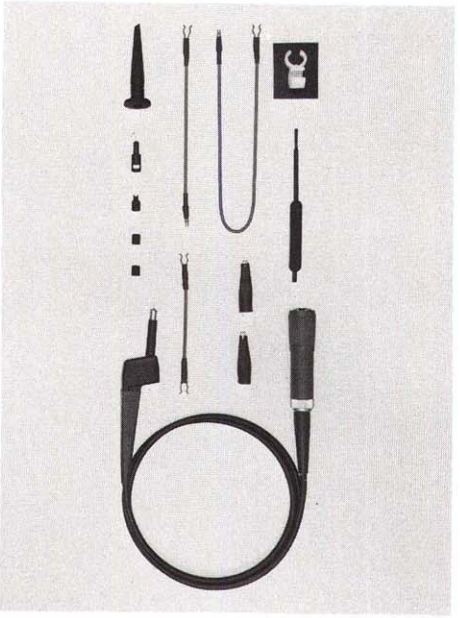
175-0125-01	1 **CABLE** ground lead, 12 in
352-0068-00	1 **HOLDER,** probe, molded
344-0046-00	1 **CLIP,** miniature alligator
013-0071-00	1 **PINCHER TIP**
134-0013-00	1 **PLUG,** banana
206-0105-00	1 **TIP,** probe, hook
206-0060-00	1 **TIP,** probe, spring

ORDERING INFORMATION

P6028 1X Probe, 6 ft,
Order 010-0075-00 . . . . . $32
Opt 01, 3.5 ft, Order 010-0074-00 . . . . . $32
Opt 02, 9 ft, Order 010-0076-00 . . . . . $32
Opt 03, 12 ft, Order 010-0077-00 . . . . . $32

**P-p voltage derating is necessary for cw frequencies higher than 1 MHz. At 10 MHz, the max allowable p-p voltage is 60 V.*

P6055 20,000:1 Cmrr 10X



The P6055 is a miniature, low-capacitance, 10X probe designed for use with TEKTRONIX Differential Amplifiers having nominal input capacitances from 20 pF to 47 pF. The attenuation ratio is adjustable to 10X to compensate for differences in input resistance of the amplifier (the amplifier input resistance must be 1 MΩ ± 2%). A special locking type readout connector allows the probe to be used with instruments with or without readout capability.

When two P6055 Probes are used to drive the two inputs of a differential amplifier, the ability to change the attenuation ratio of one probe versus the other is helpful in maintaining the cmrr of the system.

Cmrr is 20,000:1 from dc to 1 kHz derating to 100:1 at 20 MHz, measured at probe tip using probe pair with 7A13. **Attenuation** is adjustable to 10X. **Input Resistance** is 1 MΩ ± 0.5%. **Input Capacitance** is approx 10 pF when used with an instrument having 20 pF input capacitance; 12.5 pF when used with an instrument having 47 pF input capacitance. **Typical Rise Time** of the probe with 7A13 and 7704 Oscilloscope is 5.4 ns. **Voltage Rating** is 500 V (dc + peak ac).*

Included Accessories:

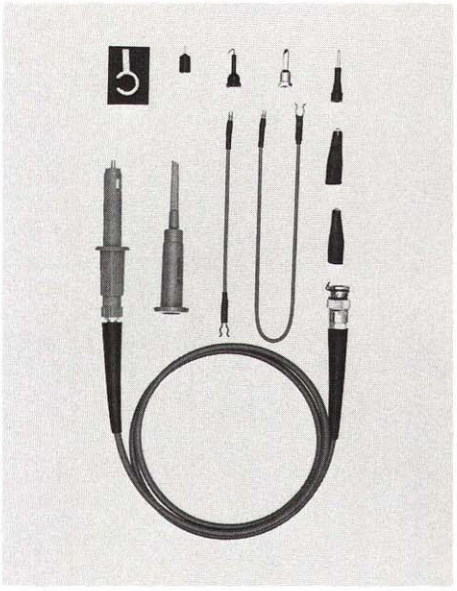
013-0107-03	1 **TIP,** probe, retractable, hook
003-0675-00	1 **SCREWDRIVER,** probe adjust
175-0124-01	1 **LEAD,** electrical, 5 in
175-1256-00	1 **LEAD,** electrical, 6 in
175-0125-01	1 **LEAD,** electrical, 12 in
206-0114-00	1 **TIP,** probe
344-0046-00	2 **CLIPS,** miniature alligator
166-0404-01	2 **TUBES,** insulating
352-0090-00	1 **HOLDER,** probe

ORDERING INFORMATION

P6055 10X Differential Probe, 3.5 ft,
Order 010-6055-01 . . . . . $140

**P-p voltage derating is necessary for cw frequencies higher than 12 MHz. At 70 MHz, the max allowable p-p voltage is 100 V.*

P6060 Dc to 35 MHz 10X



The P6060 is a precision passive probe with 10X attenuation, for use with TEKTRONIX low and mid-frequency oscilloscopes used in differential applications. The precise attenuation also provides greater accuracy for single-ended input applications, such as amplitude measurements with a differential comparator. The probe can be compensated for use with any amplifier input having a nominal input capacitance of 15 to 55 pF and input resistance of 1 MΩ.

The BNC-type connector utilizes a special grounding clip to shift the deflection factor indicator to 10X normal reading in 5000-Series Oscilloscopes.

Attenuation is 10X. Accuracy when used with a 1 MΩ ± 0.15% instrument input will be within ± 0.4%. When used with a 1 MΩ ± 2% instrument input the accuracy will be within ± 2%. **Input Resistance** is 10 MΩ within ± 0.25% with a 1 MΩ ± 0.15% instrument input; 10 MΩ within ± 0.4% when used with a 1 MΩ ± 2% instrument input. **Input Capacitance** for 15 pF instruments is ≃6.0 pF with 3.5 ft probe, and ≃7.7 pF with 6 ft; with 55 pF instruments it is ≃9.5 pF with the 3.5 ft, ≃11.5 pF for the 6 ft. **Cmrr (Probe Pair)**—At least 400:1 (with 5A20N or 5A21N) dc to 30 kHz. **Bandwidth**—3.5 ft probe at least 40 MHz (with scope bandwidth of at least 60 MHz); 6 ft probe at least 30 MHz (with scope bandwidth of at least 60 MHz). **Max Input Voltage**—600 V (dc + peak ac).*

Included Accessories:

206-0060-00	1 **TIP,** probe, spring
344-0046-00	2 **CLIPS,** miniature alligator
134-0013-00	1 **PLUG,** banana, threaded
175-0125-01	1 **CABLE,** ground lead, 12 in
175-0124-01	1 **CABLE,** ground lead, 5 in
206-0105-00	1 **TIP,** probe, hook
206-0015-00	1 **TIP,** probe, BNC
352-0090-00	1 **HOLDER,** probe, plastic
013-0071-00	1 **TIP,** probe, retractable hook, screw-on

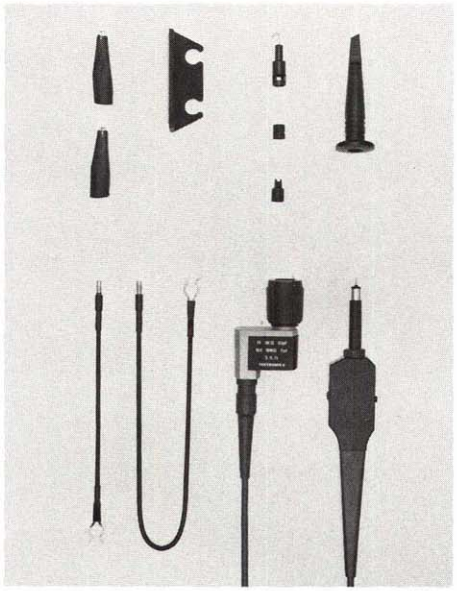
ORDERING INFORMATION

P6060 10X Probe, 6 ft,
Order 010-6060-03 . . . . . $49

Opt 01, 3.5 ft, Order 010-6060-01 . . . . . $49

**P-p voltage derating is necessary for cw frequencies higher than 3 MHz. Max input voltage at 50 MHz is 50 V.*

P6062B Dc to 100 MHz
1X, 10X Selectable Attenuation



The P6062B is a passive dual attenuation probe designed for TEKTRONIX Oscilloscopes with bandwidths to 100 MHz. A sliding switch on the probe body selects 1X or 10X attenuation. The probe provides readout coding and a pushbutton for actuating a ground reference in the 1X or 10X position. The ground reference can be used as a means of trace identification for a multitrace display. The P6062B can be compensated with instruments having a nominal input capacitance of 15 to 47 pF. The 1X position of the probe allows the use of the full instrument sensitivity. This is valuable when evaluating small signals of 10 MHz or less. The 1X-10X switch allows the user to switch in and out a decade of sensitivity without returning to the oscilloscope. The user may also arbitrarily switch from 1X to 10X in order to evaluate the effects of loading by the oscilloscope.

Attenuation, 10X and 1X. **Input Resistance** 1X position, 1 MΩ; 10X position, 10 MΩ ±0.5%, oscilloscope input resistance must be 1 MΩ within 2%. **Input Capacitance** for the 3.5 ft probe is 100 pF in the 1X position, and 13.5 pF in the 10X position; for the 6 ft version, 105 pF in the 1X position, and 14 pF in the 10X position. For the 9 ft probe 135 pF in the 1X position and 17 pF in the 10X position. **Bandwidth** of the 10X probe is at least 100 MHz for the 3.5 ft and 6 ft, and 95 MHz for the 9 ft when used with a 465 or 464 Oscilloscope. **Bandwidth** of the 1X probe 3.5 ft is at least 8 MHz, 6 ft is at least 6.7 MHz and 9 ft is at least 4.5 MHz. **Voltage Rating** is 500 V (dc + peak ac).

Included Accessories:

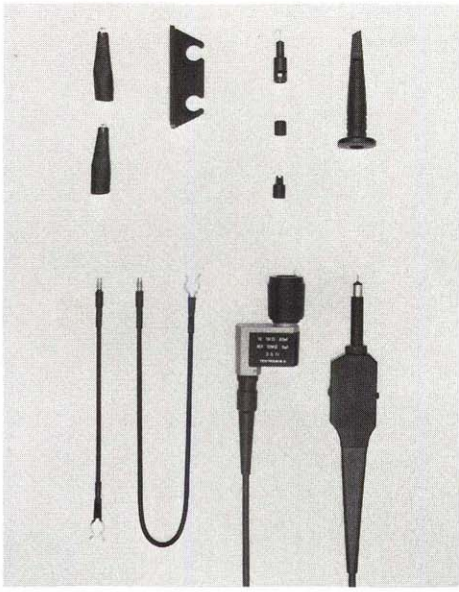
352-0341-00	1 **HOLDER,** probe
206-0114-00	1 **TIP,** probe
013-0107-03	1 **TIP,** probe; ret hook assy
175-0124-01	1 **LEAD,** elec, probe ground, 5 in
175-0125-01	1 **LEAD,** elec, probe ground, 12 in
344-0046-00	2 **CLIPS,** miniature alligator with cover
166-0404-01	1 **SLEEVE,** insul for 0.188 dia probe bushing
016-0521-00	1 **POUCH,** accessory (not shown)

ORDERING INFORMATION

P6062B Switchable Attenuation Probe, 6 ft,
Order 010-6062-13 . . . . . $95

Opt 01, 3.5 ft, Order 010-6062-11 . . . . . $95
Opt 02, 9 ft, Order 010-6062-15 . . . . . $95

P6063B Dc to 200 MHz
1X, 10X Selectable Attenuation



The P6063B is a fast-rise dual attenuation, passive probe designed for TEKTRONIX Oscilloscopes with bandwidths greater than 100 MHz. A sliding switch on the probe body selects 1X or 10X attenuation. The probe provides readout coding and a pushbutton for actuating a ground reference in the 1X or 10X position. The ground reference can be used as a means of trace identification for a multitrace display. The P6063B can be compensated with instruments having a nominal input capacitance of 15 to 24 pF.

The 1X position of the probe allows the use of the full instrument sensitivity. This is valuable when evaluating small signals of 10 MHz or less. The 1X-10X switch allows the user to switch in and out a decade of sensitivity without returning to the oscilloscope. The user may also arbitrarily switch from 1X to 10X in order to evaluate the effects of loading by the oscilloscope.

Attenuation is 10X and 1X. **Input Resistance** 1X position, 1 MΩ; 10X position, 10 MΩ within 0.5%, oscilloscope input resistance must be 1 MΩ within 2%. **Input Capacitance** for the 3.5 ft probe is 80 pF in the 1X position and 11 pF in the 10X position; for the 6 ft version 105 pF in the 1X position and 14 pF in the 10X position. **Bandwidth** of the 10X position (3.5 ft and 6 ft versions) is at least 200 MHz when used with an oscilloscope with a bandwidth greater than 225 MHz. **Bandwidth** of the 1X position for the 3.5 ft probe is at least 12 MHz and for the 6 ft probe at least 6 MHz. **Voltage Rating** is 500 V (dc + peak ac).

Included Accessories:

352-0351-00	1 **HOLDER,** probe
206-0114-00	1 **TIP,** probe
013-0107-03	1 **TIP,** probe, ret hook assy
175-0124-01	1 **LEAD,** elec, probe ground, 5 in
175-0125-01	1 **LEAD,** elec, probe ground, 12 in
344-0046-00	2 **CLIPS,** miniature alligator
166-0404-01	1 **SLEEVE,** insul for 0.188 dia probe bushing
016-0521-00	1 **POUCH,** accessory (not shown)

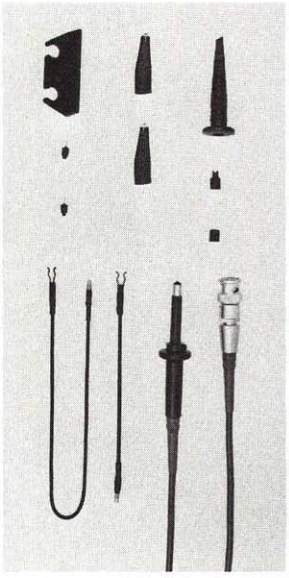
ORDERING INFORMATION

P6063B Switchable Attenuation Probe, 6 ft,
Order 010-6063-13 . . . . . $120

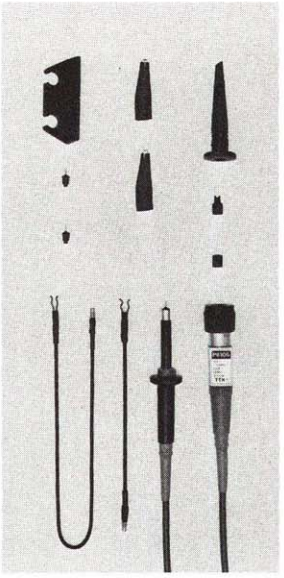
Opt 01 3.5 ft, Order 010-6063-11 . . . . . $120

Modular Probes

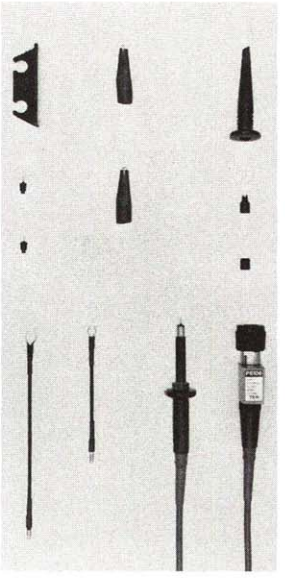
P6101 34 MHz 1X



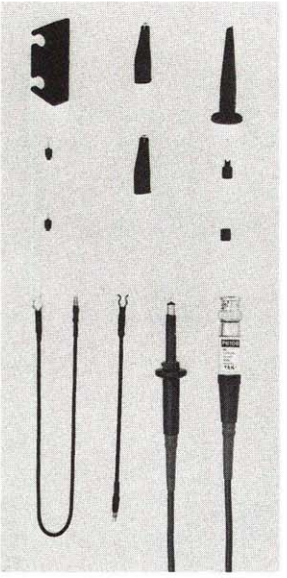
P6105 100 MHz 10X



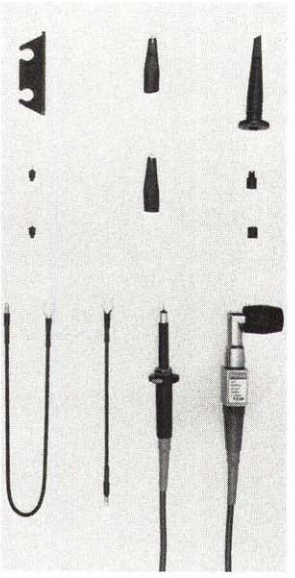
P6106 300 MHz 10X

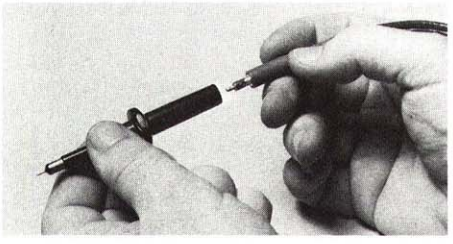


P6108 100 MHz 10X



P6149 50 MHz 10X





Modular parts snap together

Modular probes are an exciting new concept in probe design. The P6101, P6105, P6106, P6108, and P6149 Probes divide into three modules (probe heads, cables, and connector/compensation boxes). The modules snap together making maintenance and repair less expensive, faster, and much easier. Snap-on replacement modules eliminate soldering irons and tools, and modular probes do not have to be sent in to be repaired because spare modules can be ordered and stocked. Strain relief and modular component design make these probes rugged for greater reliability.

The P6101, P6105, P6106, and P6108 are available in three color-coded lengths—blue for one meter, yellow for two meters, and red for three meters. (The P6149 is two meters long.) These probes may be used to acquire high fidelity signals from low source-impedance circuits.

TEKTRONIX Modular Probes are designed for specific TEKTRONIX Instruments, but may be purchased as options for all TEKTRONIX Oscilloscopes with 1 MΩ and appropriate pF inputs as indicated in the above chart. The P6106 is standard with the 475A and 475 oscilloscopes.

The P6105 is standard with the TEKTRONIX 434, 455, 465, DM44, and rackmount oscilloscopes. And the P6108 is standard with the T932 and T935 oscilloscopes.

The P6101 is a 1X, 1 MΩ probe. The P6105, P6106, and P6108 are 10X, 10 MΩ probes.

Type	Attenuation	Length	Package Number	Loading	Useful BW MHz	Dc Max	Scope C in pF	Readout
P6101	1X	1 m 2 m 3 m	010-6101-01 010-6101-03 010-6101-05	1 MΩ 32 pF 54 pF 78 pF	34 15.5 8	500 V[1]	ANY	——
P6105	10X	1 m 2 m 3 m	010-6105-01 010-6105-03 010-6105-05	10 MΩ 10.5 pF 13.0 pF 15.5 pF	100 100 95	500 V[3]	15 to 47	YES
P6106	10X	1 m 2 m 3 m	010-6106-01 010-6106-03 010-6106-05	10 MΩ 10.5 pF 13.0 pF 15.5 pF	300[5] 250 150	500 V[4]	15 to 24	YES
P6108	10X	1 m 2 m 3 m	010-6108-01 010-6108-03 010-6108-05	10 MΩ 10.5 pF 13.0 pF 15.5 pF	100 100 95	500 V[3]	15 to 47	NO
P6149	10X	2 m	016-6149-03	10 MΩ 15.5 pF	50	500 V[3]	20 to 62	NO

[1]Max Input Voltage is 500 V dc + peak ac to 300 kHz derated to 20 V at 30 MHz
[2]Max Input Voltage 500 V dc + peak ac to 1.7 MHz derated to 27 V at 100 MHz
[3]Max Input Voltage 500 V dc + peak ac to 1.7 MHz derated to 30 V at 50 MHz
[4]Max Input Voltage 500 V dc + peak ac to 1.7 MHz derated to 70 V at 100 MHz
[5]Scope bandwidth must be 325 MHz

With oscilloscopes that are equipped with vertical scale or crt readout, the P6105 and P6106 will automatically scale the readout by a factor of 10. This makes mental calculations unnecessary. Also ground level can be determined on the display by actuating a button on the probe head, without having to return to the oscilloscope.

The P6149 features a right angle BNC connector. This can be useful when bench space is limited.

Included Accessories:

All probes, except as noted

013-0107-03	1 **TIP,** retractable hook
166-0404-01	1 **SLEEVE,** insulating
175-0124-01	1 **LEAD,** ground, 13 cm
175-0125-01	1 **LEAD,** ground, 30 cm P6101, P6105, P6108, P6149 only
175-0263-01	1 **LEAD,** ground, 7.5 cm P6106 only
——————**	2 **TIPS,** probe
——————*	3 **PR. MARKER BANDS,** (black, white, and silver gray) All except P6149 (not shown)
——————*	2 **PR. MARKER BANDS,** (gray, and silver gray) P6149 (not shown)
344-0046-00	2 **CLIPS,** miniature, alligator
352-0351-00	1 **PROBE HOLDER**
016-0521-00	1 **POUCH,** accessory (not shown)

**Available in packages of 10 only, 206-0191-01.
*Available in packages of 9 sets of different colors—016-0633-00.

ORDERING INFORMATION

P6101, 1X Probe, 2 m, Order 010-6101-03 ..... $34
Opt 01, 1 m, Order 010-6101-01 ..... $34
Opt 02, 3 m, Order 010-6101-05 ..... $34

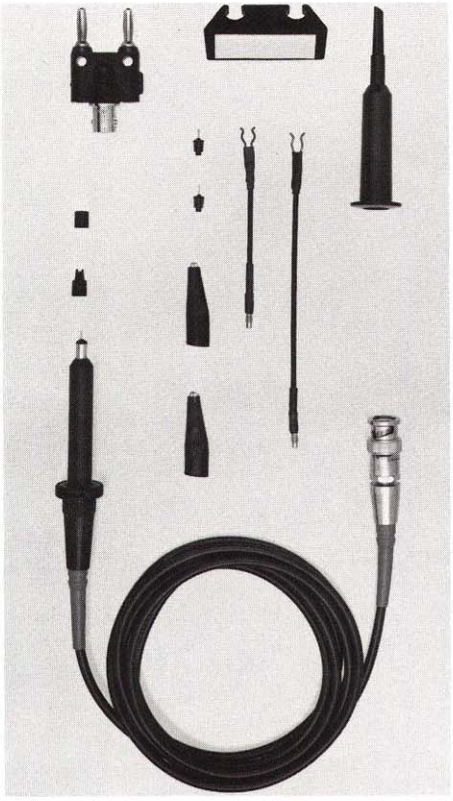
P6105, 10X Probe, 2 m, Order 010-6105-03 ..... $64
Opt 01, 1 m, Order 010-6105-01 ..... $64
Opt 02, 3 m, Order 010-6105-05 ..... $64

P6106, 10X Probe, 2 m, Order 010-6106-03 ..... $82
Opt 01, 1 m, Order 010-6106-01 ..... $82
Opt 02, 3 m, Order 010-6106-05 ..... $82

P6108, 10X Probe, 2 m, Order 010-6108-03 ..... $49
Opt 01, 1 m, Order 010-6108-01 ..... $49
Opt 02, 3 m Order 010-6108-05 ..... $49

P6149, 10X Probe, 2 m, Order 010-6149-03 ..... $61

P6420 Rf Probes



The P6420 rf probe measures high frequency ac voltage from 10 kHz to 1 GHz. It provides a dc output voltage proportional to the rms value of a sine-wave input.

Designed to be used with a digital multimeter with a 10 MΩ input resistance, the P6420 is compatible with the DM44, DM501 and DM502. For relative flatness readings, it can also be used with oscilloscopes which have a 1 MΩ input.

This new probe is easy to repair. It uses the same modular cable and the same cable BNC connector as the other TEKTRONIX Modular Probes. The standard length is 2 meters. However, 1 and 3 meter lengths, which do not change specifications, can be ordered separately.

Included Accessories:

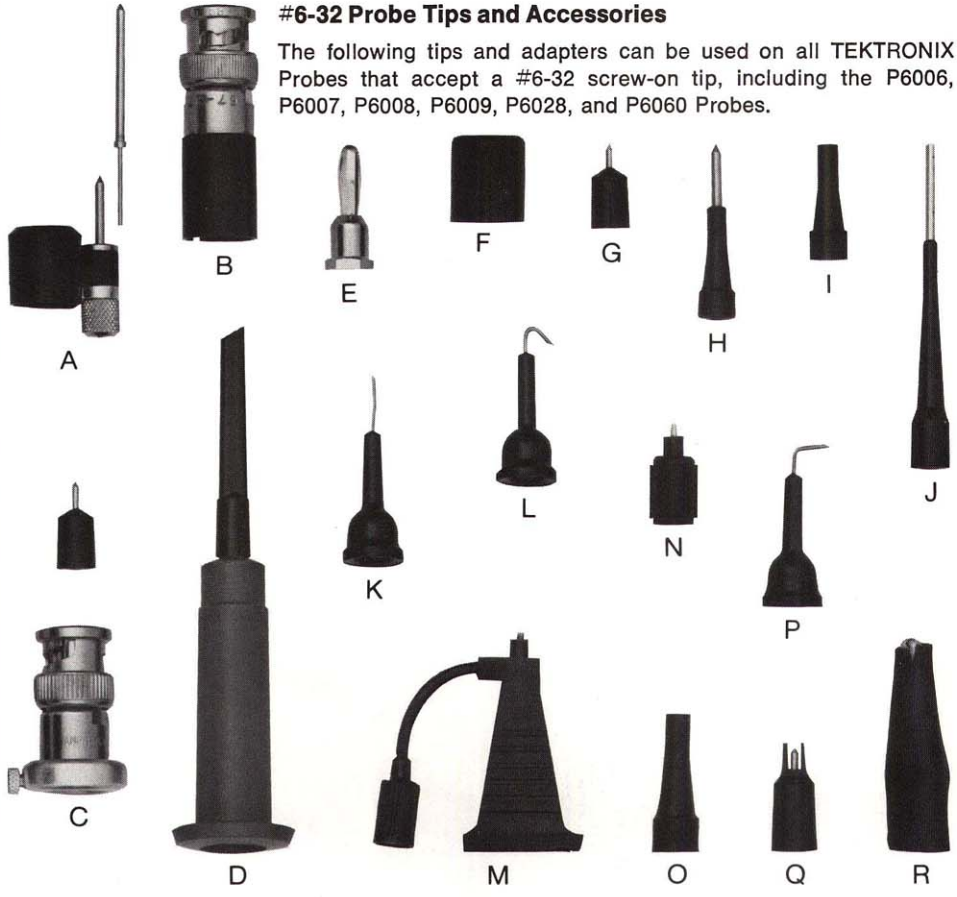
013-0097-01	1 **TIP,** retractable hook
344-0046-00	2 **CLIPS,** miniature alligator
175-0849-00	1 **LEAD,** ground, 8 cm
175-1017-00	1 **LEAD,** ground, 13 cm
166-0404-01	1 **SLEEVE,** insulating
352-0351-00	1 **PROBE HOLDER**
103-0090-00	**ADAPTER, BNC** to banana
206-0230-01	**PROBE TIPS**

ORDERING INFORMATION

P6420, 1X Probe, 2 m
Order 010-6420-03 ..... $85
For 1 meter length cable,
Order 175-1661-00 ..... $20
For 3 meter length cable,
Order 175-1661-02 ..... $20

#6-32 Probe Tips and Accessories

The following tips and adapters can be used on all TEKTRONIX Probes that accept a #6-32 screw-on tip, including the P6006, P6007, P6008, P6009, P6028, and P6060 Probes.



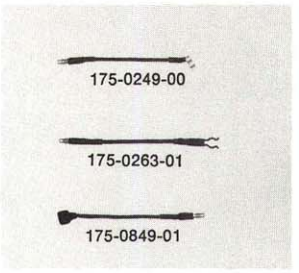
#6-32 PROBE TIPS AND ACCESSORIES

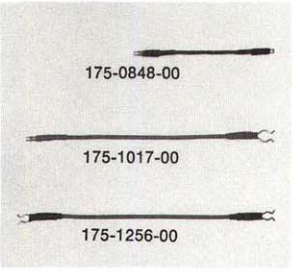
CODE	DESCRIPTION	PART NUMBER	PRICE
A	Bayonet ground assembly	013-0052-00	$3.00
B	Probe tip to BNC adapter	013-0054-00	8.00
C	Probe tip to BNC adapter (for P6028)	013-0056-00	9.00
D	Probe retractable hook tip	013-0071-00	2.40
E	Probe banana tip	134-0013-00	0.50
F	Probe ground cover (for P6009)	166-0428-00	1.00
G	Probe straight tip (0.055 in dia)	206-0015-00	0.40
H	Probe spring tip (0.080 in dia)	206-0060-00	0.80
I	Probe spring tip (accepts 0.065 in dia pin)	206-0061-00	0.60
J	Probe calibration tip (0.063 in dia)	206-0100-00	8.00
K	Probe long straight tip (0.032 in dia)	206-0104-00	0.75
L	Probe hook up	206-0105-00	0.75
M	Probe pin tip (accepts 0.025 in IBM SLT in)	206-0134-03	3.00
N	Probe ground lead adapter (#6-32 to 0.025 in x 0.025 in square pin)	206-0137-01	1.30
O	Probe spring tip (accepts 0.068 in dia pin)	206-0168-00	1.50
P	Probe right angle hook tip	206-0185-00	1.00
Q	IC test tip	206-0203-00	1.00
R	Miniature alligator clip	344-0046-00	1.00

Slip-on Probe Tips and Adapters

The following tips and adapters are designed for use with TEKTRONIX Miniature Probes that accept a slip-on tip.

Probe Ground Leads





DESCRIPTION	LENGTH (in)	PART NUMBER	PRICE
Ground lead†	3.5 in	175-0263-01	$1.50
Ground lead†	5.5 in	175-0124-01	1.20
Ground lead†	12.5 in	175-0125-01	1.20
Ground lead for S-3A, P6056, P6057	3 in	175-0249-00	3.50
Ground leads for P6053 P6054, P6075, 7A11, P6201	3 in. 5 in 12 in	175-0848-00 175-0848-01 175-0848-02	1.00 1.00 1.00
Ground leads for P6202, P6420	3 in 6 in	175-0849-00 175-0849-01	4.50 4.50
Ground lead for P6055	6 in	175-1256-00	3.50
Ground lead for S-3A	6 in 12 in	175-1017-00 175-1018-00	2.35 2.35

†For the P6053B, P6054A, P6075A, P6101, P6105, P6106, P6108, P6149 and other probes requiring clip-on ground leads.

CABLE MARKER SETS

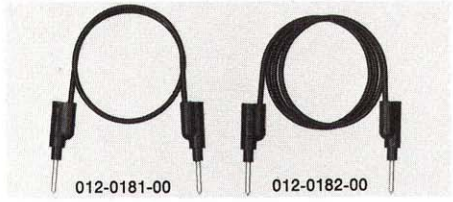
DESCRIPTION	PART NUMBER	PRICE
For 1/8 in dia cable	016-0130-00	3.50
For 3/16 in dia cable	016-0127-00	2.95
For modular cable	016-0633-00	3.75

SLIP-ON PROBE TIPS AND ADAPTERS

CODE	DESCRIPTION	PART NUMBER	PRICE
AA	Probe tip to BNC adapter	013-0084-01	$ 8.00
BB	Probe tip to BNC adapter	013-0084-02	8.00
CC	Bayonet ground assembly	013-0085-00	3.50
DD	Retractable hook tip (for P6010, P6048)	013-0090-00	2.60
EE	Retractable hook tip (for S-3A, P6202)	013-0097-01	5.00
FF	Retractable hook tip (for P6052)	013-0105-00	4.25
GG	Retractable hook tip (for 7A11, P6401)	013-0106-00	6.00
HH	Retractable hook tip (for 211, 212, 213, 214, 221)	013-0107-02	2.40
II	Retractable hook tip (for P6053B, P6054A, P6055, P6101, P6105, P6106, P6108, P6149, P6075A, P6049B)	013-0107-03	2.40
JJ	Miniature retractable hook tip	206-0222-00	5.00
KK	P6201 probe tip to BNC adapter	013-0145-00	9.00
LL	Miniature probe tip cover, IC tester, Package of 10 Package of 100	 015-0201-01 015-0201-02	 2.00 10.00
MM	Miniature probe tip to GR adapter	017-0076-00	20.00
NN	Miniature probe tip to GR 50-Ω termination adapter	017-0088-00	35.00
OO	P6201 probe tip to GR 50-Ω termination adapter	017-0094-00	$30.00
PP	Miniature probe to #6-32 adapter (for P6045, P6046, P6202, 7A11, S-3A)	103-0051-00	2.80
QQ	Miniature probe to #6-32 adapter (for all miniature probes except P6045, P6202)	103-0051-01	2.80
RR	Miniature probe to #6-32 adapter with ground connection	103-0131-00	4.00
SS	Miniature probe tip ground cover, insulating sleeve	166-0404-01	0.15
TT	Chassis mount test jack—miniature probe	131-0258-00	3.00
UU	Ground lead, insulating sleeve, P6201	166-0433-00	0.60
VV	Probe tip hook	206-0114-00	2.00
WW	Probe tip straight	206-0114-01	2.00
XX	Replaceable probe tip, pkg of 10. All miniature probes except P6202	206-0191-01	12.00
YY	Replaceable probe tip for P6202 only, pkg of 10	206-0230-01	12.00
ZZ	Probe tip flexible for 0.025 sq pin	206-0193-00	5.00
AAA	Probe tip flexible, adapts miniature probe to retractable hook tip (JJ)	103-0177-01	5.00
BBB	Probe pin tip (accepts 0.025 in, IBM SLT pin)	206-0209-00	2.50

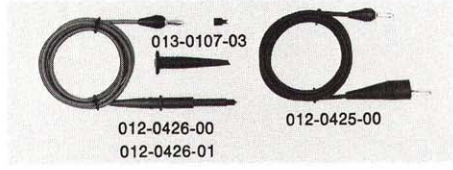
PATCH CORDS

BNC to BNC, 18 in		
Red	012-0087-00	$2.50
Black	012-0086-00	2.50
BNC to banana plug-jack, 18 in		
Red	012-0091-00	2.50
Black	012-0090-00	2.50
Banana plug-jack to banana plug-jack, 18 in		
Red	012-0031-00	2.50
Black	012-0039-00	2.50



Pin-jack to pin-jack, 0.08 in dia pin		
Red, 8 in	012-0179-00	$2.85
Red, 18 in	012-0180-00	2.85
Black, 8 in	012-0181-00	2.85
Black, 18 in	012-0182-00	2.85

TEST LEADS



Test Lead, Black, 4 ft	012-0425-00	$ 4.20
Test Lead, Red, 4 ft	012-0426-00	8.00
Test Lead, Black, 4 ft	012-0426-01	8.00
Test Lead set of 012-0425-00, 012-0426-00, and 013-0107-03	012-0427-00	14.00

COAXIAL CABLES
BNC Connectors

Coaxial, 50 Ω, 42 in	012-0057-01	$12.00
Coaxial, 75 Ω, 42 in	012-0074-00	12.00
Coaxial, 93 Ω, 42 in	012-0075-00	11.00
Coaxial, 50 Ω, 18 in	012-0076-00	11.00
Coaxial, 50 Ω Precision, 36 in	012-0482-00	19.00

N Connectors 50 Ω

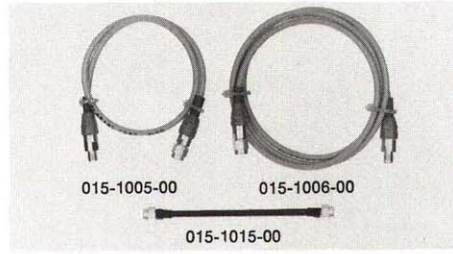
Coaxial N connectors, 6 ft	012-0114-00	$15.00

GR Connectors 50 Ω

Coaxial 10 ns RG58A/U	017-0501-00	$39.00
Coaxial 5 ns RG213/U	017-0502-00	39.00
Coaxial 1 ns RG58A/U*	017-0503-00	20.00
Coaxial 20 ns RG213/U	017-0504-00	39.00
Coaxial 2 ns RG58A/U	017-0505-00	39.00
Coaxial 5 ns RG58A/U	017-0512-00	39.00
Coaxial 10 in RG213/U	017-0513-00	39.00
Coaxial 20 in RG213/U	017-0515-00	39.00

*Connector on one end only.

50 Ω CABLES
SMA (3 mm) Connectors 50 Ω



Coaxial 2 ns	015-1005-00	$48.00
Coaxial 5 ns	015-1006-00	85.00
Coaxial semirigid 500 ps	015-1015-00	30.00
Coaxial semirigid 750 ps	015-1017-00	30.00
Coaxial 1 ns	015-1019-00	56.00

BNC to BSM Connectors 50 Ω

Coaxial, 10 in, RG58		
BSM Female to BNC Male	012-0128-00	$13.00
Coaxial, 18 in, RG58		
BSM Female to BNC Male	012-0127-00	13.00

50 Ω AIR LINE

The 20 cm 50 Ω air line is useful as a time-delay device and as an absolute impedance in a time-domain reflectometer system. The characteristic impedance is 50 Ω ±0.4%. Time delay is 0.6698 ns ±0.4%.

50 Ω Air Line	017-0084-00	$35.00

ADAPTERS

BNC Female to BNC Female	103-0028-00	$ 4.65
BNC Male to BNC Male	103-0029-00	5.25
BNC T	103-0030-00	6.00
BNC Elbow Male to Female	103-0031-00	5.00

BNC Male to GR	017-0064-00	$18.50
BNC Male to uhf Female	103-0032-00	4.50
BNC Male to Binding Post	103-0033-00	4.00
BNC Male to Dual Binding Post	103-0035-00	11.00
BNC Male to N Female	103-0058-00	6.50

BNC Female to clip leads	013-0076-00	$12.00
BNC Female to GR	017-0063-00	18.50
BNC Female to uhf Male	103-0015-00	3.25
BNC Female to BSM Male	103-0036-00	7.75
BNC Female to N Male	103-0045-00	11.00
BNC Female to Dual Banana	103-0090-00	6.50

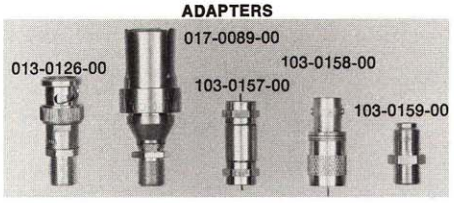
GR to N Male	017-0021-00	$19.00
GR to C Male	017-0027-00	28.00
GR to N Female	017-0062-00	22.00
GR to C Female	017-0065-00	28.00

GR to BNC Female	017-0063-00	$18.50
GR to BNC Male	017-0064-00	18.50
50 Ω termination, thru-line	017-0083-00	50.00

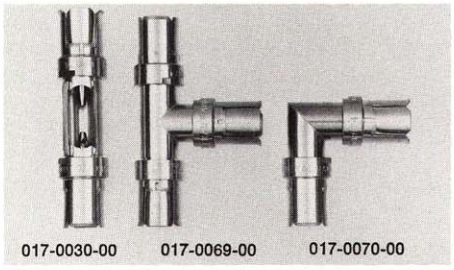
*(GR to BNC Male)
*Upper frequency limit vswr not specified

N Male to GR	017-0021-00	$19.00
N Female to GR	017-0062-00	22.00
N Male to BNC Female	103-0045-00	11.00
N Female to BNC Male	103-0058-00	6.50

ADAPTERS

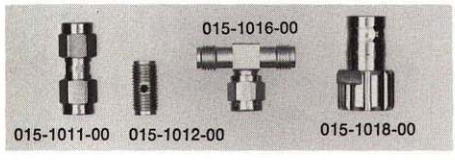


"F" Female to BNC Male	013-0126-00	$10.00
"F" Female to GR874	017-0089-00	22.00
"F" Male to "F" Male	103-0157-00	7.50
"F" Male to BNC Female	103-0158-00	7.50
"F" Female to "F" Female	103-0159-00	7.50



GR Insertion Unit	017-0030-00	$49.00
GR T	017-0069-00	55.00
GR Elbow	017-0070-00	50.00

SMA Male to GR	015-1007-00	$38.00
SMA Female to GR	015-1008-00	50.00
SMA Male to N Female	015-1009-00	47.00
SMA Male to 7 mm APC	015-1010-00	165.00



SMA Male to Male	015-1011-00	$15.00
SMA Female to Female	015-1012-00	15.00
SMA T	015-1016-00	25.00
SMA Male to BNC Female	015-1018-00	5.00

ATTENUATORS—TERMINATIONS

50 Ω feedthrough termination[1]	011-0049-01	$24.00
50 Ω 10X (20 dB) attenuator[2]	011-0059-02	28.00
50 Ω 5X (14 dB) attenuator[2]	011-0060-02	28.00
50 Ω 2X (6 dB) attenuator[2]	011-0069-02	28.00
50 Ω 2.5X (8 dB) attenuator[2]	011-0076-02	28.00
50 Ω feedthrough termination (5 W)[3]	011-0099-00	33.00

Characteristics—Dc resistance is 50 Ω ± 1 Ω. Attenuation accuracy is ±2% dc, ±5% at 2 GHz. Power rating (except 011-0099-00) is 2 W average.

vswr

[1]Less than 1.1 dc—250 MHz and less than 1.2 dc—500 MHz.

[2]Less than 1.1 dc—1.0 GHz and less than 1.2 dc—2.0 GHz.

[3]1.1 dc—100 MHz.

75 Ω feedthrough termination	011-0055-00	$20.00
93 Ω feedthrough termination	011-0056-00	22.00
50 Ω to 75 Ω min loss attenuator	011-0057-00	22.00
50 Ω to 93 Ω min loss attenuator	011-0058-00	22.00
75 Ω 10X attenuator	011-0061-00	24.00
93 Ω 10X attenuator	011-0062-00	20.00
600 Ω feedthrough termination (1 W, dc to 1 MHz)	011-0092-00	27.00
75 Ω to 50 Ω min loss attenuator (ac coupled)	011-0112-00	35.00

CHARACTERISTICS

Accuracy of Indicated Attenuation Ratio is ±2% at dc.

Power Rating of attenuators is ½ W and terminations 1 W.

Voltage Standing Wave Ratio (vswr) not specified.

ATTENUATORS and TERMINATORS
N 50 Ω

Frequency range is dc to 12.4 GHz. Power rating is 2 W average, 300 W peak. Impedance is 50 Ω.

10 dB attenuator	011-0085-00	$65.00
20 dB attenuator	011-0086-00	65.00
40 dB attenuator	011-0087-00	90.00

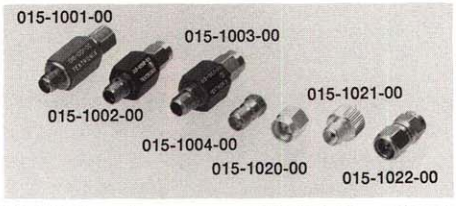
GR

125 Ω min loss	017-0052-00	$72.00
50 Ω 10X attenuator	017-0078-00	86.00
50 Ω 5X attenuator	017-0079-00	70.00
50 Ω 2X attenuator	017-0080-00	80.00
50 Ω termination, end-line	017-0081-00	75.00

CHARACTERISTICS

Accuracy of indicated attenuation ratio is ±2% at dc, ±3% at 1 GHz. Voltage standing wave ratio (vswr) is less than 1.1 up to 1 GHz. Power rating is 1 W.

3 mm 50 Ω



50 Ω 2X attenuator	015-1001-00	$120.00
50 Ω 5X attenuator	015-1002-00	120.00
50 Ω 10X attenuator	015-1003-00	120.00
50 Ω termination Female	015-1004-00	50.00
Short-Circuit termination Male	015-1020-00	15.00
Short-Circuit termination Female	015-1021-00	15.00
50 Ω termination Male	015-1022-00	32.00

CHARACTERISTICS

	Dc — 12.40 GHz		12.41 — 18.00 GHz		Power
	Atten Accuracy	Vswr	Atten Accuracy	Vswr	Continuous
Termination	±1 Ω	1.15	±1 Ω	1.15	0.5 W
2X (6 dB)	±0.75 dB	1.40	±1.00 dB	2.00	1.0 W
5X (14 dB)	±0.75 dB	1.40	±1.00 dB	1.60	1.0 W
10X (20 dB)	±0.75 dB	1.40	±1.00 dB	1.60	1.0 W

50 Ω COUPLING CAPACITOR

The coupling capacitor is a short length of coaxial line having a disc capacitor (4700 pF, ±20%) in series with the inner conductor. Reflection ratio (in 150 ps tdr system), max is 0.03. Voltage rating is 200 V.

Coupling Capacitor SMA (3 mm)	015-1013-00	$120.00

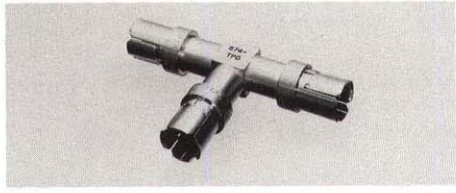
The coupling capacitor is a short length of coaxial line having a disc capacitor (4700 pF) in series with the inner connector. High frequencies are transmitted with small reflection, but dc and low frequencies are blocked. Voltage rating is 500 V.

Coupling Capacitor GR	017-0028-00	$41.00

50 Ω POWER DIVIDERS

This coaxial tee is designed for use in broad-band 50 Ω systems where the mismatch introduced by ordinary "Tee" connectors is undesirable. Load isolation is nominally 6 dB while the voltage attenuation ratio is nominally 2X (input to either load arm, other load arm terminated in a standard 50 Ω termination). Max vswr is 1.50 from dc to 12.00 GHz and 1.90 from 12.01 to 18.00 GHz.

Power Divider SMA (3 mm)	015-1014-00	$200.00



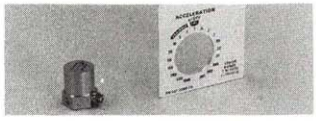
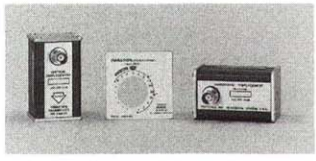
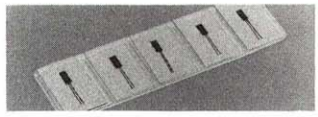
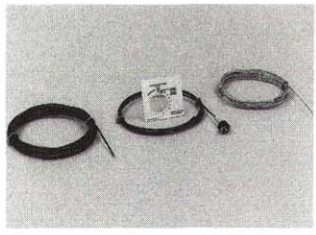
This coaxial tee has a 16.67 Ω resistor in each leg, connected so that the tee looks like 50 Ω if two legs are terminated in 50 Ω. It is designed for use in broad-band 50 Ω systems where the mismatch introduced by ordinary "Tee" connectors is undesirable. It is especially useful in a time-domain reflectometer set-up where test line, pulser, and oscilloscope must be coupled with a minimum of reflection-producing discontinuities.

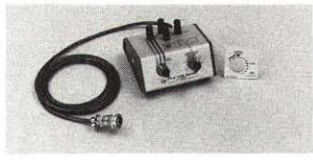
Power Divider GR	017-0082-00	$200.00

ACCESSORY HOUSING

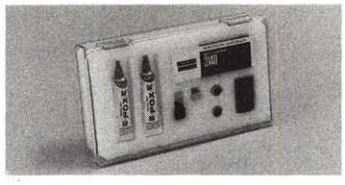
Accessory housing without electrical components is useful for applications requiring special circuitry.

Accessory Housing	011-0081-00	$19.00

TRANSDUCER PACKAGE		CONTENTS	DESCRIPTION	RECOMMENDED ACCESSORIES
	PRESSURE 015-0161-00*	TRDCR: 3000 psig. Scale: 1 to 1000 psi/DIV; 0.1 to 100 (kgf/cm²)/DIV.	Trdcr element: Bonded STRG 350 Ω; $f_n \approx$ 65 kHz. Accuracy 2%.	20 ft cable 012-0209-00
	PRESSURE 015-0162-00*	TRDCR: 300 psig. Scale: 0.1 to 100 psi/DIV; 0.01 to 10 (kgf/cm²)/DIV.	Trdcr element: Bonded STRG 350 Ω; $f_n \approx$ 24 kHz. Accuracy 2%.	20 ft cable 012-0209-00
	FORCE 015-0163-00*	TRDCR: 3000 lbs f. Load button. Eye bolt (2). Scale: 1 to 1000 lbs f/DIV; 0.5 to 500 kgf/DIV.	Trdcr element: Bonded STRG 350 Ω. Accuracy 1%.	20 ft cable 012-0209-00
	FORCE 015-0164-00*	TRDCR: 50 gram f; 50 lb f. Adapter. Scales: 0.01 to 20 lbs f/DIV; 5 (10^{-3}) to 10 kgf/DIV. 0.01 to 20 gram f/DIV; 0.02 (10^{-3}) to 40 (10^{-3}) mm/DIV.	Trdcr element: Unbonded STRG 350 Ω. Accuracy 2%.	
	ACCELERATION 015-0165-00	TRDCR: 10,000 g. Scale: 0.001 to 1000 g/DIV.	Trdcr 1.5 Hz to 15 kHz; $f_n \approx$ 30 kHz. Element: Piezoelectric. Accuracy 5%.	20 ft cable 012-0211-00
	VERTICAL VIBRATION 015-0166-00 HORIZONTAL VIBRATION 015-0167-00	TRDCR: ±0.025 inch. Displacement Scale: 1 (10^{-6}) to 10 (10^{-3}) inch /DIV; 0.02 (10^{-3}) to 0.2 mm/DIV. Velocity Scale: 20 (10^{-6}) to 20 (inch/sec)/DIV; 0.5 (10^{-6}) to 0.5 (10^{-3}) (m/s)/DIV.	Trdcrs: Inductive self gen 10 Hz to 1 kHz; Damped $f_n \approx$ 8 Hz. Outputs ≈600 mV/inch/s and ≈10 mV/0.001 inch. Accuracy 5%.	20 ft cable 012-0136-00
	DISPLACEMENT 015-0168-00	TRDCR: ±0.2 inch. Feeler gage 0.040-inch. Scale: 10 (10^{-6}) to 0.1 inch/DIV; 0.2 (10^{-3}) to 2 mm/DIV.	Element: DC to DC LVDT DC to >120 Hz. Accuracy 2% within ±0.1 inch.	20 ft cable 012-0209-00
	STRAIN 015-0171-00	Strain Gages: 30,000 μ strain. Package of five.	Elements: Foil STRG 120 Ω. Accuracy 1%. 0.125-inch long attached leads.	Strain gage Adapter 015-0169-00 Cement kit 015-0172-00
TEMPERATURE	015-0173-00	Thermocouple:		
	+230°F	+105°C Max.	PVC Ripcord Insulation; #30 Iron Constantan.	
	+1000°F	+480°C Max.	Fiberglass Insulation; #30 Iron Constantan.	
	+900°F	+480°C Max with Magnet Mounting.	Fiberglass Insulation; #24 Iron Constantan.	
		Adapter (2). Scale: 0.5 to 500°F/DIV; 0.2 to 200°C/DIV.	Accuracy 5% from +10°C to max °C.	



STRAIN GAGE ADAPTER (015-0169-00)*
Provides means for connecting 1, 2, or 4 arms of a Wheatstone Bridge to the modified Transducer Power Supply. Has variable shunt resistor for gage factor calibration. The adapter has four binding post terminals and a six-foot cable with 6-pin connector. Scale included is 5 to 50,000 μ strain/DIV.



CEMENT KIT (015-0172-00)
Provides means for mounting and connecting foil strain gages. Includes Room Temperature Curing Epoxy cement, RTV Clear Silicon Rubber coating, Neoprene pads and metal plates, cementable Wiring terminals, and clear Mylar film.

CABLE (012-0136-00) **$28**
20 ft low-noise coaxial cable with BNC connectors on both ends.

CABLE (012-0209-00) **$105**
20 ft low-noise six-conductor cable with 6-pin connector on each end.

CABLE (012-0210-00) **$60**
20 ft six-conductor cable with 6-pin male connector on one end.

CABLE (012-0211-00) **$27**
20 ft low-noise coaxial cable with miniature coaxial connector on one end and BNC connector on the other.

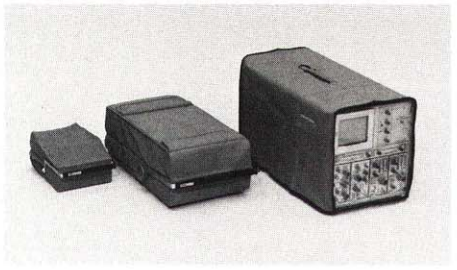
CONNECTOR (131-0618-00) **$13.50**
Mates Type PS501-1 Transducer Power Supply INPUT 6-pin connector.

TRANSDUCER PACKAGE PRICE LIST

015-0161-00	$415
015-0162-00	$415
015-0163-00	$695
015-0164-00	$490
015-0165-00	$360
015-0166-00	$161
015-0167-00	$200
015-0168-00	$360
015-0169-00	$175
015-0171-00	$ 23
015-0172-00	$ 29
015-0173-00	$ 48

*Requires PS501-1 custom modified Transducer Power Supply mounted in a TM 500-Series Mainframe. Consult a Tektronix Field Engineer for price and installation information on power supply and adapter.

OSCILLOSCOPE PROTECTIVE COVERS



The cover provides protection for the oscilloscope during transport or storage. Made of waterproof blue vinyl, the covers are available for both laboratory and portable instruments. The covers for 500, 5000, and 7000-Series Laboratory Oscilloscopes have clear vinyl frontal areas.

PROTECTIVE COVERS

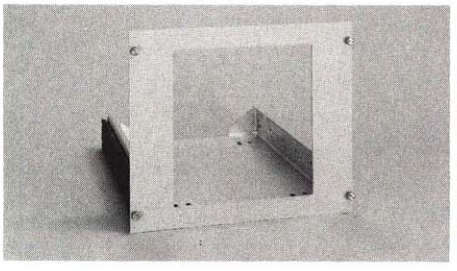
INSTRUMENT	PART NUMBER	PRICE
200 Series	016-0512-00	$12.00
323, 324, 1401A, 1401A-1, 1501	016-0112-00	15.00
314, 335	016-0612-00	39.00
326	016-0532-00	30.00
453A, 454A, 491	016-0074-01	16.00
455	016-0344-00	14.50
434, 464, 466	016-0365-00	15.75
465, 475, 485	016-0554-00	15.00
560 Series (except 565, 567, 568)	016-0067-00	14.50
565, 567, 568	016-0069-00	14.50
540 Series	016-0068-00	14.50
1480C, 1481C, 1482C, 1485C	016-0085-00	14.50
5000 Series	016-0544-00	12.00
7300, 7400, 7600 Series	016-0192-01	12.00
7704A, 7900	016-0531-00	12.00

PLUG-IN UNIT CARRYING CASES

CARRYING CASE FOR 2, 3, 10, AND 11 SERIES PLUG-IN UNITS—Accommodates two plug-in units.
Order 437-0070-00 ..... **$42.00**

CARRYING CASE FOR LETTER-SERIES OR 1-SERIES PLUG-IN UNITS—Provides protection for one oscilloscope plug-in unit.
Order 437-0065-00 ..... **$36.00**

RACK ADAPTERS



For rackmounting the 7000-Series Oscilloscopes and 611 in a standard 19 in wide rack. Rack adapter includes slide-out assemblies. 7000-Series mask finish is light gray, 611 mask finish is black.

For 7704 and 7904, rack height is 15.75 in, rack depth is 21.75 in, shipping weight is approx 41 lb.
Order 040-0554-01 ..... **$295.00**

For 611, rack height is 14 in, rack depth is 21.75 in, shipping weight is approx 41 lb.
Order 040-0551-01 ..... **$225.00**

For 455 and 465M, includes cradle mount, rack height 7 in, rack depth 18.75 in.
Order 040-0825-00 ..... **$200.00**

RACK ADAPTERS

For rackmounting most TEKTRONIX Generators in a standard 19 in wide rack. The rack height is 5.25 in, rack depth is 19.75 in. Rack adapter includes slide-out assemblies. Shipping weight is approx 24 lb.

The adapter provides forced air ventilation and blank panels are provided to cover the unused openings. Mounting kits must be ordered separately for each instrument to be mounted.

Rack Adapter includes half-rack width blank panel (333-1384-00).
Order 016-0268-00 ..... **$375.00**

284 Mounting Kit includes quarter-rack width blank panel (016-0109-00).
Order 016-0187-00 ..... **$48.00**

106, 114, 115, and 191 Mounting Kits.
Order 016-0186-00 ..... **$24.00**

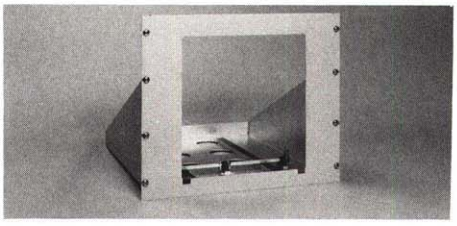
2101 and 2901 Mounting Kits.
Order 016-0188-00 ..... **$14.50**

286 Mounting Kit.
Order 016-0190-00 ..... **$22.00**

For rackmounting two TM 503's.
Order 040-0616-01 ..... **$69.00**

For rackmounting one TM 503.
Order 040-0617-01 ..... **$100.00**

CRADLE MOUNTS



For rackmounting 500 and 7000-Series cabinet-type oscilloscopes in a standard 19 in wide rack. Cradle mount consists of a cradle (or "shelf") without slide-out assemblies and a mask to fit over the regular instrument panel. 500-Series mask finish is blue vinyl, and 7000-Series mask finish is light gray.

For 7704A, rack height is 15.75 in, rack depth is 22 in, shipping weight is approx 16 lb.
Order 040-0560-00 ..... **$105.00**

For 540 Series and 575, rack height is 17.5 in, rack depth is 21-9/16 in, shipping weight is approx 16 lb.
Order 040-0281-00 ..... **$60.00**

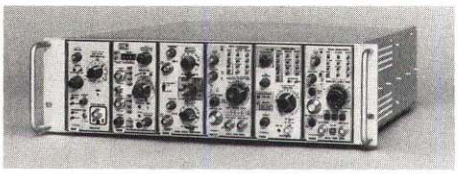
For 561B and 564B, rack height is 15.75 in, rack depth is 21-9/16 in, shipping weight is approx 17 lbs.
Order 040-0321-01 ..... **$60.00**

REAR-SUPPORT CRADLES

Provide rear support for rackmount instruments with slide-out assemblies, when mounted in a 19 in backless rack. Shipping weight is approx 3 lb.
For R561B, R564B, and R647A.
Order 040-0344-00 ..... **$14.50**

For RM565 and R567.
Order 040-0346-00 ..... **$15.75**

STORAGE CABINETS

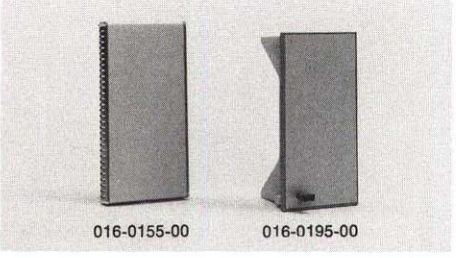


For 7000-Series Plug-in Units—Holds 6 plug-in units, for mounting in a 19 in rack, 5.25 in high.
Order 437-0126-01 ..... **$180.00**

For 1-Series and Letter-Series Plug-in Units—Holds 3 plug-in units. Measures 19 in wide, 8¾ in high, 9⅜ in deep. Net weight is approx 9 lb.
Order 437-0031-00 ..... **$75.00**

For 2 and 3-Series Plug-in Units—Holds 4 plug-in units. Measures 19 in wide, 7 in high, 13-5/16 in deep. Net weight is approx 10 lb.
Order 437-0071-00 ..... **$70.00**

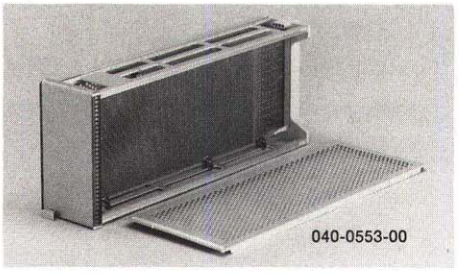
BLANK PANEL



Blank Panel—When operating the 5000/7000-Series Mainframes or the TM 500 or 2600 Series Generators with less than a full complement of plug-ins, the blank panel may be used to cover an unused compartment. The panel for the 7000 Series is also good for EMI shielding.

7000 Series, 2600 Series, Order 016-0155-00 ..... $16.50
5000 Series, Order 016-0195-00 ..... $ 7.50
TM 500 Series, Order 016-0195-01 ..... $ 7.50

BLANK PLUG-IN CHASSIS

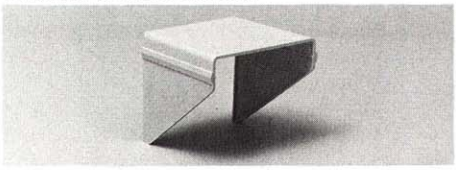


Blank Plug-in Chassis—Available for all TEKTRONIX Mainframes. The 7000 Series provides a printed circuit board, plug-in frame, and securing hardware. The 560 Series, 1-Series, and Letter Series plug-in chassis have an interconnecting plug securing hardware and plug-in frame.

7000 Series, Order 040-0553-01 ..... $65.00
TM 500 Series, Order 040-0652-03 ..... $28.00
560 Series, Order 040-0245-00 ..... $42.00
1 and Letter Series, Order 040-0065-00 ..... $42.00

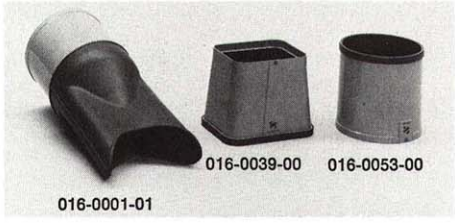
VIEWING ACCESSORIES

The viewing accessories listed normally mount on the oscilloscope graticule cover. In many cases, they will also fit camera-mounting bezels. If you intend using a camera on your oscilloscope, check with your Tektronix Field Engineer for bezel-viewer compatibility before ordering.



View Hood (folding)—for 200 Series, 314, 323, 324, 326, 335, 400 Series, 576, 577, 5000, and 7000-Series Oscilloscopes.

For 576, order 016-0259-00 .....$10.00
For 577, 5000, and 7000 Series order 016-0260-00 .....$10.00
For 200 Series (not pictured), order 016-0199-01 .....$ 3.00
For 323 and 324 (not pictured), order 016-0247-01 .....$ 3.55
For 326, 314, and 335 (not pictured), order 016-0297-00 .....$ 3.25
For 464, 466, 455 (not pictured), order 016-0592-00 .....$11.50

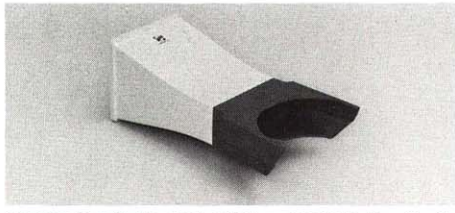


Polarized Viewers—For TEKTRONIX 5 in oscilloscopes. The viewers reduce troublesome reflections and glare under high ambient light conditions.
Rectangular Viewer, order 016-0039-00 .....$18.50
Plastic Round Viewer, order 016-0053-00 .....$25.00

Viewing Hood—For TEKTRONIX 5 in oscilloscopes. Includes molded rubber eyepiece and separate tubular light shield.
Order 016-0001-01 .....$18.50

Collapsible Viewing Hood—For oscilloscopes with rectangular crt's. Blue vinyl material, folds flat for convenient storage.
For 422, 453A, 454A, 485, 491, order 016-0082-00 .....$14.75
For 422, 453A, 454A, 485, 491, order 016-0274-00 .....$10.00

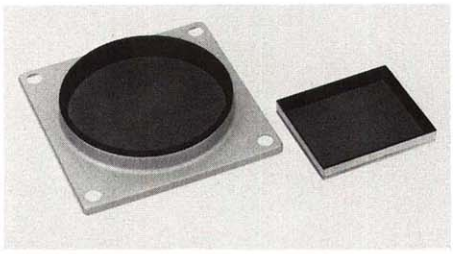
Polarized Collapsible Viewing Hood—To reduce reflections and glare under high ambient light conditions for 432, 434, 455, 465, 475, 464, 466, order 016-0180-00 .....$17.00



Viewing Hood—For 576, 5000 and 7000-Series Oscilloscopes. Molded gray polystyrene with polyurethane eyepiece.
For 576, order 016-0153-00 .....$12.50
For 5000 and 7000 Series, 601, 602, 603, 604, 528 and 577, order 016-0154-00 .....$16.00

Viewing Hood (folding binoculars)—For some 400 Series.
For 434, 455, 464, 466,
Order 016-0566-00 .....**$13.00**

CRT MESH FILTERS



The mesh filter improves display contrast for oscilloscope viewing under high ambient light conditions. The filter is a direct replacement for the existing graticule cover on most TEKTRONIX instruments, or, in the case of the new portable oscilloscopes, snaps in the crt opening on the front panel.

A fine metal screen with a matte black surface is utilized to reduce light reflections. Although light transmission from the crt is reduced to approximately 28%, the high attenuation of external reflections allows viewing low-intensity displays in room light or other bright surroundings.

The mesh filter also serves as an emi filter. Installed on the instrument, the metal frame of the filter is grounded, providing effective filtering of the emi spectrum.

INSTRUMENT*	PART NUMBER	PRICE
314, 326,335	378-0063-00	$10.00
323, 324	378-0596-00	23.00
432, 434	378-0682-00	22.00
422, 491, 453A, 454A, 485	378-0648-00	20.00
465, 475, 464, 466, 434	378-0726-01	28.00
540 Series, 565	378-0572-00	25.50
529, 561B, 564B, 568	378-0575-00	23.00
7400	378-0696-00	25.00
7500, 7700 Series	378-0603-00	25.00

**For both cabinet and rackmount instruments.*

CATHODE-RAY TUBE LIGHT FILTERS

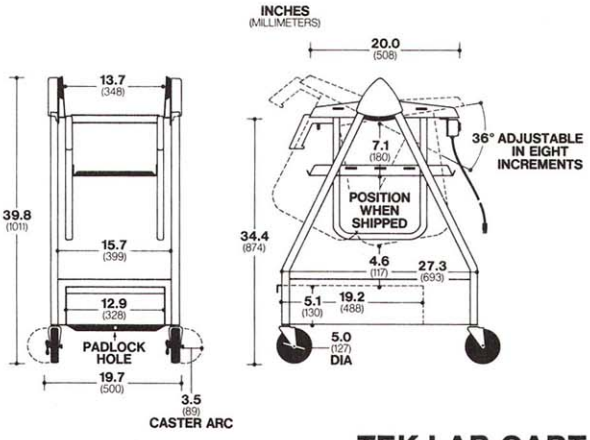
INSTRUMENT*	COLOR	PART NUMBER	PRICE
314, 335	Blue	378-2016-00	$1.00
	Amber	378-0843-00	1.60
200 Series	Blue	378-0691-00	0.95
455	Clear	337-2122-01	1.40
	Blue	337-2122-00	1.40
323, 324	Smoke-gray	426-0403-00	2.50
	Blue†	426-0811-00	2.50
	Amber	426-0513-00	2.50
326	Blue†	426-0871-00	2.70
422, 491, 453A, 454A, 485	Smoke-gray	378-0549-00	1.50
	Green	378-0557-00	1.50
	Blue†	378-0664-00	1.50
	Amber	378-0559-00	1.50
465, 475, 464, 466	Blue	337-1674-00	2.15
	Clear	337-1674-01	2.15
540, 550 Series, 565, 575	Smoke-gray†	378-0567-00	2.90
	Green	378-0568-00	2.20
	Blue	378-0569-00	2.20
	Amber	378-0570-00	2.20
529, 561B, 567, 568	Smoke-gray†	378-0560-00	2.20
	Green	378-0561-00	2.20
	Blue	378-0562-00	2.20
	Amber	378-0563-00	2.20
520A, 521A, 522A	Smoke-gray†	378-0581-00	2.20
576	Blue†	378-0616-00	2.20
	Amber	378-0616-01	2.20
602	Smoke-gray†	378-0586-00	2.20
	Amber	378-0595-00	6.00
603, 604	Clear	337-1440-00	1.50
	Green	337-1440-01	1.50
	Amber	337-1440-02	1.50
	Blue	337-1440-03	1.50
	Gray	337-1440-04	1.50
	Graticule (8x10 div)	331-0303-00	3.30
605, 607	Gray†	337-1674-06	2.15
	Graticule (8x10 div)	331-0301-00	2.90
7904, 7844, 7313, 7700 Series, 7613 7623	Blue†	378-0625-00	2.20
	Amber	378-0625-01	2.20
	Gray	378-0625-02	2.20
	Green	378-0625-03	2.20
	Gray Tv Graticule CCIR	378-0625-05	4.00
	Gray Tv Graticule NTSC	378-0625-06	4.00
	Clear Shield With Spectrum Analyzer Graticule	337-1159-02	3.50
7613, 7623, 7623A, 7633	Spectrum Analyzer	378-0625-07	4.00
	Green (UV)	378-0625-08	2.20
	Tv Graticule CCIR	378-0625-09	4.00
	Tv Graticule NTSC	378-0625-10	4.00
7403N, 7603	Blue	378-0684-00	2.70
	Amber	378-0684-01	2.70
	Gray	378-0684-02	2.70
	Green	378-0684-03	2.70
	Gray Tv Graticule CCIR	378-0684-04	4.50
	Gray Tv Graticule NTSC	378-0684-05	4.50
	With Spectrum Analyzer Graticule	337-1439-01	2.20
	Blue Implosion Shield†	337-1700-01	2.20
	Clear Implosion Shield	337-1700-04	2.20
5100 and 5400 Series (except 5441)	Clear	337-1440-00	1.50
	Green	337-1440-01	1.50
	Amber	337-1440-02	1.50
	Blue	337-1440-03	1.50
	Gray	337-1440-04	1.50
5441	Clear†	337-1674-01	2.15
	Gray	337-1674-06	2.15
	Graticule (8x10 div)	331-0391-00	3.90
434	Clear	378-0677-00	1.90
	Blue	378-0678-00	2.70

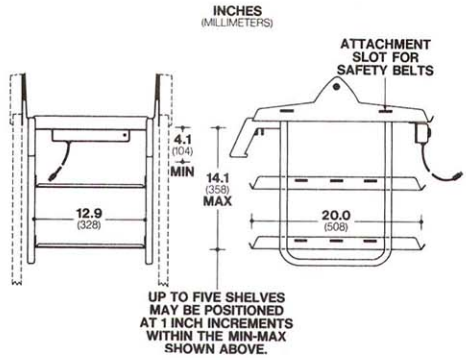
**For both cabinet and rackmount instruments unless rackmount version is listed.*
†Standard filter supplied with instrument.

QUICK REFERENCE

Product	Cart Model
TM 503	3
TM 504	3
TM 506	205
21	206
31	206
432	200C
434	200C
455, 465M	200C
464	200C
465	200C
466	200C
475, 475A	200C
485	200C
491	200C
520-522	205
528	*
530, 543, 550-Series	3
560-Series	3
576	3
577	3
602-607	*
611	205
613	205
632	205
650-Series	205
670-Series	205
1105	*
1140A	205
1340	205
1420-Series	*
4601	206
4610	206
4623	206
4632	206
4661	206
4921	206
4922	206
5100-Series	3
5400-Series	3
7313	3
7603	3
7613	3
7623A	3
7633	3
7704A	3
7834	3
7844	3
7904	3
All rackmounts (R Series)	7

*These products are applicable to several carts—see dimensions and features for your specific needs.





TEK LAB CART MODEL 3

Recommended For:

5100, 5400, and 7000-Series three and four plug-in oscilloscopes, all 400-Series, 576, 577, TM 503, and TM 504 mounted on top tray.

MODEL 3 includes drawer in base with provision for padlock, brakes on front casters, power distribution module (four outlets and 15 ft cord), removable scope lock-down bar on top tray, one shelf, one safety belt, UL listed. Net weight 57 lb, 25.8 kg. Shipping weight 75 lb, 34 kg. Blue vinyl finish. **Order Model 3** **$295**

INTERNATIONAL VERSION deletes power module for shipment outside U.S.A.

Order Option 01 ..... **No charge**

TM 503, TM 504 mounted on shelves.

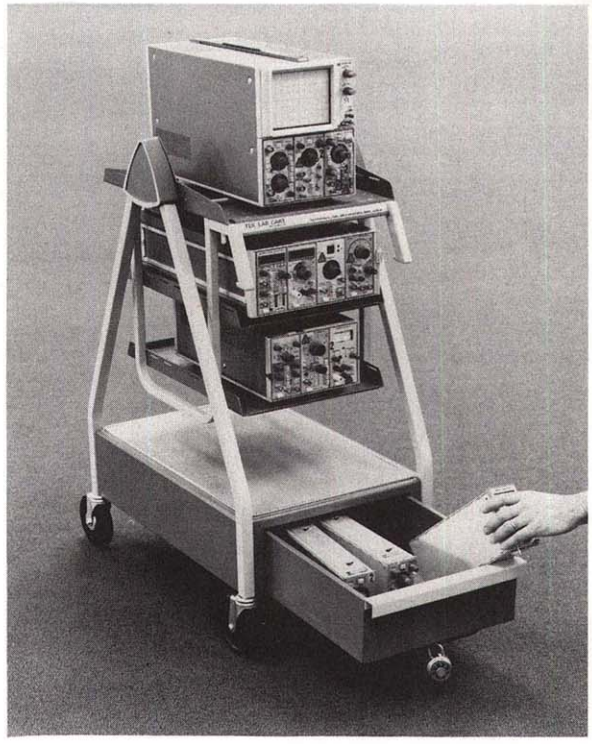
Optional Accessories

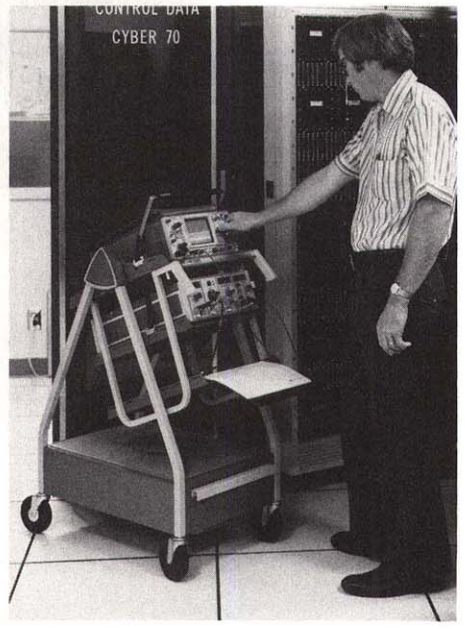
Extra shelf with four mounting screws. Net weight 0.9 lb, 0.4 kg. Shipping weight 3 lb, 1.4 kg.

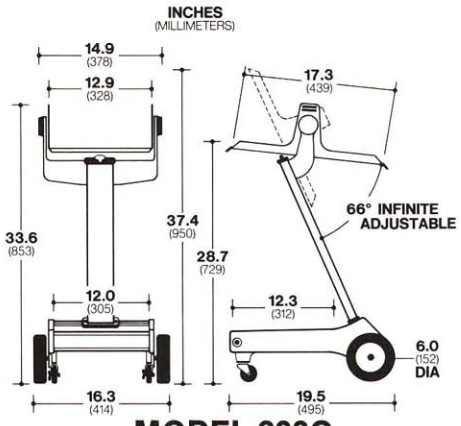
Order 436-0132-01 ..... **$25**

SAFETY BELT to secure instruments on top tray, shelves, or base. (Not needed for 5000- or 7000-Series Scopes on top tray.) Net weight 0.5 lb, 0.23 kg. Shipping weight 1 lb, 0.45 kg.

Order 346-0136-01 ..... **$15**







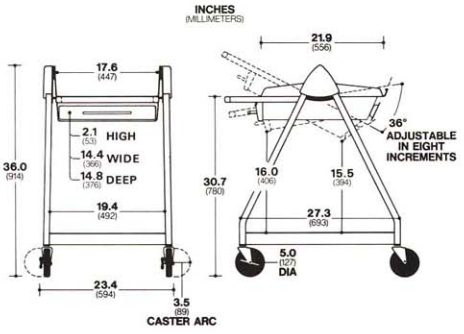
MODEL 200C

Recommended For:

All 400-Series Portable Scopes, TM 503, and TM 504.

MODEL 200C includes brakes on front casters, safety belt to secure instrument on top tray. Blue vinyl finish. Net weight 16 lb, 7.3 kg. Shipping weight 27 lb, 12.2 kg.

Order Model 200C **$160**



SCOPE-MOBILE® CARTS

MODEL 205

Recommended For:

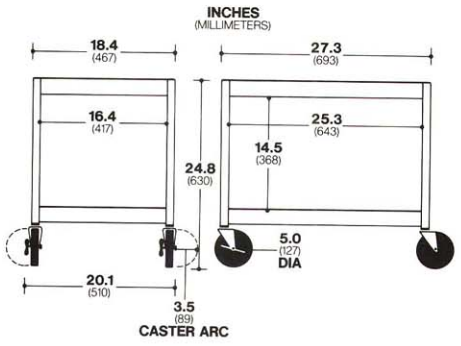
All rackmount width instruments. Note width dimension of top tray in diagram above. Rackmounting ears overhang sides of tray.

MODEL 205 includes brakes on front casters, storage drawer, power distribution module (three outlets, 15 ft cord). Blue vinyl finish. Net weight 43 lb, 19.5 kg. Shipping weight 57 lb, 25.8 kg.

Order Model 205 . . . . . **$260**

OPTIONAL SAFETY BELT recommended to secure instruments on top tray. Net weight 0.5 lb, 0.23 kg. Shipping weight 1 lb, 0.45 kg.

Order 346-0070-01 . . . . . **$24**



MODEL 206

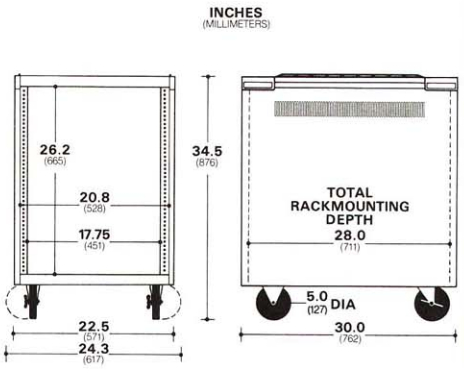
Recommended For:

Computer terminals, calculators, and peripherals. General instruments, laboratory and office equipment.

MODEL 206 includes brakes on casters at one end of cart. Plastic laminate on top tray and base. Light grey vinyl finish. Net weight 30 lb, 13.6 kg. Shipping weight 38 lb, 17.2 kg.

Order Model 206 . . . . . **$120**

SCOPE-MOBILE® Carts



TEK RACK CART MODEL 7

Recommended For:

Rackmounted systems and instruments.

MODEL 7 allows mounting of equipment to front or rear of cart. Adjustable rails for slide mounted equipment are provided. The Model 7 is designed and UL listed for up to 300 lbs mounted in place. It has removable side panels and a light grey vinyl finish. Several rackmount accessories are available such as blank panels, etc. A brochure describing the Model 7 and accessories is available from your local Tektronix Field Office Representative, or Distributor.

Net Weight 60 lbs, shipping weight 77 lbs.

Order Model 7 . . . . . **$450**

Optional Accessories

Stabilizer

Required to meet UL specifications for slide mounted equipment.

Order 016-0318-00 . . . . . **$85**

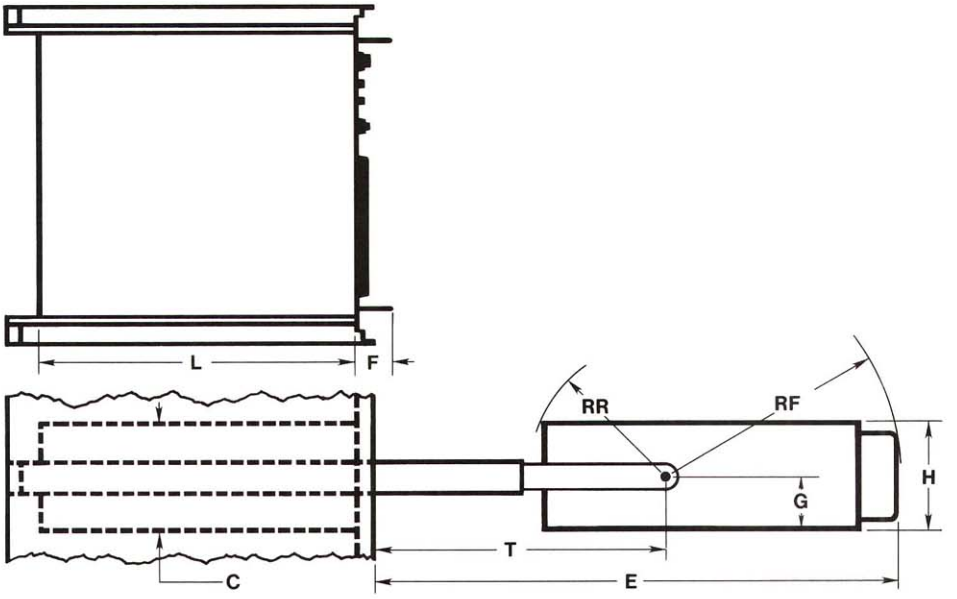
Safety Belt

To secure instruments to top surface of cart.

Order 346-0136-01 42 in **$15**

Order 346-0156-01 57 in **$15**

Rackmount Instrument Dimensions



DIMENSIONS EXCLUSIVE OF PLUG-IN UNITS AND PROBES

Symbol	Description	Definition
H	Height	Height of front panel.
L	Length	Rack front to rearmost permanent fixture excluding cables.
F	Forward Clearance	Back of front panel to foremost protrusion.
G	Vertical Axis	Bottom of front panel to horizontal plane of rotation.
E	Extended Inst	Maximum forward clearance with instrument out and horizontal.
RF	Radius — Front	Front radius of rotation.
RR	Radius — rear	Rear radius of rotation.
T	Track	Rack front to pivot point.
C	Cabinet	Cabinet height.

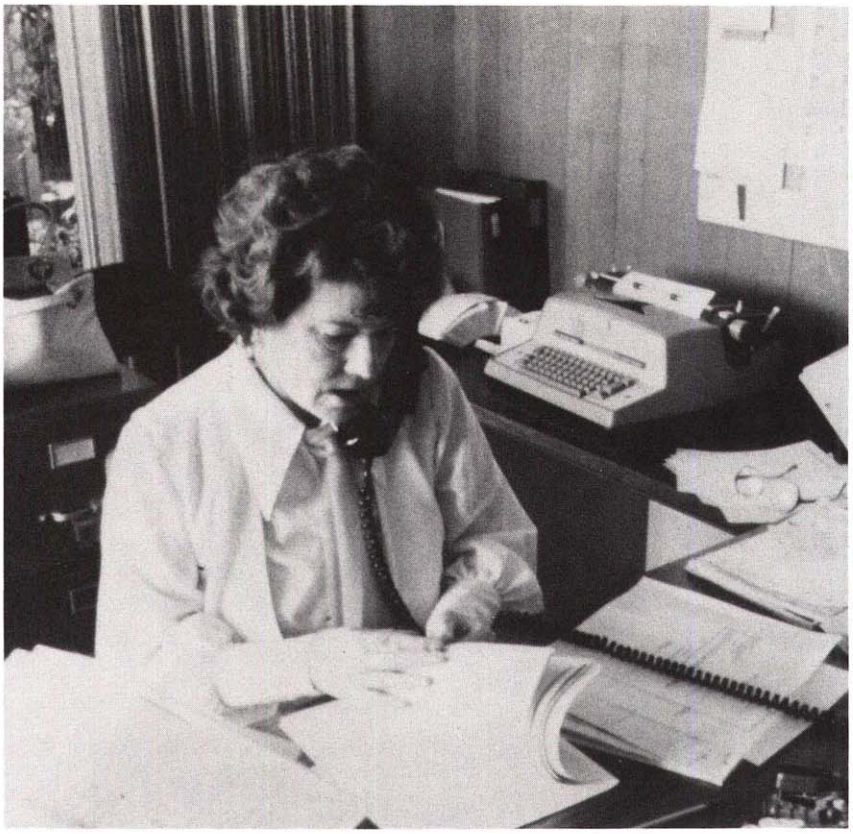
MOUNTING DIMENSIONS

PRODUCT	H		L		F		G		E		RF		RR		T		C	
	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
R434	5.3	13.5	18.0	45.7	1.6	4.0	—	—	—	—	—	—	—	—	—	—	5.3	13.5
R465*, R475*, R475A*	7.0	17.8	16.3	41.4	1.8	4.6	3.5	8.9	20.4	51.8	11.0	27.9	7.9	20.1	9.6	24.4	6.8	17.3
R485*	7.0	17.8	16.2	41.1	1.8	4.6	3.5	8.9	19.3	49.0	10.9	27.7	7.9	20.1	9.3	23.6	6.8	17.3
R491*	7.0	17.8	17.4	44.2	2.1	5.1	3.5	8.9	21.1	53.6	11.9	30.2	8.5	21.6	9.3	23.6	6.8	17.3
R5100N*, R5400*	5.3	13.5	19.0	48.3	1.1	2.8	1.8	4.6	24.6	62.5	—	—	—	—	—	—	5.3	13.5
R7704*	7.0	17.8	22.4	56.9	2.3	5.8	1.8	4.6	33.3	84.6	15.3	38.9	10.7	27.2	18.5	47.0	7.0	17.8
R7313*, R7603*, R7613*, R7623*	5.3	13.5	22.3	56.6	2.0	5.1	—	—	25.2	64.0	—	—	—	—	—	—	5.3	13.5
R7844*	7.0	17.8	24.8	56.6	2.3	5.8	1.75	4.4	—	—	—	—	—	—	—	—	7.0	17.8
R7903*	5.3	13.5	22.5	57.2	2.3	5.8	—	—	25.3	64.3	—	—	—	—	—	—	5.3	13.5
R7912*	5.3	13.5	26.9	68.3	1.8	4.6	—	—	26.9	68.3	—	—	—	—	—	—	5.3	13.5
RTM506	5.25	13.3	18.9	48.0	1.82	4.7	—	—	—	—	—	—	—	—	—	—	5.25	13.3
T922R *	5.2	13.2	17.0	43.2	1.7	4.3	—	—	24.2	61.5	—	—	—	—	—	—	5.2	13.2
016-0115-02	5.3	13.5	16.3	41.4	0.3	0.8	—	—	—	—	—	—	—	—	—	—	5.3	13.5
016-0268-00	5.3	13.5	19.8	50.3	1.8	4.6	—	—	—	—	—	—	—	—	—	—	5.2	13.2
040-0551-00	14.0	35.6	22.4	56.9	0.6	1.5	—	—	30.9	78.5	—	—	—	—	—	—	—	—
040-0554-00	15.8	40.1	21.5	54.6	1.9	4.8	—	—	31.3	79.5	—	—	—	—	—	—	—	—
040-0600-00	5.25	13.3	18.3	46.5	0.7	1.8	—	—	—	—	—	—	—	—	—	—	5.25	13.3
040-0601-00	5.25	13.3	18.3	46.5	0.7	1.8	—	—	—	—	—	—	—	—	—	—	5.25	13.3
040-0616-00	5.3	13.5	16.5	41.9	1.1	2.8	1.8	4.6	24.6	62.5	—	—	—	—	—	—	5.3	13.5
040-0617-00	5.3	13.5	16.5	41.9	1.1	2.8	1.8	4.6	24.6	62.5	—	—	—	—	—	—	5.3	13.5
040-0624-00	5.25	13.3	18.3	46.5	0.7	1.8	—	—	—	—	—	—	—	—	—	—	5.25	13.3
437-0031-00	8.8	22.4	9.5	24.1	0.3	0.8	—	—	—	—	—	—	—	—	—	—	7.1	18.0
437-0071-00	7.0	17.8	13.4	34.0	1.4	3.6	—	—	—	—	—	—	—	—	—	—	6.6	16.8
437-0126-01	5.3	13.5	22.3	56.6	2.0	5.1	—	—	25.2	64.0	—	—	—	—	—	—	5.25	13.3

*These instruments mount with sliding tracks to a standard 19-inch-wide rack. Rear support for sliding tracks is required, such as an enclosed rack.

Business Information

When you buy a TEKTRONIX product, you are buying more than an oscilloscope . . . or a computer terminal . . . or a logic analyzer . . . or any of our numerous test and measurement products. You are also investing in the people and services behind your TEKTRONIX product.



A staff of Customer Service Representatives serves as your initial interface with the company.

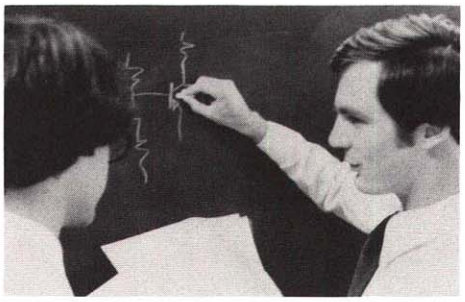
Trained Sales Engineers give you expert service advice and after-the-sale support.

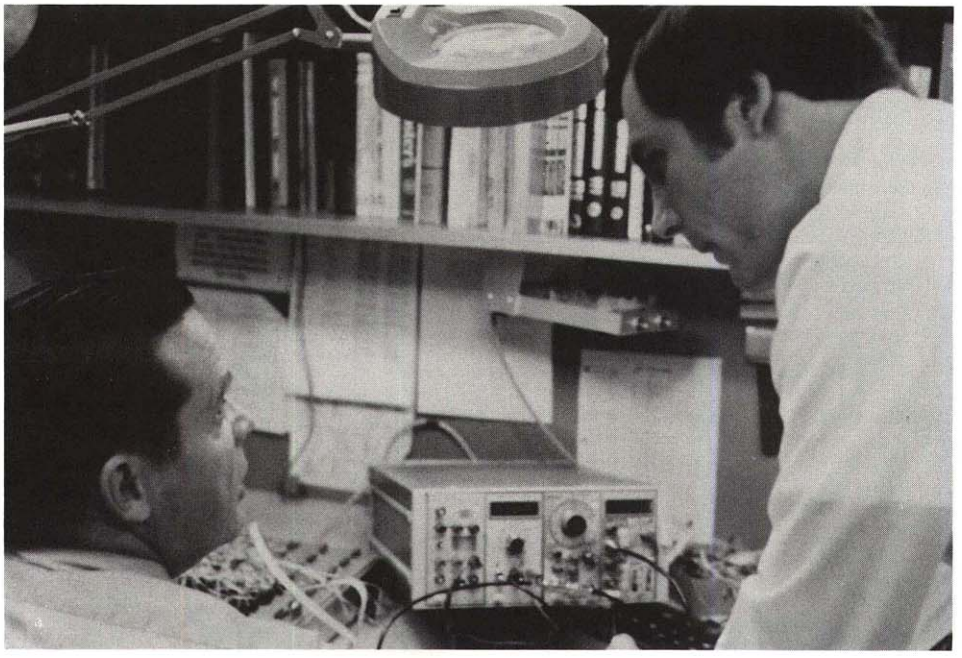
A network of service centers throughout the U.S. and most other parts of the world provides speedy and competent calibration, maintenance, and repair service.

The long term support program insures up to 12 years of service after an instrument is taken off the production line.

The training and support program offers classes in TEKTRONIX product theory, operation, maintenance, and repair at our main plant in Beaverton, Oregon, or at a location near you. Audio and video training tapes are also available.

Each of these services adds value to your TEKTRONIX product.





SALES ENGINEERS

Your Sales Engineers are fully prepared to respond to your technical and business requirements. They have a strong technical background and extensive product and business training. Periodic refresher courses fully acquaint them with new products and services. Be sure to take advantage of their services.

COMMUNICATIONS

Your Sales Engineers are a valuable communication link between you and the factory. They know the exact person to contact in each circumstance, and can reach that person fast and easily. Let them help your communications on any problem related to your TEKTRONIX products.

ORDERING

There are many types of products, each designed for a specific application area. Your Sales Engineer can help you select the one best suited to your present and future needs, and will be happy to arrange a demonstration of the product . . . in your application if you so desire.

If you are a Purchasing Agent or Buyer, your Sales Engineer or Customer Service Representative can provide information on prices, terms, shipping estimates, and best method of transportation on TEKTRONIX products, accessories and replacement parts.

OPERATION

Your TEKTRONIX product can be most useful to you when you are familiar with all control functions. Your Sales Engineer will be glad to demonstrate the use of your product in various applications to help you become more familiar with its operation. If your product is to be used by several engineers or other users, your Sales Engineer will be happy to conduct informal classes on its operation in your location.

FACTORY TRAINING

Often there is a need for in-depth training that cannot be fully accomplished locally. To meet these needs, Tektronix has established a program of factory training which is an extension of Tektronix sales engineering. Customers who participate in this program attend classes at the Tektronix customer training centers located in the Tektronix Industrial Park in Beaverton, Oregon, or on the Isle of Guernsey. Your Sales Engineer has full details, and will make all the arrangements.

APPLICATIONS

Sales Engineers have strong technical backgrounds and extensive product experience; periodic refresher courses keep them abreast of new products, applications, and services. Many are specialists in such fields as: Signal Processing Systems, Television Products, Information Display Products and Spectrum Analyzers. At your request, they will arrange to demonstrate TEKTRONIX instrumentation for you — in your application, if you wish.

CALIBRATION & CERTIFICATION

Services furnished are provided in accordance with all applicable Tektronix specifications. Actual test data can be made available when required.

Tektronix' calibration measurements are traceable to the National Bureau of Standards to the extent allowed by the Bureau's calibration facilities.

TEKTRONIX Service Quality Program satisfies the requirements of MIL-I-45208A, and MIL-C-45662A.

TRACEABILITY

The reference standards of measurement of Tektronix are compared with the U.S. National Standards through frequent tests by the U.S. National Bureau of Standards.

The Tektronix working standards and testing apparatus used are calibrated against the reference standards in a rigorously maintained program of measurement control.

The manufacture and final calibration of TEKTRONIX products are controlled by the use of Tektronix reference and working standards and testing apparatus in accordance with established procedures and with documented results. (Reference MIL-C-45662A)

Certificates of traceability to NBS are available with new products, as well as products you may have serviced at a later date.

A certificate of compliance stating that a particular product being shipped conforms to its published (or quoted) specification is also available.

CUSTOMER ASSISTANCE

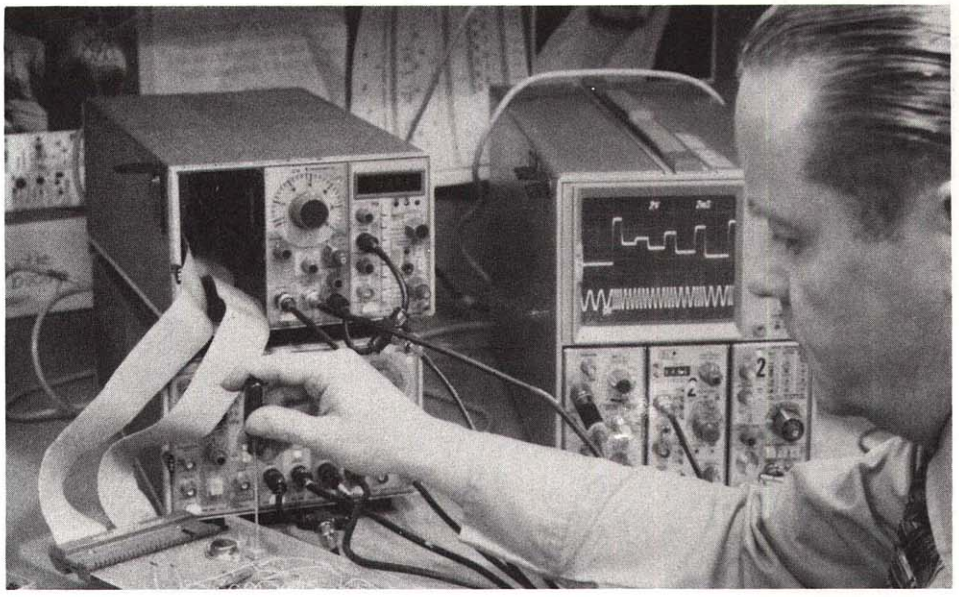
Tektronix willingly assumes much of the responsibility for continued efficient operation of the products it manufactures. If you should experience a stubborn maintenance problem, we will gladly help you isolate the cause. Often a telephone call will help you get your product back in operation with minimum delay. If yours is a large laboratory, we can help your maintenance engineers by conducting informal classes on test and calibration procedures, troubleshooting techniques, and general maintenance.

PRODUCT SERVICE

To help assure adequate product service and maintenance facilities for our customers, Tektronix has established Field Offices and Service Centers at strategic points throughout the United States. Contact your Sales Engineer or Service Center for details concerning • Warranty • Calibration • Emergency Repairs • Repair Parts • Scheduled Maintenance • Reconditioning and Overhaul • Pickup and Delivery • Maintenance Agreements • On-Site Service for Fixed Installations — Other Services available through these local offices and centers. Outside the United States, service is offered in all countries where the products are locally sold.

EMERGENCY REPAIR

This service will help you in situations where products require immediate attention. If your TEKTRONIX product malfunctions, or if you want a particular characteristic optimized, just bring it to your local service center. Work starts when you arrive. In most cases, we will solve the problem immediately and get you on your way in a matter of minutes. Should your oscilloscope need emergency attention during field trips, please contact any of our service centers. They will be glad to assist you with repairs and get you on your way — without costly delays.



MAINTENANCE AGREEMENTS

Your TEKTRONIX products are initially covered by warranty. Several types of contracts are usually available to help you extend that initial coverage. The Blanket Repair Agreement, for example, allows you to establish a "not-to-exceed" amount and a fixed turnaround time for local repairs; it also saves on paperwork by centralizing the billing procedure. Many other aspects of service are negotiable.

If you'd like us to maintain your products on a regular basis, ask a service center about our fixed fee maintenance program. For a fixed cost that you can budget for, we'll remind you when a product is due for calibration, and perform the service within a specified turnaround time.

Contact your service center for a schedule of service fees, more information about maintenance agreements, local services offered, or possible provisions for your special requirements.

REPAIR PARTS

Repair and replacement parts service is geared directly to the field, therefore, all requests for repairs and replacement should be directed to the Tektronix Field Office in your area. This procedure will assure you the fastest possible service. Please include product type number and serial number with all requests for parts or service. PLEASE DO NOT RETURN INSTRUMENTS OR PARTS BEFORE RECEIVING DIRECTIONS.

Tektronix, Inc.

P. O. Box 500, Beaverton, Oregon 97077

Telephone: (503) 644-0161 TWX: 910-467-8708 TEKTRONIX BEAV. Cable: TEKTRONIX

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Suite 113
Phone (602)244-9795
Tucson Area: Enterprise 383

CALIFORNIA
*Concord 94520
2345 Stanwell Circle
Phone (415) 689-2710
From Oakland: (415) 254-5353

*Irvine 92714
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Phone (714)556-8080-89
(213)778-5225, 6

*Los Angeles
21300 Erwin Street
Woodland Hills 91367
Phone (213)999-1711

*San Diego 92111
6841 Convoy Court
Phone (714)292-7330

*Santa Clara 95051
3200 Coronado Drive
Phone (408)249-5500

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1871 West Oakland Park Blvd.
Phone (305)731-1220
Also serves Puerto Rico and U.S. Virgin Islands
From Miami: 947-6053

*Orlando 32803
Suite 109, 1040 Woodcock Rd.
Phone (305)894-3911
From The Cape Kennedy Area: 636-0343

Pensacola 32503
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Phone (904)476-1897

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Phone (317)545-2351

KANSAS
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10580 Barkley
Suite 62
Overland Park, Kansas 66212
Phone (913)341-3344

LOUISIANA
*New Orleans
3004 34th St.
Metairie 70001
Phone (504)837-8454

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Baltimore
1526 York Road
Lutherville 21093
Phone (301) 321-7000
From Harrisburg, Lancaster, and York Area call: ENterprise 1-0631

*Rockville 20850
2 Research Court
Phone (301)948-7151

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Lexington 02173
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Farmington Hills 48018
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MINNESOTA
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3563 N. Lexington Ave.
Phone (612)484-8571

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*St. Louis
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Hazelwood 63042
Phone (314)731-4696

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964 South Springfield Avenue
Phone (201)379-1670

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Southern Nevada Area: ENterprise 678

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(212) 895-9215

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Rochester 14623
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Phone (716)244-2600

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North Syracuse 13212
Phone (315)455-6661
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*Field Office/Service Center
†Service Center

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Telex Vienna 13933

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Phone (514)697-5340, Telex 05-821570
Cable: TEKANADA

825 - 12th Avenue S.W.
Calgary, Alberta
T2R 0J2
Phone (403)269-3138, Telex 038-21730

6025 103 A Street
Edmonton, Alberta
T6H 2J7
Phone (403)434-9466, Telex 037-2795

Toronto
133 Wynford Drive
Don Mills, Ontario
M3C 1K1
Phone (416)445-8650, Telex 06-966595

1792 Courtwood Crescent
Ottawa, Ontario
K2C 2B5
Phone (613)225-2850, Telex 053-4119

Vancouver
4519 Canada Way
Burnaby, B.C.
V5G 1K1
Phone (604)438-4321, Telex 043-54602

Halifax
Burnside Commercial Centre
10 Akerley Blvd.
Dartmouth, Nova Scotia
B3B 1J4
Phone (902)469-9476, Telex 019-22656

DENMARK
Tektronix A/S
DK - 2880 Bagsvaerd
Krogshojvej 29
Phone (02) 98 77 11, Telex 16482

FRANCE
TEKTRONIX
Z. I. Courtaboeuf, B.P. 13
91401 Orsay
Phone 907 78 27
Telex TEKFRANS 690332
Cable: TEKFRANS Orsay

Centre Regional de Lyon
163, Boulevard des Etats-Unis
69008 Lyon
Phone (78)76.40.03
Telex: TEKLYON 300150

Centre Regional de Nancy
16, rue de la Cote
54000 Nancy
Phone (28)27.24.88
Telex TEKNANCY 850872

Centre Regional d'Aix-en-Provence
Rue Le Corbusier
13100 Aix-en-Provence
Phone (91)27 24 87
Telex TEKAIX 440045

Centre Regional de Rennes
103A, avenue de Crimee
35000 Rennes
Phone: (99) 51 21 16
Telex: TEKREN 740829

Centre Regional de Toulouse
284, route Saint-Simon
31300 Toulouse
Phone (61)40.24.40
Telex TEKTOULS 530243

JAPAN
Sony/Tektronix Corporation
9-31, Kitashinagawa - 5, Shinagawa-Ku
Tokyo 141
(P.O. Box 14, Haneda Airport, Tokyo 149)
Phone 445-0221 (Area 03/Tokyo)
Telex 02422850
Cable: SONYTEK Tokyo

c/o Taiso-Ebisu Building 1-6-11
Ebisuminami Shibuya-ku
Tokyo 150
Phone 710-8141 (area 03/Tokyo)

c/o Takahashi Building North No. 2
2-19 Isemachi Kita-ku
Osaka-shi
530
Phone 312-2751 (area 06/Osaka)

8 Hijie-cho-2 Nakamura-ku
Nagoya
Phone 581-3548 (area 052/Nagoya)

THE NETHERLANDS
Tektronix Holland N.V.
Meidoornweg 2
(P.O. Box 164)
Badhoevedorp
Phone 02968-6155
Telex: 18490

SWEDEN
Tektronix AB
Fack
S-171 04 SOLNA
Phone: 08/83 00 80
Telex: 17831 Tekswed S
Cable: TEKTROSWED Stockholm

Tektronix AB
Kommendorsgatan 6
S-414 59 GOTHENBURG
Phone 031/42 70 35

SWITZERLAND
Tektronix International A.G.
(P.O Box 57)
CH-6301 Zug
Phone 042 21.91.92, Telex 78808
Cable: TEKINTAG

UNITED KINGDOM
Tektronix U.K. Limited
Beaverton House
36-38, Coldharbour Lane
(P.O. Box 69)
Harpenden, Herts
Phone Harpenden 63141, 61251,
Telex 25559
Cable: TEKTRONIX Harpenden

181A, Mauldeth Road
Burnage
Manchester 19
Phone 061-224-0446, Telex 668409

7 Shiel House, Shiel Walk
SCOTLAND
Livingston, West Lothian
Phone Livingston 32766/7

INTERNATIONAL DISTRIBUTORS AND REPRESENTATIVES

Supplied and Supported by Tektronix, Inc., P.O. Box 500, Beaverton, Oregon, U.S.A. 97077
Telephone: (503) 644-0161 TWX: 910-467-8708 TEKTRONIX BEAV. Cable: TEKTRONIX

ARGENTINA
Coasin S.A.
Virrey del Pino 4071
Buenos Aires
Phone: 52-3185, 51-9363
Telex: 012-2284
Cable: COASIN, Buenos Aires

25 de Mayo N° 1930
Cordoba
Phone: 51-3037

BRAZIL
Importacao, Industria e Comercio Ambriex S.A.
Rua Ceara, 104 2° e 3° ands.
Rio de Janeiro, RJ
Phone: 264-7406, 264-7625, 264-0461
Telex: 391-2121128
Cable: RAIOCARDIO, Rio de Janeiro

Rua Tupi, 535
Sao.Paulo, SP
Phone: 67-7806, 66-0912, 66-6016, 67-1870

CHILE
Equipos Industriales S.A.C.I.
Moneda 812 - Of. 912
(Casilla 13550)
Santiago
Phone: 716-882, 382-942
Telex: 3520241 FLOBRA
Cable: FLOBRA, Santiago

COLOMBIA
Selectronica Ltda.
Calle 12 No. 7-32, Of. 707
(Apartado Aereo 25124)
Bogota
Phone: 422376, 822413

ECUADOR
Proteco Coasin Cia Ltda.
Ave. 6 de Deciembre 865 y Roca
(P. O. Box 228A)
Quito
Phone: 52-6759, 52-9684
Telex: 2865 PROTECO-ED
Cable: PROTECO, Quito

HONG KONG
Gilman & Co. Ltd.
Electrical/Electronic Dept.
280 Gloucester Road
World Trade Centre, 24/F.
Causeway Bay
(G. P. O. Box 56)
Phone: 5-794266
Telex: 83667 GILMN HX
Cable: GILMAN, Hong Kong

INDIA
Hinditron Services Private Ltd.
69-A, L. Jagmohandas Marg.
Bombay-400 006
Phone: 365344
Telex: 953-0112326
Cable: TEKHIND, Bombay

412 Raj Mahal Vilas Extension
Bangalore-560 006
Phone: 33139
Telex: 953-043-741
Cable: TEKHIND, Bangalore

KOREA
M-C International (Korea) Ltd.
Room 1407, Center Building
91-1, Sokong-dong, Chung-ku
(C. P. O. Box 1355)
Seoul
Phone: 23-4101/5
Telex: K2428
Cable: EMCEEKOREA, Seoul

MALAYSIA
Mecomb Malaysia Sdn. Bhd.
No. 2, Lorong 13/6A
(P. O. Box 24)
Petaling Jaya, Selangor
Phone: 773455
Telex: 37605
Cable: MECOMB Petaling Jaya

MEXICO
Tecnicos Argostal, S.A.
Depto. Control de Calidad
Av. Jalisco 180
(Apdo. Postal M-2511, Mexico 1, D.F.)
Mexico 18, D.F.
Phone: 515-85-80
Telex: 017-74208
Cable: ARGOSTAL, Mexico

Av. Universidad 3335 Norte
Monterrey, N.L.
Phone: 51-13-60
Telex: 038865

Calz. J. Jesus Glz. Gallo 383
Guadalajara, Jal.
Phone: 17-26-46, 17-78-12
Telex: 068-2710

NEW ZEALAND
W. & K. McLean Ltd.
103-105 Felton Mathew Avenue
Glen Innes
(C. P. O. Box 3097)
Auckland 6
Phone: 587-037
Telex: NZ 2763 KOSFY
Cable: KOSFY, Auckland

5th Floor, Westbrook House
181 Willis Street
(C. P. O. Box 496)
Wellington 1
Phone: 851-450
Telex: NZ 3053 KOSFY

2nd Floor, McLean Building
210 Oxford Terrace
(C. P. O. Box 2421)
Christchurch 1
Phone: 64-403

PAKISTAN
Pak-Land Corporation
Central Commercial Area
Iqbal Road
P.E.C.H. Society
Karachi-29
Phone: 437315, 438084
Cable: PAKLAND, Karachi

PANAMA
Executive Marketing Corporation
Apartado 4929
Panama 5
Phone: 64-9354, 64-9851
Telex: 328-2220
Cable: MARKETING PA, Panama

PERU
Importaciones y Representaciones Electronicas S.A. (IRE Ingenieros)
Avda. Franklin D. Roosevelt 105
Edificio Rimac
Lima
Phone: 28-86-50
Telex: 25663
Cable: IREING, Lima

PHILIPPINES
Philippine Electronic Industries, Inc.
3rd Floor, RCA Global Building
8755 Paseo de Roxas
(P. O. Box 498, Makati Commercial Center)
Makati, Rizal 3117
Phone: 87-99-26, 87-99-27, 87-99-28
Telex: 7222036
Cable PHILECTRON, Manila

SINGAPORE
Mechanical & Combustion Engineering Co. Pte. Ltd.
10-12, Jalan Kilang
(P. O. Box 46, Alexandra Post Office)
Singapore 3
Phone: 647151
Telex: RS-23178
Cable: MECOMB, Singapore

SRI LANKA
Maurice Roche Limited
G.P.O. Box 61
Colombo
Phone: 25846, 25847, 25848
Cable: LAXAPANA, Colombo

SURINAME
Wong Sang Tsoi & Co.
20-24 Dominestraat
(P. O. Box 163)
Paramaribo
Phone: 73511, 75187, 72154, 76369
Cable: SANGTSOICO, Paramaribo

TAIWAN
Heighten Trading Co. Ltd.
16 Nanking East Road, Section 3
(P. O. Box 1408)
Taipei 104
Phone: 551-9916
Telex: 21472
Cable: HEIGHTEN, Taipei

THAILAND
G. Simon Radio Company Ltd.
30, Patpong Avenue
Bangkok
Phone: 30991-3
Cable: SIMONCO, Bangkok

URUGUAY
Coasin Uruguaya S.R.L.
Casilla de Correo No. 1400
Correo Central
Montevideo
Phone: 91-79-78
Cable: COAUR, Montevideo

VENEZUELA
Equilab, C.A.
Torre KLM 6° Piso
Avda Romulo Gallegos
Santa Eduvigis
(Apartado 60497)
Caracas 106
Phone: 283.1166 (5 lines)
Telex: 21860 EQUIX
Cable: EQUILAB, Caracas

INTERNATIONAL DISTRIBUTORS AND REPRESENTATIVES

Supplied and Supported by Tektronix Limited, P. O. Box 36, St. Peter Port, Guernsey, Channel Islands
Telephone: Guernsey 26411 (eight lines), Telex: 41193

Tektronix Limited maintains a warehouse of United States-made instruments, accessories and parts on the Island of Guernsey to quickly support these distributors in filling customer orders. Technical support of customers and distributors is also available from this facility. In addition, Tektronix has manufacturing facilities within the European Economic Community and European Free Trade Association.

ANGOLA
Equipamentos Tecnicos, Lda.
(P.O. Box 6319)
Luanda
Phone 6917
Telex 3147 EQUIPAL LUANDA
Cable: EQUIPAL

EAST AFRICA (Kenya, Tanzania and Uganda)
Engineering & Sales Co., Ltd.
Bankhouse, Government Road
(P.O. Box 46658)
Nairobi, Kenya
Phone 26815
Cable: **Engsales Nairobi**

WEST AFRICA
SITEL
Societe Ivorienne de Telecommunication
20 Avenue de la Fosse
BP 2580 Abidjan (cote d'Ivorie)
Ivory Coast
Telephone: 32-18-52
32-14-75
Telex: 525 RAYBACH-ABIDJAN

EGYPT
Giza Systems Engineering Company
P. O. Box 1913
4 El-Hesn Street
Giza
Cairo
Egypt
Telephone 98 7114
98 7276

FEDERAL REPUBLIC OF GERMANY
Rohde & Schwarz Vertriebs GmbH
2 **Hamburg** 50
Grosse Bergstrasse 213-217
(P.O. Box 1228)
Phone (1411) 38 14 66
Telex 0 213 749
Cable: ROHDESCHWARZ Hamburg

75 Karlsruhe
Kriegsstrasse 39
(P.O. Box 5229)
Phone (0721) 2 39 77
Telex 7 826 730
Cable: ROHDESCHWARZ Karlsruhe

5 Koeln 1
Sedanstrasse 13-17
Phone (Koeln 0221) 77 22 1
Telex 888-5417
Cable: ROHDESCHWARZ Koeln

8 Muenchen 37
Dachauer Strasse 109
Phone (0811) 52 10 41
Telex 523703
Cable ROHDESCHWARZVERTRIEB Muenchen

WEST BERLIN
Rohde & Schwarz Handels-GmbH
1 **Berlin** 10
Ernst-Reuter-Platz, 10
Phone (0311) 34 14 03 6
Telex 0 181 636
Cable: ROHDESCHWARZ Berlin

FINLAND
Into O/Y
P.O. Box 153
00101 Helsinki
Phone 90-171123
Telex 121836
Cable: INTO, Helsinki

GREECE
Marios Dalleggio Representations
2, Alopekis Street
Athens 139
Phone 710.669, Telex 216435
Telex Answer Code: DALM GR
Cable: DALMAR Athens

IRAN
Berkeh Company Ltd.
20 Salm Road
Roosevelt Avenue
Tehran
Phone 828294 & 831564
Telex 212956 BERK IR
Cable: BERKEHKAR, Tehran

ISRAEL
Eastronics Ltd.
11 Rozanis Street
Tel-Baruch
(P.O. Box 39300)
Tel Aviv
Phone 475151
Telex 033-638
Cable: EASTRONIX Tel Aviv

ITALY
Silverstar Spa, Ltd.
Via dei Gracchi No. 20
20146 **Milano**
Phone 4996 (12 lines)
Telex SILSTAR 39189 Milano
Cable: SILVERSTAR Milano

Via Paisiello No. 30
00198 **Roma**
Phone 844.88.41/5 (five lines)
Telex 61511 SILSTAR Roma
Cable: SILVERSTAR Roma

Piazza Adriano, 9
10139 **Torino**
Phone 44.32.75/6
Cable: SILVERSTAR Torino

JORDAN
TAREQ Scientific Bureau
Salt Road
P.O. Box 463
Amman
Phone: 36855 & 22855
Telex: 1611 ADER JO
Cable: ADERDRUG AMMAN

KUWAIT
***TAREQ Company**
P.O. Box Safat 20506
Phone: 436100 & 436045
Telex: ZUAITER 2315 KT
Cable: ZUAITER KUWAIT

LEBANON
Projects S.A.L.
(P.O. Box 5281)
Beirut
Phone 251680
Telex 20466LE
Cable: PROJECTS Beirut

MOROCCO
SCRM
29 BD Girardot
Casablanca
Phone 27 69 11
Telex 21815
Cable: SCRM CASA (21815)

*Customers in
United Arab Emirates
Contact TAREQ COMPANY KUWAIT

NIGERIA
Mofat Engineering Co. Ltd.
P.O. Box 6069
89 Wakeman Street
Yaba
Lagos
Phone 43195
Telex 21595 Mainlang
Cable: MOFATENG, LAGOS

Mofat Engineering Co. Ltd.
SW8/131 Ijebu Bye-pass
Oke—Ado
P.O. Box 3464
Ibadan
Phone 22824

NORWAY
Morgenstierne & Co. A/S
Konghellegt.3.
(P.O. Box 6688 Rodelokka, Oslo 5)
Oslo
Phone 35 61 10, Telex 11719
Cable: MOROF Oslo

PORTUGAL
Equipamentos de Laboratorio Lda.
Estrada Lisboa - Sintra Amadora
P.O. Box 1100 (Casal de Garoto)
Lisbon
Phone 97 65 51, Telex 12702 EQILAB
Cable: EQUILAB, Lisboa

REPUBLIC OF SOUTH AFRICA
Protea Physical & Nuclear Instrumentation (Pty.) Ltd.
(P.O. Box 39127)
746 Sixth Street
Wynberg, Sandton TVL
Bramley 2018
Phone 786-1020
Telex 8-4689
P.O. Box 3839
Capetown
Phone 51-2357
P.O. Box 68
Congella
Durban
Phone 35-1253, 35-2645

SAUDI ARABIA
Electronic Equipment Marketing Establishment
P. O. Box 3750
Riyadh
Phone: 32700, 32761
Telex: 20120

SPAIN
C.R. Mares, S.A.
Valencia 333
Barcelona (9)
Phone 257.62.00, Telex 27332
Cable: MARES Barcelona
Gaztambide, 60-1°
Madrid (15)
Phone 449-33-00, Telex 7332
Cable: MARES Madrid

TURKEY
Erkman Elektronik Aletler
Ticaret Anonim Sirketi
Necatibey Caddesi 92/3
Karakoy, Istanbul
Phone: 44 15 46/44 76 51
Telex: 23353 MSE TR
Cable: Ingmesuer, Istanbul

ZAMBIA
Baird and Tatlock (Zambia) Ltd.
Chandwe Musonda Road
(P.O. Box 1038)
Lusaka
Phone 75315/6, Telex 4277
Cable: PIPETTE, Lusaka
Brunell Road
(P.O. Box 1097)
Ndola
Phone 3522 & 2253/4/6, Telex 3441
Cable: PIPETTE, Ndola

Customers in the following countries:
Bulgaria, Czechoslovakia, Hungary, Poland, Romania, U.S.S.R. and Yugoslavia
Contact: Rohde & Schwarz-Tektronix Ges.m.b.H & Co. KG
Sonnleithnergasse 20, A-1100 Wien, Austria. Phone Vienna 62 61 41, Telex Vienna 13933

Orders should be placed with your Tektronix Field Engineering Office listed on page 260.

Tektronix, Inc., offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning. Any of the following terms may be arranged with a Tektronix Field Engineer.

NET 30 DAYS

Tektronix, Inc., standard terms of sale are NET 30 days following the date of shipment. As with all credit terms, satisfactory credit accommodations must be arranged.

EXTENDED TERMS OF SALE

Extended terms of 60 to 180 days are available on the same single payment basis as standard terms. Since the cost of extended terms is not included in catalog prices, a service charge is added to the invoice. The amount of the service charge depends upon the number of days the terms are extended.

LEASE AGREEMENT

All new and used instruments are available under this program. Accessories and parts are not available unless they are associated with the products being leased. Minimum lease is $1000.

A standard lease term of 6, 12, 18, 24, 30, and 36 months is offered. Longer terms are negotiable. Under a Lease Agreement, the customer pays for the use of the product for the term of agreement. It is not a month-to-month rental . . . it is a non-cancellable, fixed-term lease requiring no advance payment. At the expiration of the lease there is the opportunity to update the instruments, to renew the existing lease, or to return the equipment at the expense of Tektronix, Inc. The customer may exercise an option to purchase the equipment at any time during the term of the lease, provided he gives thirty days written notice. A portion of the installments will be credited toward the purchase price.

The standard Tektronix, Inc., warranty and quantity discount apply to products leased under this installment term.

SECURITY AGREEMENT

This program provides monthly installment payment terms while TEKTRONIX Products are in use. Accessories and parts are not available unless they are associated with the products being purchased. New and used products may be purchased with a deduction for applicable quantity discounts.

An advance payment equal to approximately 10% of the purchase price of the equipment desired is required for a Security Agreement. Installment terms covering the balance of the contract price are available for 6, 12, 18, 24, 30, or 36 months. Minimum balance amounts may be financed, ranging from $200 for six months to $2000 for thirty-six months. Longer terms of 48 to 60 months are available by quotation for financed balances of more the $10,000. There are no maximum finance balances.

All products carry the standard Tektronix, Inc., warranty. The customer is responsible for the equipment and applicable property taxes, licenses, etc. Upon completion of the term of agreement and prescribed payments, the customer owns the equipment.

INFORMATION DISPLAY PRODUCTS

Most Information Display Products are available under an *operating lease* program. The minimum fixed terms of this program are 12, 24, 36 months, or longer. Automatic extension on a month-to-month basis with a declining rate is also available after the fixed minimum term. Equipment leased on this program is maintained by Tektronix, Inc., during the terms of the agreement. Rental of Information Display Products for customer evaluation is available for periods of 90 or more days.

During the term of the operating leases or rentals described, the customer may exercise an option to purchase the equipment provided 30 days notice is given. A portion of the installments already paid will be credited toward the purchase price.

Questions regarding warranty should be discussed with your Tektronix Field Engineer.

WARRANTY

It is Tektronix' intent to provide unmatched value for our customers in products, services, and business practices. A part of this intent is expressed in our warranty practice. All TEKTRONIX products are warranted against defects in materials and workmanship. The period of coverage is specified in a warranty statement accompanying each product.

SHIPMENT

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified.

Unless otherwise specified, shipment will be made via most economical method. Surface and air shipments will be insured at full valuation unless your order instructs otherwise.

Specification and price change privileges reserved.

Functional Index

Alphanumeric Index

COULD WE BE OF FURTHER SERVICE

If you would like additional information or assistance in solving your measurement requirements, or would like a demonstration of one of our products, complete and return this reply card.

Phone (_____) _____ Ext. _____

Name & Title _____

Dept/Mail Station _____

Company _____

Address _____

City _____ State _____ Zip _____

☐ Please contact me for a demonstration of: _____

☐ I would like consultation/planning assistance in the area of: _____

☐ I would like additional information on: _____

☐ My application area is: _____

☐ I am considering purchase of the following TEKTRONIX Products:

Products	Estimated Purchase Date

Tektronix®
COMMITTED TO EXCELLENCE

C-116

COULD WE BE OF FURTHER SERVICE

If you would like additional information or assistance in solving your measurement requirements, or would like a demonstration of one of our products, complete and return this reply card.

Phone (_____) _____ Ext. _____

Name & Title _____

Dept/Mail Station _____

Company _____

Address _____

City _____ State _____ Zip _____

☐ Please contact me for a demonstration of: _____

☐ I would like consultation/planning assistance in the area of: _____

☐ I would like additional information on: _____

☐ My application area is: _____

☐ I am considering purchase of the following TEKTRONIX Products:

Products	Estimated Purchase Date

Tektronix®
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C-116

MAIL LIST QUESTIONNAIRE

MEASUREMENT PRODUCTS

Mr. ☐ Miss ☐
Ms. ☐ Prof. ☐
Mrs. ☐ Dr. ☐ (16) Phone (____) _____ Ext. _____ Date _____

(06) Name & Title _____
Dept./
(07) Mail Station _____
(08) Company _____
(09) Address _____
(10) City/State _____ City _____ Cdn Prov. (11) _____ State (12) _____ Cdn. (13) _____ Zip Code (14) _____

1 Please check the ***ONE*** category that best describes your title: (17)

A ☐ Owner
B ☐ President
C ☐ Vice-President
D ☐ Manager
E ☐ Purchasing Agent
F ☐ Research Director
G ☐ Supervisor
H ☐ Senior Engineer
I ☐ Engineer
J ☐ Technician
K ☐ Consultant
L ☐ Professor
M ☐ Doctor/Other Medical
N ☐ Retired
O ☐ Chief Engineer

2 Please check the ***ONE*** category that best describes the type of work you are doing: (18)

A ☐ Management
B ☐ Purchasing
C ☐ Research
D ☐ Design/Development
E ☐ Mfg./Production
F ☐ Engr. Support
G ☐ Standards/QC
H ☐ Mktg./Sales
I ☐ Consulting
J ☐ Computer Programming
K ☐ Info. Data Processing
L ☐ Teaching/Instructional
M ☐ Medical Diagnosis/Treatment
N ☐ Maintenance/Service
O ☐ Numerical Analysis

3 Please check the ***ONE*** category that best describes what you consider yourself to be: (19)

A ☐ Manager/Supvr.
B ☐ Buyer/Specifier
C ☐ Biologist
D ☐ Chemist
E ☐ Engineer
F ☐ Financial Analyst
G ☐ Geologist
H ☐ Instructor/Educator
I ☐ Medical Professional
J ☐ Mathematician
K ☐ Physicist
L ☐ Sales Representative
M ☐ Consumer EDP
N ☐ Scientific EDP
O ☐ Student
P ☐ Technician

4 Please check your product interests or if you are a user of that product:

PRODUCT INTEREST (44) — USER (45)

A ☐ ☐ Oscilloscope, laboratory/plug-in
B ☐ ☐ Oscilloscope, high frequency
C ☐ ☐ Oscilloscope, storage
D ☐ ☐ Oscilloscope, battery operated
E ☐ ☐ Oscilloscope, portable
F ☐ ☐ Oscilloscope, low cost
G ☐ ☐ Logic Probes/Digital Service Instruments
H ☐ ☐ Spectrum Analyzers, low frequency
I ☐ ☐ Spectrum Analyzers, high frequency
J ☐ ☐ Time Domain Reflectometry
K ☐ ☐ Curve Tracers
L ☐ ☐ Counters/Signal Sources/DVM's/Scopes
M ☐ ☐ Cameras, Oscilloscope
N ☐ ☐ Monitors, physiological
O ☐ ☐ Engine Analyzers

OTHER INTEREST

(25) 08 ☐ ☐ Automated Test Systems
09 ☐ ☐ Waveform Digitizing Instrument
10 ☐ ☐ Digital Processing Oscilloscope
12 ☐ ☐ Radiometer/Photometer
13 ☐ ☐ Spectrometer
02 ☐ ☐ Television Products
17 ☐ ☐ Display Monitors
04 ☐ ☐ Computer Terminals/Peripherals
06 ☐ ☐ Calculators, Programmable

5 Please check the categories that best describe your company's/department's business: (20)

A ☐ Aerospace
B ☐ Aircraft
C ☐ Air Force
D ☐ Army
E ☐ Navy
F ☐ Chemicals/Plastics/Synthetics
G ☐ Components, capacitors/resistors
H ☐ Components, IC/Discrete
I ☐ Consulting
J ☐ Consumer Electronics
K ☐ Data Processing
L ☐ Educational, Engineering
M ☐ Educational, Medical
N ☐ Educational, Vocational
O ☐ Electric/Gas Utility
P ☐ Electronic Test Equip.
Q ☐ Engineering
R ☐ Environmental Monitoring/Control
S ☐ Fed. Gov't. (non-Military)
T ☐ Financial Services
U ☐ Forestry/Wood Products
V ☐ Industrial Control
W ☐ Industrial Equipment
X ☐ Leasing/Rental
Y ☐ Manufacturing, Consumer Products
Z ☐ Manufacturing, Industrial Products
01 ☐ Medical Research
02 ☐ Medical Services
03 ☐ Mining/Mineral Science
04 ☐ Nuclear
05 ☐ Oceanography
06 ☐ Petroleum/Energy
07 ☐ Printing/Publishing
08 ☐ Scientific Research
09 ☐ Service/Maintenance
10 ☐ State/Local Gov't.
11 ☐ Telephone/Telegraph
12 ☐ TV/CATV/Radio
13 ☐ Laser

6 Please check your purchasing influence: (21)

A ☐ Purchase
B ☐ Approve
C ☐ Recommend
D ☐ Specify/Evaluate

TEKTRONIX USE ONLY
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(01) Record No. _____ (Change Delete Only)
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☐ I am considering purchase of the following TEKTRONIX Products:

Products	Estimated Purchase Date

☐ **Please add my name to your Mail List. I have checked the appropriate boxes on the reverse side.**

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MICROFICHE CATALOG

This 1977 Tektronix General Catalog is also available on 24X, NMA standard microfiche. You may request your personal set of 3 fiche on the adjacent reply card. Ask for A-3277-1 for use with the U.S. Outside the U.S. ask for X-3277-1.

TEKSCOPE

A bimonthly publication whose objective is to provide informative, timely articles presented in a readable manner across the whole of Tektronix technology. Each issue of TEKSCOPE contains articles describing instruments, measurements, and techniques. Servicescope, a regular feature of TEKSCOPE, provides information for those responsible for the servicing of TEKTRONIX products. The New Products section provides information on products recently introduced, including photos, brief descriptions of unique features, and major specifications for each product. A New Literature section gives a brief description of new brochures, application notes, and catalogs available from Tektronix.

PRODUCT FAMILY CATALOGS

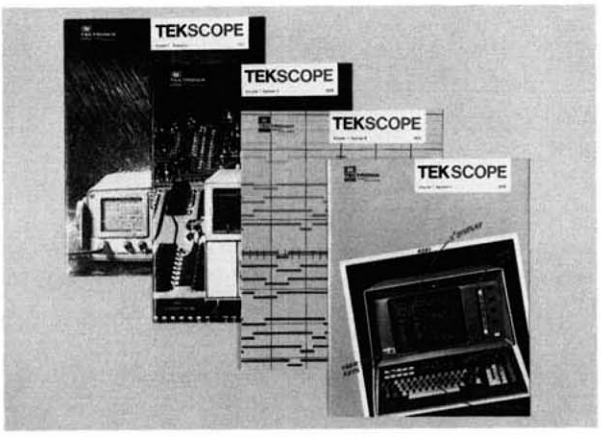
To provide a more convenient and complete source of information for a specific product family, Tektronix has available individual catalogs for product groups such as the 7000-Series, Television Products, TM 500 Test and Measurement System, TELEQUIPMENT and others.

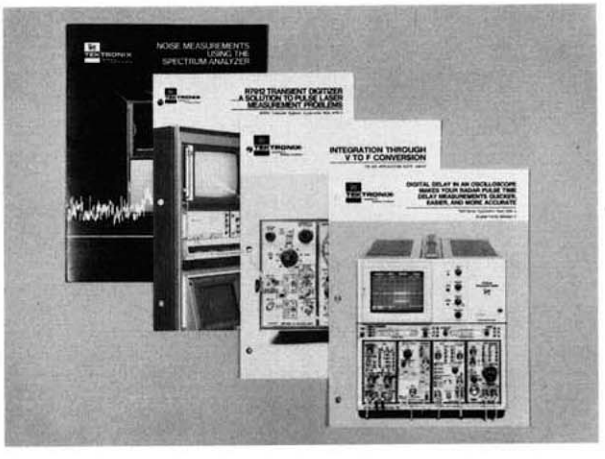
APPLICATION NOTES

Some unique measurement capabilities of TEKTRONIX products in the field of television broadcasting, radar, communications, etc., are described in a series of application notes available at no charge.

INSTRUCTION MANUALS

TEKTRONIX instruction manuals are written for both the user and maintenance personnel. Shipped with each instrument, instruction manuals contain instrument specifications, operating instructions, circuit descriptions, maintenance information and calibration instructions as well as complete schematics and electrical and mechanical parts lists. Additional copies are available, at reasonable cost, through your nearby Tektronix Field Office.





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